No. 765,994. PATENTED JULY 26, 1904.

A. C. E. RATEAU.

# PUMPING APPARATUS.

APPLICATION FILED MAY 26, 1903.

NO MODEL. 3 SHEETS—SHEET 1.

Fig. 1.

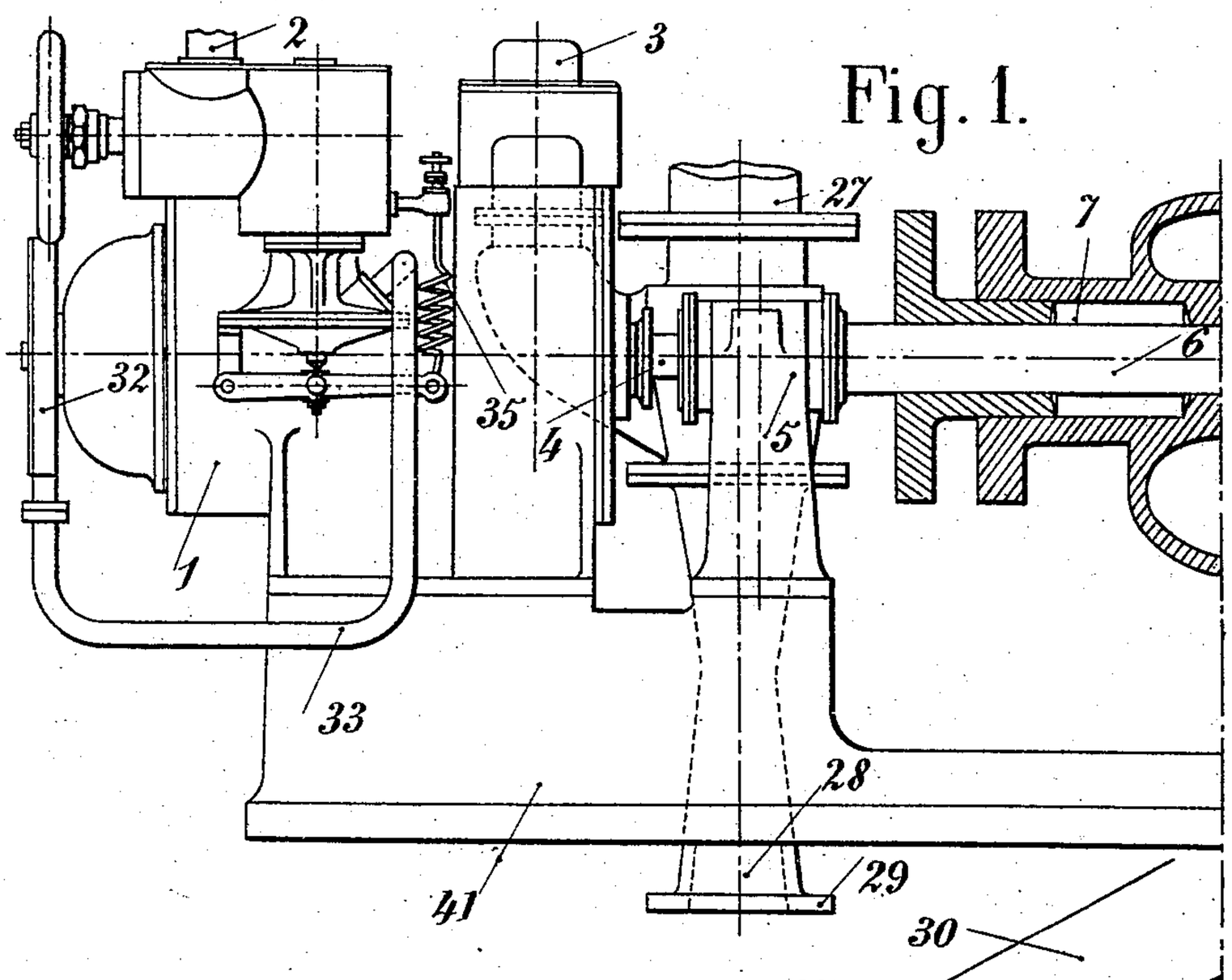
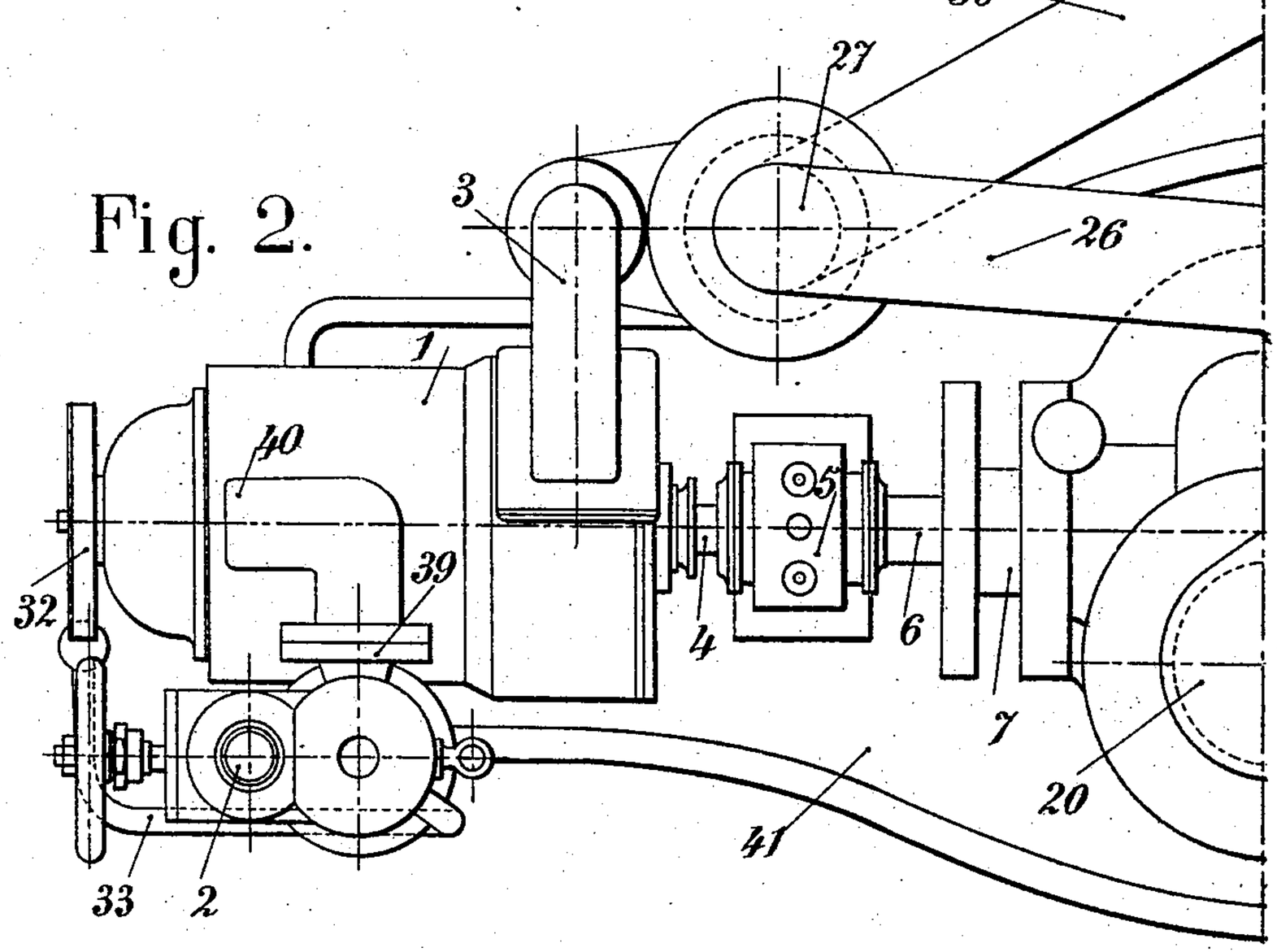



Fig. 2.

