No. 768,076. PATENTED AUG. 23, 1904.

A. C. E. RATEAU.

PUMPING APPARATUS.

APPLICATION FILED DEC. 15, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

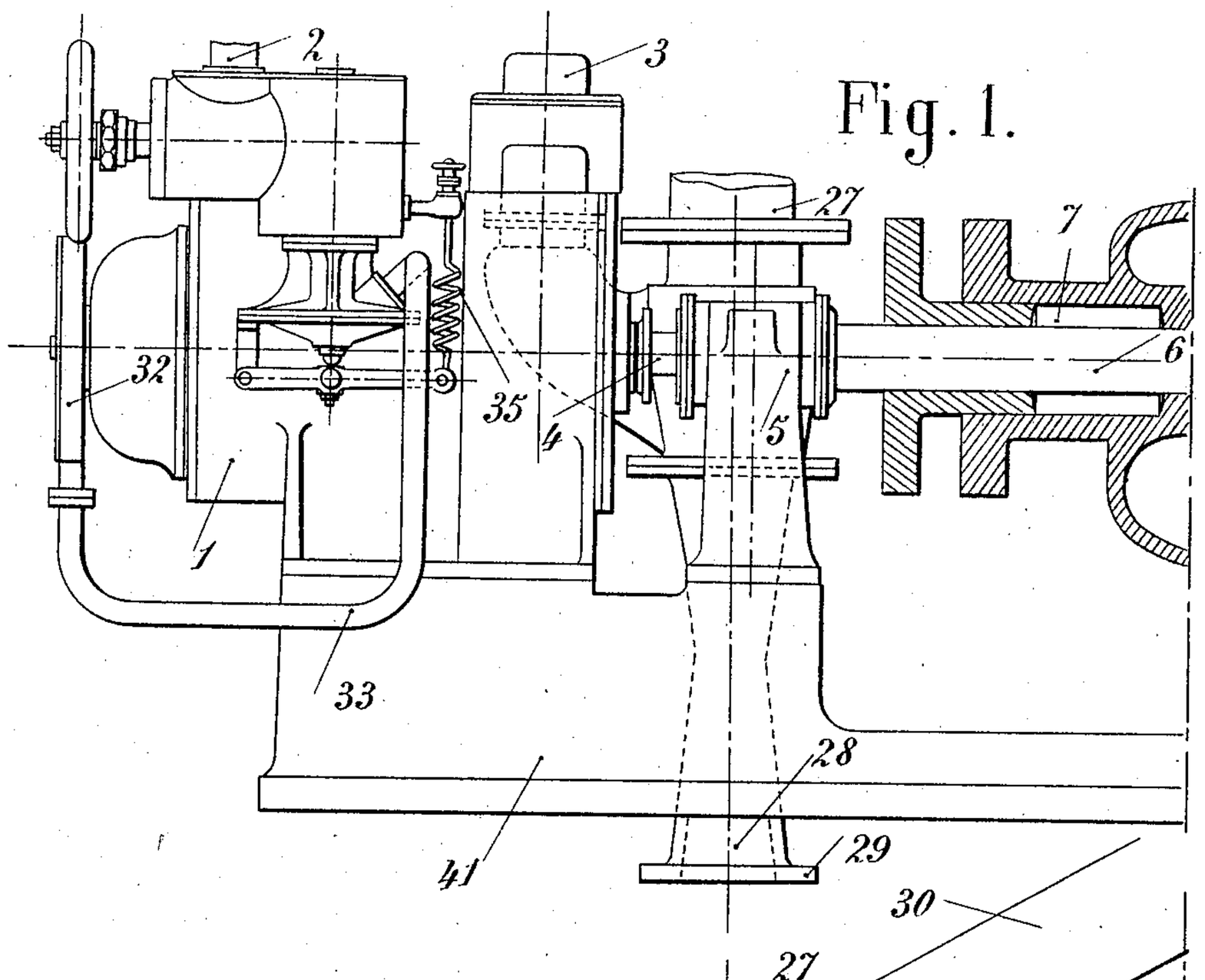
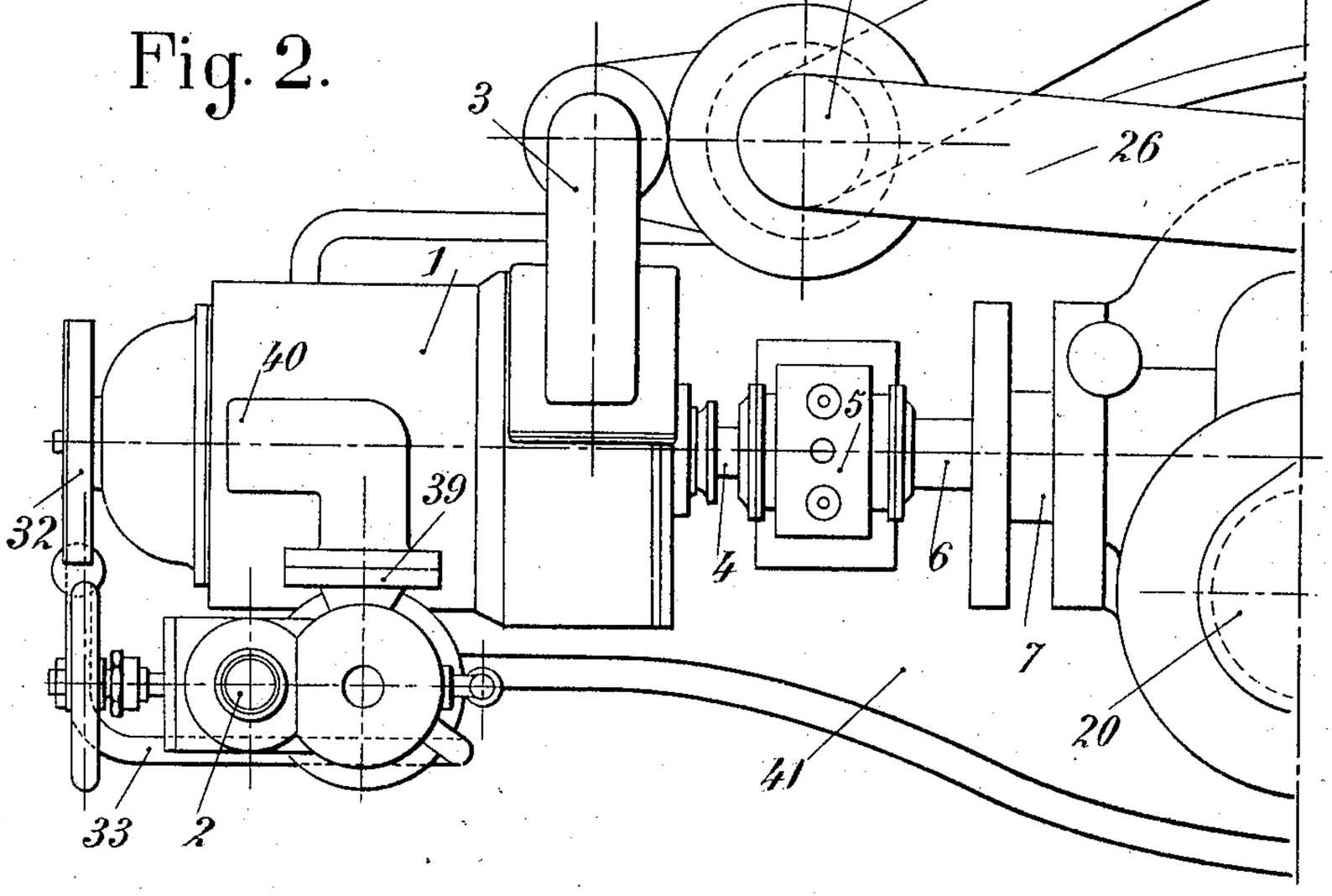


Fig. 2.



