

No. 712,593.

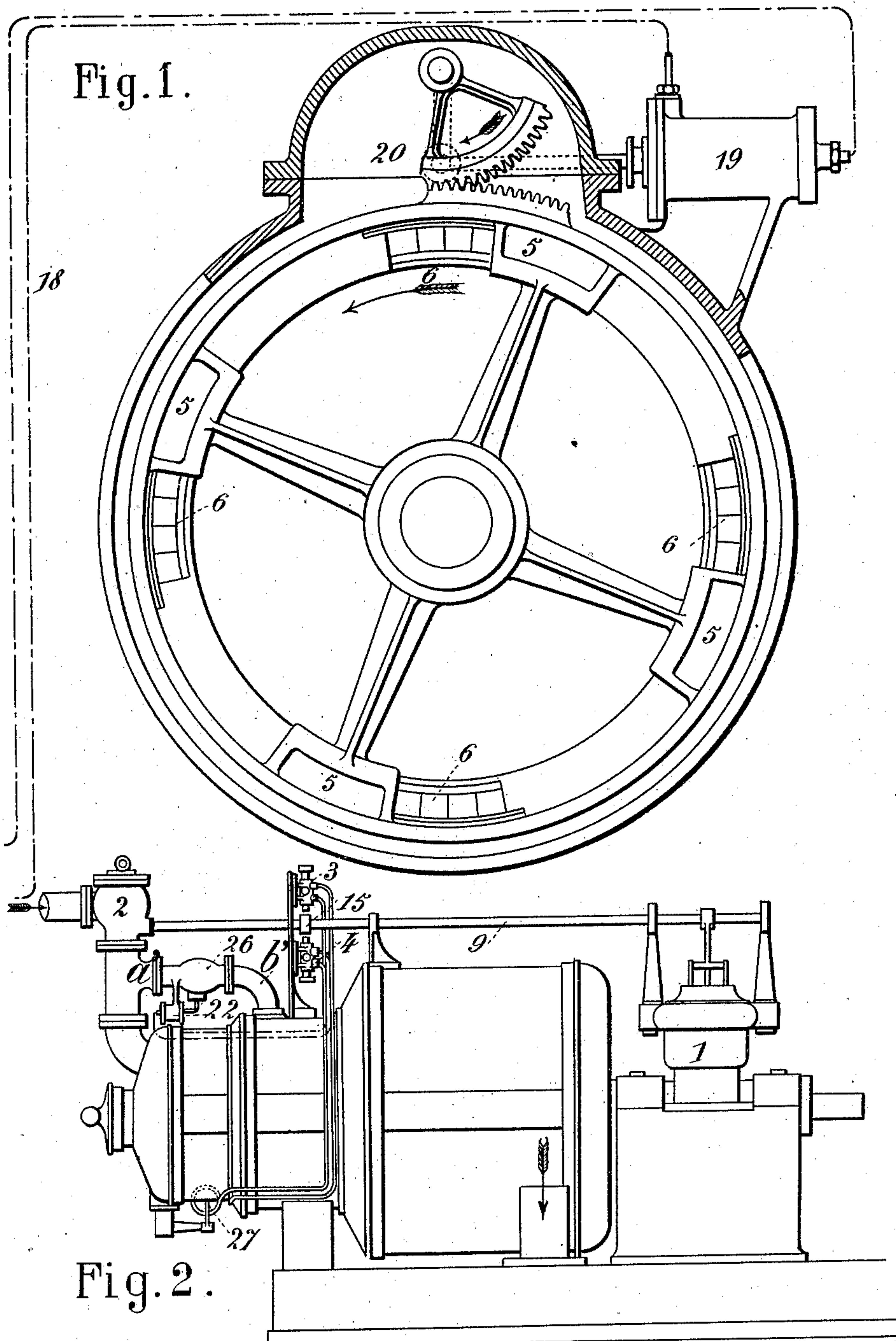
Patented Nov. 4, 1902.