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NO MODEL. 3 SHEETS—SHEET 2.

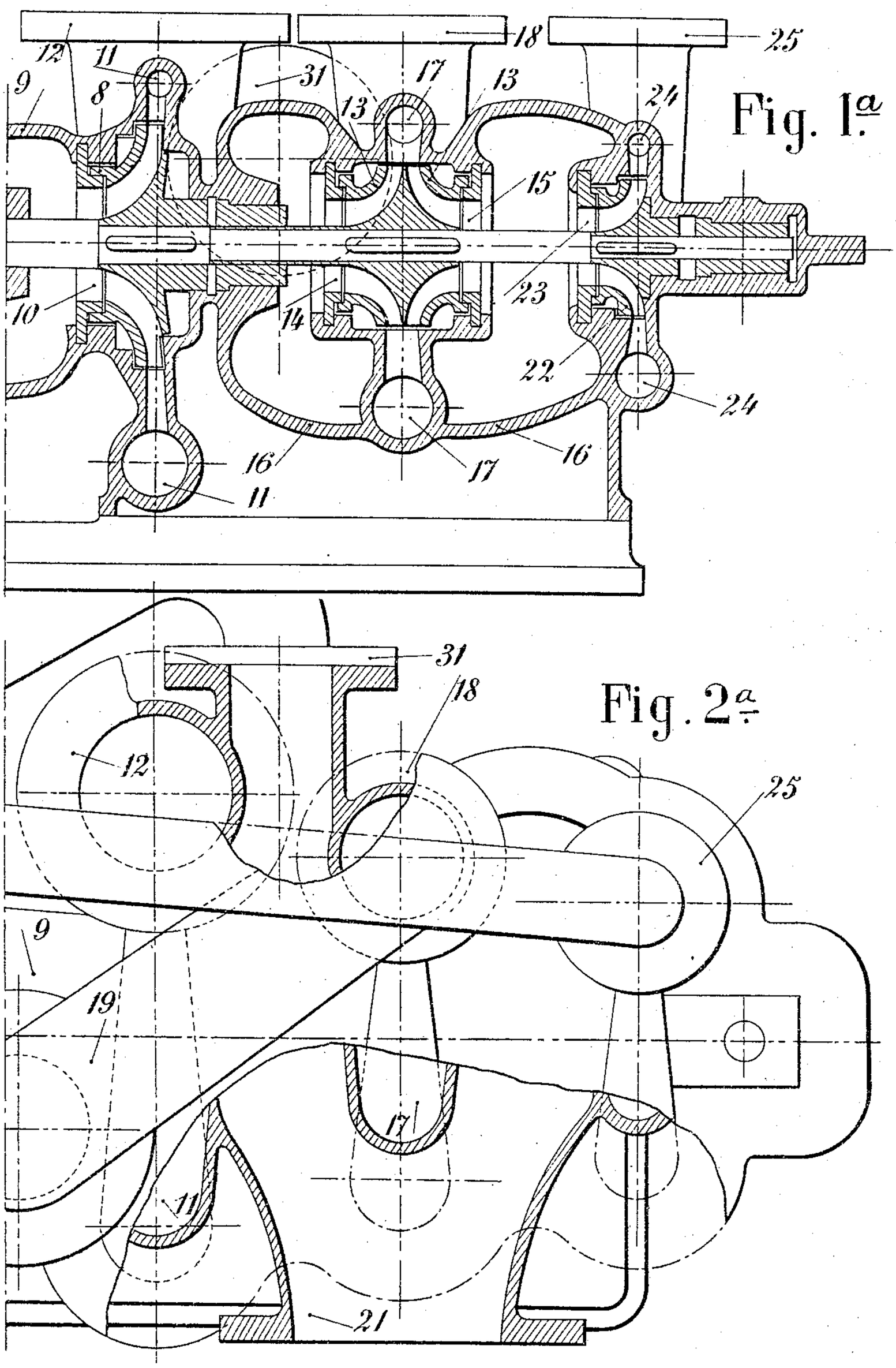


Fig. 1a.