Witnesses:
Wilhelm Vogt
Thomas M. Smith

Inventor:
Auguste C. E. Rateau,
By J. Walter Douglas
Attorney.

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NO MODEL. 3 SHEETS—SHEET 2.

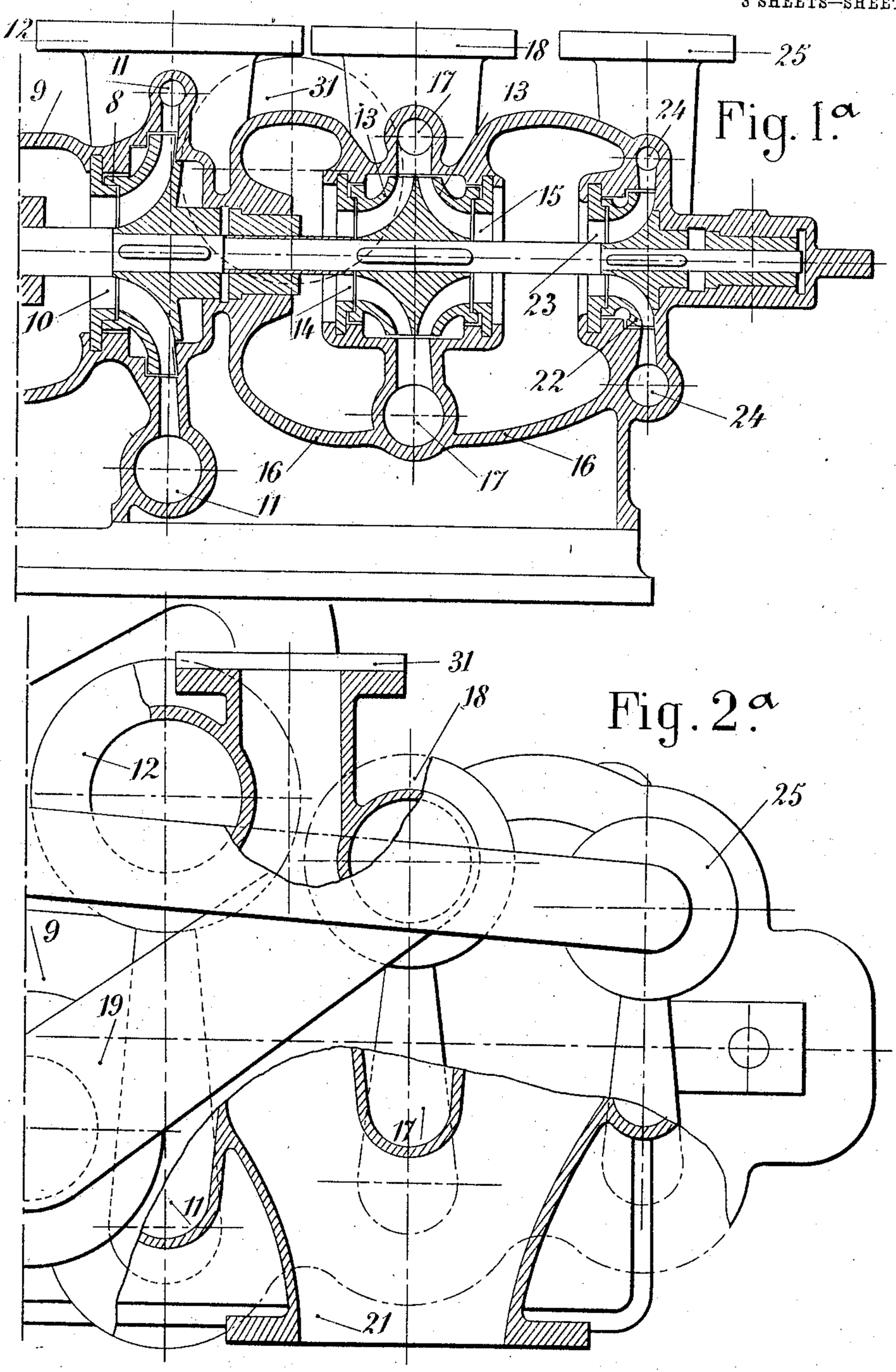

Fig. 1ª

Fig. 2ª

Witnesses:
Wilhelm Vogt
Thomas M. Smith

Inventor:
Auguste C. E. Rateau,
By J. Walter Douglass.
Attorney.