A. C. E. RATEAU.  
AUTOMATIC GOVERNOR FOR TURBINES.

(Application filed May 20, 1902.)

(No Model.)

2 Sheets—Sheet 1.



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2 Sheets—Sheet 2.

Fig. 4.

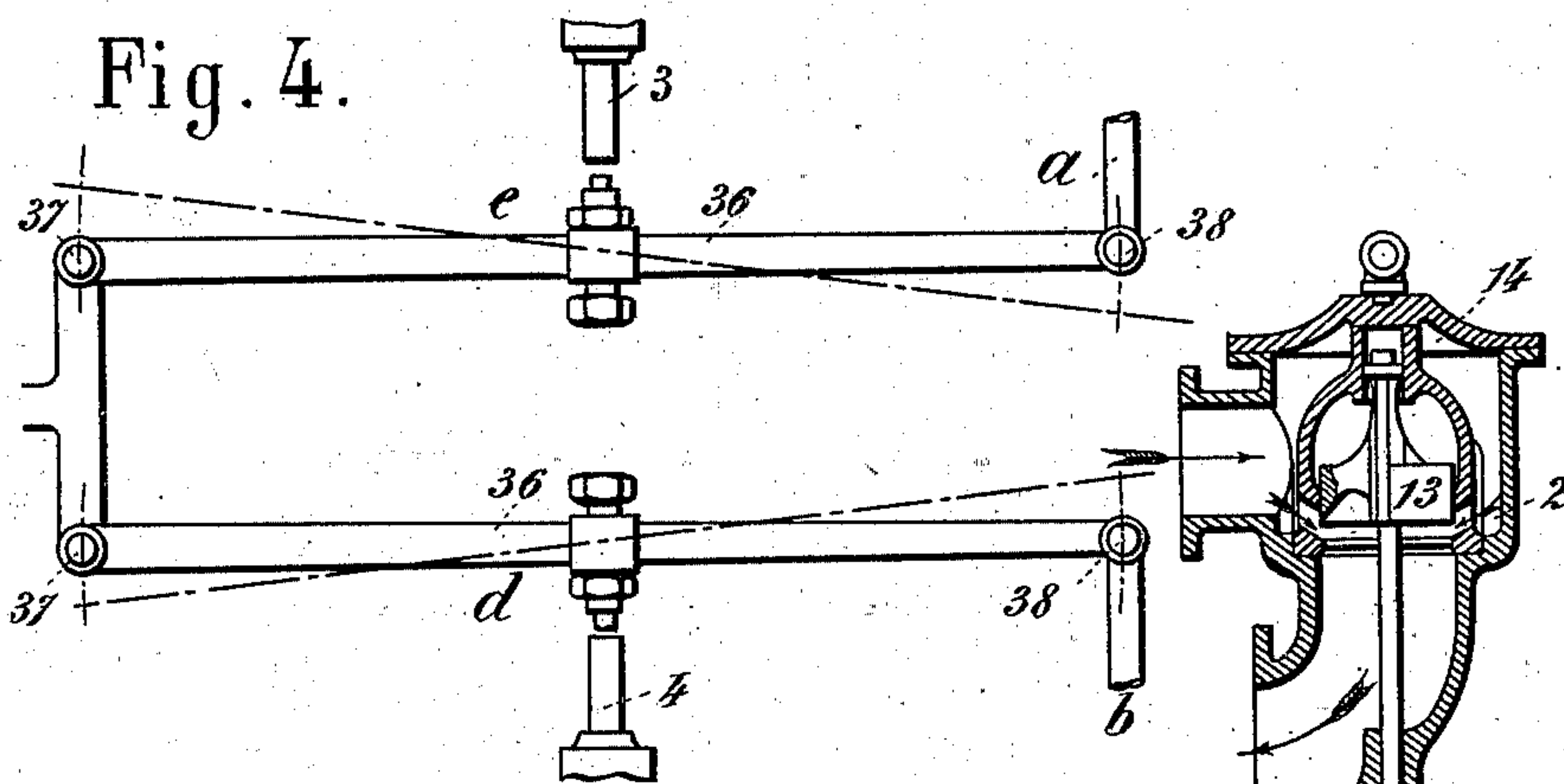


Fig. 1<sup>a</sup>.