Fig. 2a.

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NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

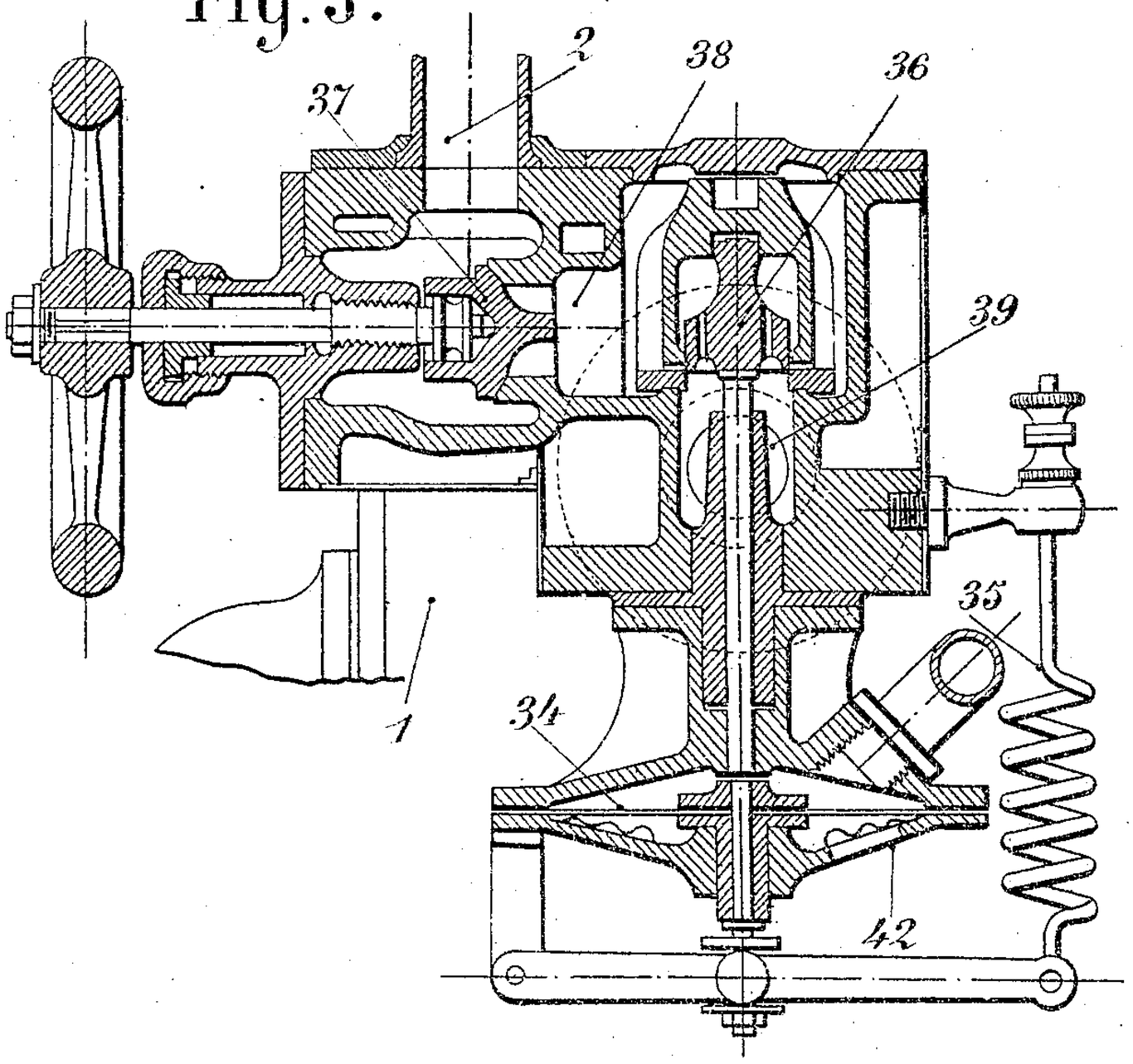
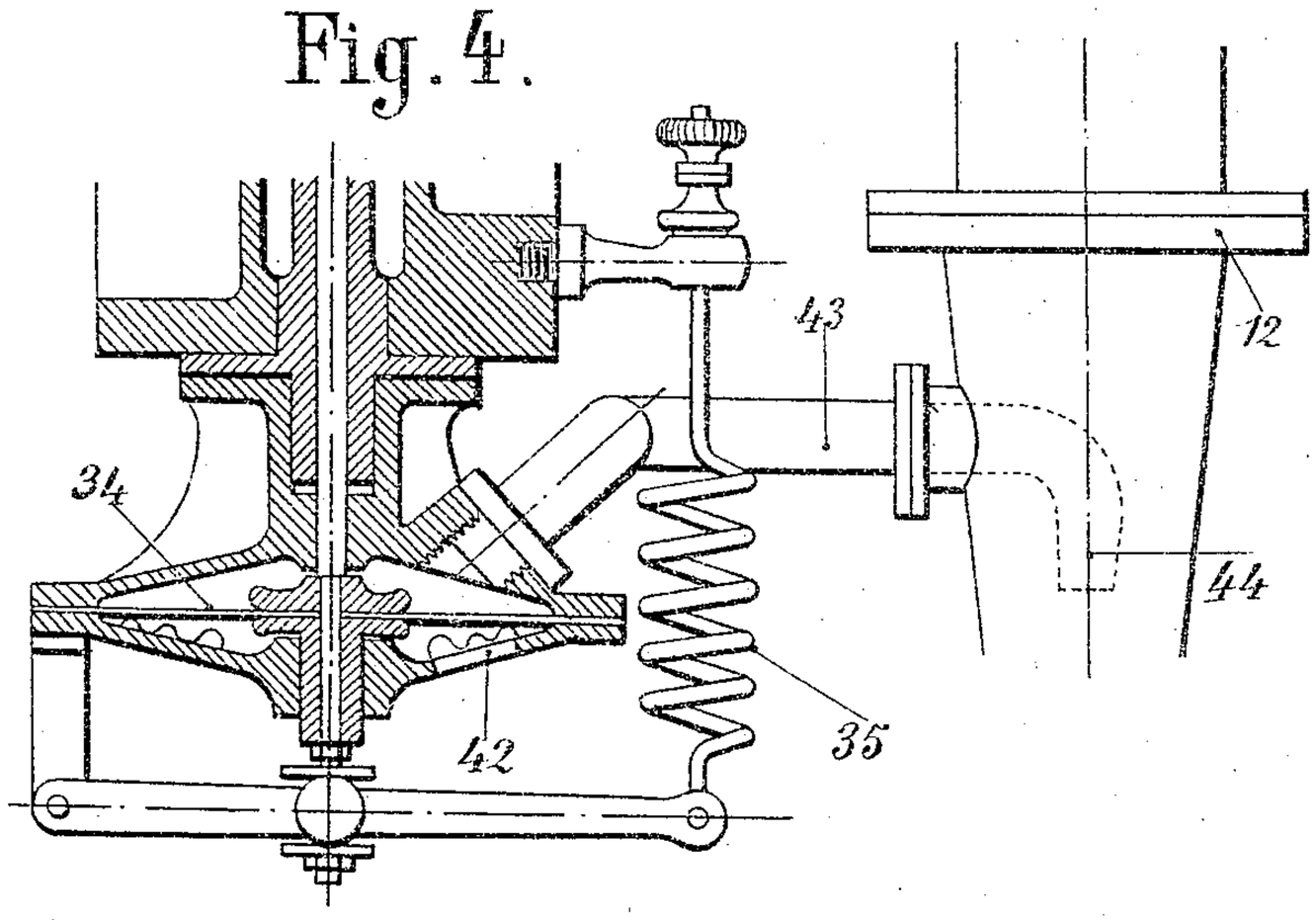



Fig. 4.