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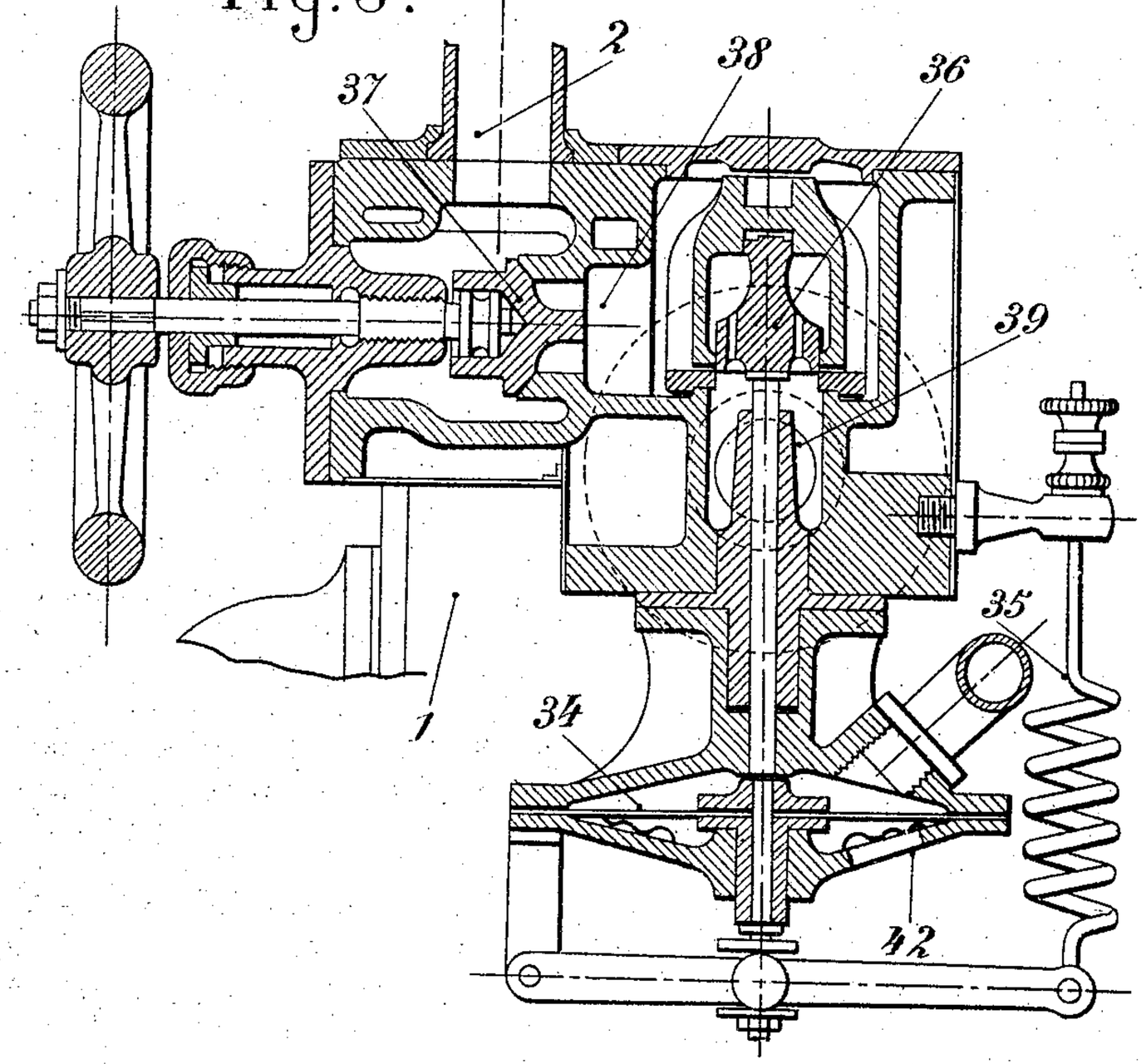
NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.