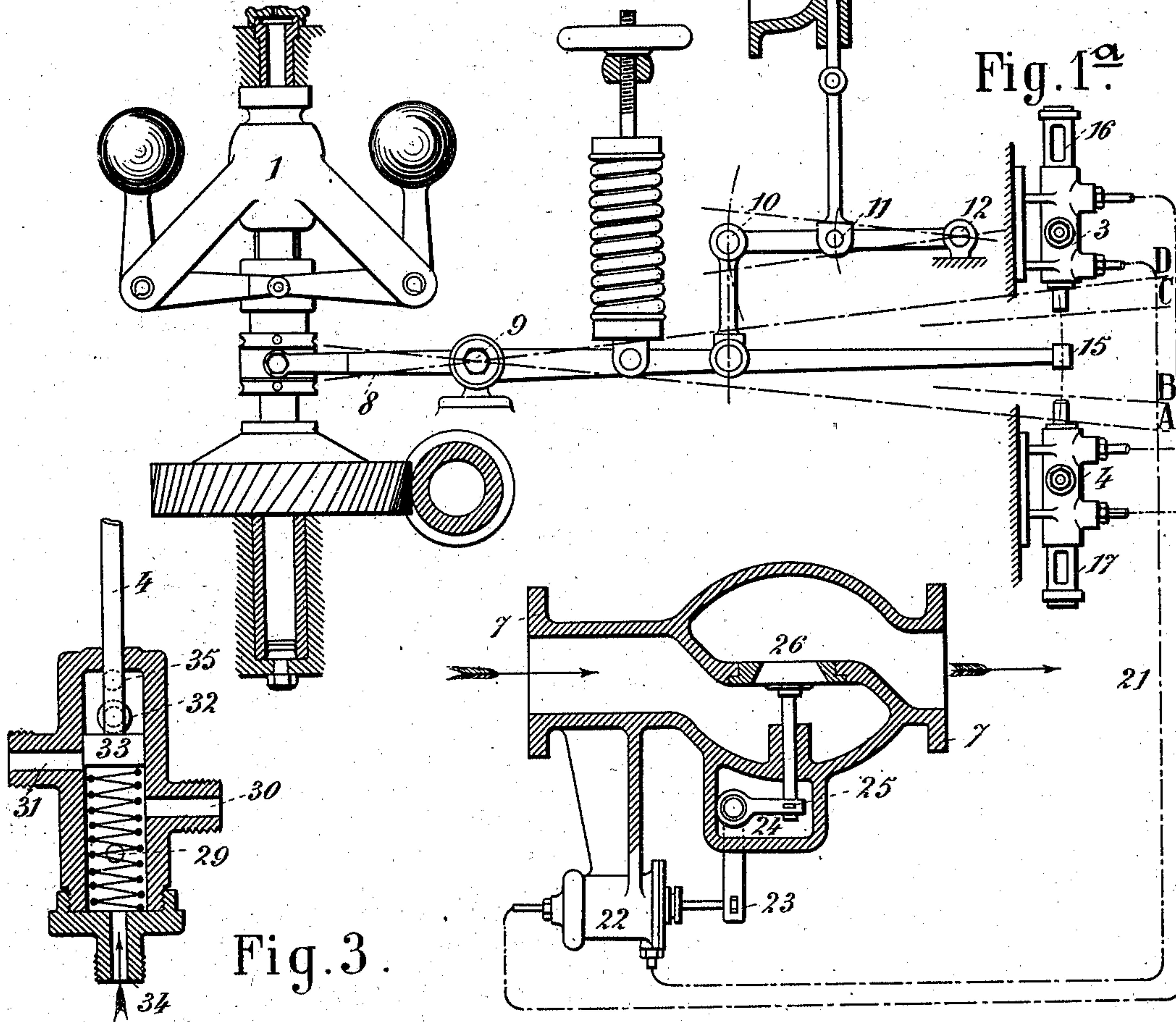


Fig. 3.