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No. 765,994. Patented July 26, 1904.

# UNITED STATES PATENT OFFICE.

AUGUSTE CAMILLE EDMOND RATEAU, OF PARIS, FRANCE.

## PUMPING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 765,994, dated July 26, 1904.

Original application filed December 15, 1902, Serial No. 135,191. Divided and this application filed May 26, 1903. Serial No. 158,791. (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 certain new and useful Improvements 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. In an application for a patent filed by me under date of December 15, A. D. 1902, Serial No. 135,191, of which application the present application is a division, I have described and claimed such a pumping apparatus. As explained in said application, the main 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. In my present application a form of obturator interposed between the steam-inlet and the turbine will be described in conjunction with the other parts of the apparatus, and this obturator together with means regulated by the discharge from the main pump for controlling the obturator form the subject-matter of the present application.

The nature and object 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 are partial longitudinal sectional views of a pumping apparatus embodying main features of my invention. Figs. 2 and 2ª are plan views. Fig. 3 is a sectional view, on a larger scale, showing the obturator and one arrangement for governing the inlet of steam to the turbine; and Fig. 4 is a view to a larger scale, showing the arrangement for governing by means of the pressure of fluid in the delivery-pipe.

Referring to the drawings, 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 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 contains 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.

In the operation 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, if desired, 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 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 and passes out through the flange 18 and through the pipe 19 into the suction-pipe 20 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 and passes through the pipe 26 into the ejecto-condenser. 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, passing 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. As described in my original application, Serial No. 135,191, 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 carrying a vertical rod adjoining a flexible membrane 34, balanced by a counter regulating-spring 35. A centrifugal fan 32 is keyed upon the shaft of the turbine, and in operation air is drawn from the atmosphere by this fan and forced 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. By regulating the counter-spring 35 the speed of the system may be varied within fairly large limits.

In the present invention the means for governing the inlet-valve to the turbine is controlled by the delivery of fluid from the pump. This means should be used where a constant volume of fluid is to be delivered. For this purpose the delivery-pipe, which is provided with the flange 12, as shown in Fig. 4, is caused to communicate through the pipe 43 with the upper portion of the membrane 34. The pipe 43 terminates inside the delivery-column in an open tube 44. The pressure of fluid entering the Pitot tube thus formed varies with the speed, and consequently with the delivery of the column, and thus imparts a pressure upon the flexible membrane, which will vary with the delivery of the pump. The governing of the obturator will therefore in this case take place proportionally to the delivery and no longer proportionally to the speed.

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, and a main centrifugal pump located on and operated by the turbine-shaft, in combination with an obturator interposed in the steam-inlet of the turbine, and means controlled by the discharge from the main pump for governing said obturator.

2. In a pumping apparatus of the character described, a steam-turbine and its shaft, a main centrifugal pump located on and driven by said shaft, a delivery-pipe into which said pump discharges, an obturator interposed in the steam-inlet, a flexible membrane in operative connection with said obturator, one face of said membrane being in communication with the external atmosphere, and a Pitot tube extending from above the other face of said membrane into the delivery-pipe from the main pump and arranged to convey varying pressures in said delivery-pipe to the membrane, whereby the governing of the obturator is controlled by the discharge from the main pump.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

AUGUSTE CAMILLE EDMOND RATEAU.

Witnesses:
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J. ALLISON BOWEN.