Witnesses:
Wilhelm Vogt
Thomas M. Smith.

Inventor:
Auguste C. E. Rateau,
By J. Walter Douglas
Attorney.

No. 768,076. Patented August 23, 1904.

UNITED STATES PATENT OFFICE.

AUGUSTE CAMILLE EDMOND RATEAU, OF PARIS, FRANCE.

PUMPING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 768,076, dated August 23, 1904.

Application filed December 15, 1902. Serial No. 135,191. (No model.)

To all whom it may concern:

Be it known that I, AUGUSTE CAMILLE EDMOND RATEAU, a citizen of the Republic of France, residing at Paris, France, have invented a new and useful Improvement in Pumping Apparatus, of which the following is a specification.

The growing employment of centrifugal pumps for pumping to a great height either in installations for working mines or in industrial installations for any purpose has led me to invent an arrangement of pumping apparatus which allows the centrifugal pump to be directly driven by a steam-turbine. The difficulty met with in this type of apparatus is to make the centrifugal pump deliver in good quantities. It is necessary for this purpose when the height exceeds certain limits to be able to feed the centrifugal pump. I therefore place two pumps upon the same shaft, the main one and an accessory feed-pump, the two pumps being directly driven by the steam-turbine. As in many cases it is necessary to provide means for condensing the steam in the turbine, the system is rendered complete by the addition of an ejecto-condenser, which is fed with the liquid to be raised. Lastly, the novel machine is itself governed in a manner which forms part of the invention.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figures 1 and 1ª show a partial longitudinal section of the pumping apparatus. Figs. 2 and 2ª show a plan view. Fig. 3 is a sectional view, on a larger scale, showing the arrangement for governing by the inlet of steam.

1 is the turbine, provided with one or more moving wheels.

2 is the inlet for the steam, which passes into the obturator, which will be mentioned later.

3 is the exhaust-outlet, the steam passing into the ejecto-condenser.

4 is the turbine-shaft extending beyond the casing.

5 is the bearing for the shaft.

6 is the shaft extending beyond the bearing upon which the pumps are mounted.

7 is the stuffing-box of the pump-inlet.

8 is the propeller of the main pump.

9 is the casing, into which the water passes on its way to the port of the propeller 8.

10 is the port of the inlet of the propeller 8.

11 is the delivery-chamber receiving water at the outlet from the propeller 8.

12 is the flange of the outlet-pipe of the delivery-chamber.

13 13 represent the propeller of the feed-pump provided with two sets of ports.

14 and 15 are the ports of the propeller 13 13.

16 is the casing containing the water passing to the ports 14 and 15 of the feed-pump.

17 is the delivery-chamber, which receives the water at the outlet from the propeller 13 13.

18 is the flange of the pipe leading from the delivery-chamber 17.

19 is the pipe conveying the water passing from the feed-pump to the main pump.

20 is the inlet-pipe for the water into the interior of the casing 9 of the main pump.

21 is the inlet-suction orifice of the feed-pump, which draws water into the casing 16.

22 is the propeller of the pump intended to supply the ejecto-condenser.

23 is the port of the pump feeding the ejecto-condenser and which obtains its water-supply from the casing 16.

24 is the delivery-chamber, receiving water at the outlet from the propeller 22.

25 is the flange of the pipe from the delivery-chamber 24.

26 is the delivery-pipe of the pump feeding the ejecto-condenser and leading to the suction-pipe of the ejecto-condenser.

27 is the inlet-pipe into the ejecto-condenser.

28 is the ejecto-condenser.

29 is the outlet-orifice for the water of condensation from the ejecto-condenser.