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# UNITED STATES PATENT OFFICE.

AUGUSTE CAMILLE EDMOND RATEAU, OF PARIS, FRANCE.

## AUTOMATIC GOVERNOR FOR TURBINES.

SPECIFICATION forming part of Letters Patent No. 712,593, dated November 4, 1902.

Application filed May 20, 1902. Serial No. 108,158. (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 Automatic Governors for Turbines, of which the following is a specification.

My invention has relation to a mechanism for automatically governing steam or gas turbines, and in such connection it relates to the construction and arrangement of such a mechanism.

Heretofore in the governing of steam or gas turbines certain difficulties have arisen, which difficulties it is the object of my present invention to overcome. Thus in former governing means a valve throttling the steam immediately before its inlet into the turbine is placed under the control of a centrifugal governor, or, as hereinafter designated, a "speed-measurer." This arrangement is convenient and perfect in action. One defect, however, in the arrangement is that when only small quantities of steam are passing through the turbine the initial pressure at the inlet is much less than the pressure at the boilers, and hence a portion of the pressure of the steam is lost without any compensating advantage. When condensing-turbines are used, this loss is minimized, but it still exists, and it is therefore desirable to arrange the parts in such a manner that the initial pressure may be kept as high as possible. For this purpose obturators or shut-off slides are arranged with reference to the blades distributing the fluid to the cells of the turbine in such a manner that the inlets to a greater or lesser number of blades may be closed, as required, and operate as in hydraulic turbines. The controlling of the distributors has already been devised; but in this instance the distributors have been regulated manually. To be efficient, the regulation of the distributors should be under the automatic control of the speed-measurer, without, however, thereby causing periodic oscillations or variations of speed.

In the arrangement embodying my invention, as will be hereinafter more fully described, the governing of the turbine through the inlet-valve for the motive fluid is still used, because it has the advantage of being both

rapid and certain. In addition, however, the speed-measurer is caused to act at the same time upon one or more obturators in such a manner that these obturators open or close the inlet to the blades distributing the motive fluid in the turbines, according as more or less power is required. The rapidity of the movement of the obturators is so calculated as to avoid periodic disturbances or speed variations, which would result, if care be not taken, where the two governing means do not act simultaneously.

It has been described in a previous application for patent, Serial No. 70,438, filed by me under date of August 1, 1901, how it is possible to produce in a multicellular turbine a momentary increase in power by means of an auxiliary pipe directly admitting a certain quantity of more or less expanded additional steam to a moving wheel, the position of which wheel being higher up in the series of wheels, according to the more or less increased power required. In the mechanism described in said previous application it was proposed to open by hand the cock or valve placed upon this pipe, called the "surcharge-pipe." My present arrangement is applicable to the automatic regulation of this surcharge-pipe and is carried out so that the governing means will permit of the smallest or the largest quantities of steam desired passing in under the best possible conditions of efficiency. To attain this object, the travel of the speed-measurer is divided into three portions or intervals. In the middle portion or interval, which may be as small as desired, the speed-measurer acts only upon the valve for the inlet of steam, and hence governs solely by throttling. In the first portion, corresponding to the range of highest speeds of the speed-measurer, the valve for the inlet of steam continues to be closed by the speed-measurer and at the same time starts into operation a mechanism which operates the obturator or obturators of the distributing-blades of the turbine. In the last portion, corresponding to the range of lowest speeds, the speed-measurer sets into operation a mechanism which controls the obturator of the surcharge-pipe. The mechanisms for operating both series of obturators are each preferably controlled by a piston operated by motive fluid—such, for in-



stance, as water or oil under pressure, steam-  
or compressed air. In general oil is prefer-  
able, although electricity may be applied di-  
rectly in the form of a motor for operating  
5 the obturators. In any event the movement  
of the obturators is regulated to a speed suf-  
ficiently as not to cause vacillation or oscil-  
lation in the power.