30 is the pipe leading the water at the outlet from the ejecto-condenser into the casing 16 of the feed-pump.

31 is the flange of the inlet-pipe for the

water from the ejecto-condenser into the casing 16.

32 is the centrifugal fan, keyed to the end of the shaft of the steam-turbine.

33 is the delivery-tube for the air coming from the fan 32 and passing into the apparatus governing the speed.

34 is a flexible membrane governing the obturator-rod placed at the steam-inlet.

35 is a counter-spring for regulating the flexible membrane 34.

36 is the obturator, provided with passages placed at the steam-inlet.

37 is a valve governed by a hand-wheel, which can interrupt communication with the steam-inlet tube 2.

38 is the casing containing the steam-obturator.

39 is the outlet-orifice for the steam after passing through the obturator.

40 is the pipe leading the steam into the turbine after its passage through the obturator.

41 is a frame common both to the turbine and the pumps.

42 is the orifice putting the flexible membrane into communication with the outer air.

43, Fig. 4, is a pipe connecting together the upper portion of the casing inclosing the flexible membrane 34 and the main delivery-pipe 12 of the pump.

44 is the end of the pipe 43, passing into the pump-delivery and terminating in an open tube.

Working of the apparatus.—The turbine is driven by means of steam passing through the inlet-pipe 2. The pipe 2 is directly closed by means of a needle-valve 37, actuated by a hand-wheel. As soon as the said valve is open steam passes through an obturator provided with passages. The method of governing said obturator will be explained later. It then passes to the steam-turbine, expands in the different wheels composing it, (the turbine may, however, be composed of a single moving wheel,) and at its outlet from the turbine passes through the connecting-pipe 3, which leads to the ejecto-condenser. The turbine-shaft after having traversed the bearing 5 passes directly to the pumps. The pumps are formed of the main pump, the propeller 8 of which sucks water into the casing 9 and forces it into the delivery-chamber 11. The water which fills the casing 9 is derived from the two-passage feed-pump 13 13. It is the said second pump which takes water directly through the suction-orifice 21 from the reservoir containing the water. The two-passage pump 13 13 is capable of sucking at a distance of several meters. It forces the liquid under a differing head, dependent upon the dimensions of the pump 8. It is almost entirely upon the latter pump that the height to which the water is pumped depends. The water from the two-passage pump 13 13 is collected by the delivery-chamber 17, passes out through 18, and passes through the pipe 19 into the suction-pipe 20 of the main pump. The main pump has a propeller 8 of relatively small width or caliber, and the diameter of the propeller 8 is relatively larger than the diameter of the propeller of the feed-pump 13, the caliber of which feed-pump propeller being relatively larger than the caliber of the propeller 8 of the main pump. At its passage out of the main pump the water passes into the delivery-column through the pipe 12.

If desired, the outlet to the condenser may adjoin the steam-turbine. For this object the turbine is provided with an ejecto-condenser 28, which is fed under pressure by a small centrifugal pump 22, placed at the end of the shaft. The said centrifugal pump takes water from the portion of the suction-chamber 16 which feeds the passages 15 of the feed-pump. The water which passes out from the small centrifugal pump, through the delivery-chamber 24, and the pipe provided with the flange 25 passes through the pipe 26 into the ejecto-coridenser. The water causes the steam passing out from the turbine to be condensed, and the whole of the steam and the water of condensation returns through the pipe 30 and the pipe provided with the flange 31 into that portion of the sucking-chamber 16 which feeds the pump-port 14 of the feed-pump. It will be seen that in this arrangement a fraction of the suction-water serves for the condensation. The water is derived from the main circuit of the liquid which passes from the suction-orifice 21 to the last delivery-pipe provided with the flange 12. The advantage of this arrangement consists in allowing the condensation of the steam of the turbine to greatly increase its useful effect by means of a small supplementary expenditure of mechanical work.

Mounting the three pumps upon the same shaft which is directly driven by a steam-turbine allows a compact and efficient assemblage to be formed. The centrifugal pumps may be made to profit by the great speeds which steam-turbines allow of, and thus consequently obtain great elevations, which have not hitherto been possible to obtain with this class of apparatus.

The speed of the turbine may be regulated in two different ways. It may be governed by acting directly upon the obturator placed in the path of the inlet-steam. In its passage out through the valve 37 the steam traverses the casing 38, which surrounds the obturator 36. The latter carries a vertical rod which adjoins a flexible membrane 34, balanced by a counter-regulating spring 35. One means of governing consists in keying upon the shaft of the turbine the centrifugal fan 32. The air drawn by this fan passes through the pipe 33 to the upper portion of the membrane 34.

When the speed increases, the membrane causes the obturator to descend by drawing with it the obturator-rod and tends to strangle the steam-inlet orifice. This method of governing is thus very sensitive, for the pressure of air drawn by the fan increases as the square of the speed. One may, moreover, by means of the counter-spring alter the speed of the system within fairly large limits. The process allows, therefore, the centrifugal pump to pump to varying heights. The method of governing just indicated is for governing speed, and consequently it alters the elevation to which the water is pumped.

Having thus described the nature and object of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a pumping apparatus of the character described, a steam-turbine and its shaft, a main centrifugal pump of high pressure located upon the turbine-shaft and driven thereby, a centrifugal feed-pump of low pressure also located upon the turbine-shaft and driven thereby to constitute a means for forcing water into the chamber of the main pump, an ejecto-condenser arranged to receive the exhaust from the turbine, an auxiliary centrifugal pump arranged on the turbine-shaft and adapted to force water from the chamber of the feed-pump into and through the ejecto-condenser, and a discharge from said ejecto-condenser leading directly to the chamber of the feed-pump.

2. In a pumping apparatus, a shaft, a steam-turbine arranged on said shaft and adapted to drive the same at a high rate of speed, a high-pressure centrifugal pump located on said shaft and traveling at the same rate of speed, said pump having a propeller of relatively small caliber and large diameter, a low-pressure centrifugal pump located on said shaft and traveling at the same rate of speed as the high-pressure pump, said low-pressure pump having a propeller of relatively larger caliber and relatively smaller diameter than the caliber and diameter of the propeller of the main pump, a source of fluid-supply discharging into the chamber of the low-pressure pump, and a direct discharge from the low-pressure to the high-pressure pump, constituting the sole source of supply for said high-pressure pump.

3. In a pumping apparatus, a shaft, a steam-turbine arranged on said shaft and adapted to drive the same at a high rate of speed, a high-pressure centrifugal pump having a relatively small caliber and large diameter located on said shaft and traveling at the same rate of speed, a low-pressure centrifugal pump having a relatively large caliber and small diameter located on said shaft and traveling at the same rate of speed as the high-pressure pump, a source of fluid-supply discharging into the chamber of the low-pressure pump, and a direct discharge from the low-pressure to the high-pressure pump, and constituting the sole source of supply for said high-pressure pump, in combination with a valve controlling the inlet of steam to the turbine and a centrifugal fan secured to and traveling with the turbine-shaft, said fan arranged to control the steam-inlet valve of the turbine.

4. In a pumping apparatus of the character described, the combination of a steam-turbine and a shaft driven at a high rate of speed directly by said turbine, with a high-pressure single-way centrifugal pump having a relatively large diameter and small caliber and a low-pressure two-way centrifugal pump having a relatively small diameter and large caliber, both pumps located on and driven at the same rate of speed by said shaft, a source of fluid-supply from which said low-pressure pump sucks the fluid through both its ways, a chamber into which both ways of the low-pressure pump discharges, and a connection between said discharge-chamber and the inlet-chamber of the high-pressure pump, said connection constituting the sole source of fluid-supply for the high-pressure pump.

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

AUGUSTE CAMILLE EDMOND RATEAU.

Witnesses:
PAUL DE MERTSAL,
EDWARD P. MACLEAN.