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

Figures 1 and 1<sup>a</sup> represent when combined  
15 a diagrammatic view of a mechanism embody-  
ing main features of my invention. Fig. 2 is  
a side elevational view of a turbine with the  
governing mechanism applied thereto. Fig.  
3 is a vertical sectional view of a distributor  
20 by means of which four blades and their obtu-  
rators may be governed, and Fig. 4 is a view  
illustrating a modified form of the levers con-  
necting the governor or speed-measurer with  
the remaining portions of the apparatus.

Referring to Figs. 1 and 1<sup>a</sup> of the drawings,  
25 1 represents the governor or speed-measurer  
of the usual centrifugal type. The steam-  
inlet valve 2 is governed directly by this  
speed-measurer. 3 and 4 are cylinders which  
30 govern the inlet of steam or motive fluid to  
the obturator-pistons 22 or 19. The obtura-  
tor 5 for the turbine-blades is in the form of  
a slide. The surcharge-pipe 7 leads steam to  
a blade higher in series than the blade to  
35 which steam from the valve 2 is delivered.  
The speed-measurer 1 acts upon a lever 8,  
pivoted at 9 and rigidly connected by means  
of levers and intermediate pins 10, 11, and  
12 to the valve 13, which throttles the steam  
40 passing from the steam-chest 14 toward the  
turbine more or less. The valve 13 consists  
of a plain ring sliding with soft friction in  
the cylindrical box which surrounds it and is  
guided by the upper portion of the box.  
45 When the ring is moved, its lower edge more  
or less closes the circular orifice formed in  
the box through which the steam passes.  
The pin 15 on the lever 8 acts upon the dis-  
tributing-pistons contained in the cylinders  
50 3 and 4. It pushes one or the other when the  
axis of the lever 8 passes beyond the position  
9<sup>B</sup> or 9<sup>C</sup>, respectively. The pistons are al-  
ways pushed back toward the lever 8 by  
means of small springs contained in the boxes  
55 16 and 17. By this arrangement the lever of  
the speed-measurer acts solely upon the valve  
13 when it is between the positions B and C  
and continues to act upon the valve when  
pushing one or the other of the distributing-  
60 pistons. It is only checked by the small ef-  
fect necessary to push the pistons and over-  
come the small resistance of the springs.  
The speed-measurer may therefore on the  
occasion of a sudden disturbance in the steam  
65 act as rapidly upon the valve as if the sup-  
plementary method of governing did not ex-  
ist. This piston contained in the cylinder 4

distributes oil through the pipe 18 to the cyl-  
inder 19, which actuates the rotating slide 5  
by the intermediary of the toothed sector 20. 70  
The use of the rotating slide in question pre-  
supposes, of course, that steam is being dis-  
tributed to a portion only of the circumfer-  
ence of the wheel of the turbine. The piston  
3 distributes oil through the pipe 21 to the 75  
cylinder 22, the piston in which by the inter-  
mediary of the lever 23 24 and the lever 25  
opens the surcharge-valve 26 more or less.

Fig. 2 shows the application of the arrange-  
ment to a turbine. 2 is the steam-inlet valve, 80  
governed by the governor 1 and the oscillat-  
ing shaft 9. *a' b'* is the surcharge-pipe. The  
pistons contained within the cylinders 3 and  
4 are arranged one on each side of the pin 15,  
which is keyed upon the shaft 9 of the valve. 85  
27 is the cylinder by means of which the ob-  
turator closing the inlet to the blades is op-  
erated, and 22 the cylinder operating the ob-  
turator 26 of the surcharge-pipe. In the pre-  
ceding example a single obturator is shown, 90  
which closes in succession the distributing-  
blades of the turbine. It would also be pos-  
sible to act upon separate obturators, which  
are closed one after the other.

Fig. 3 shows a distributor by which four 95  
blades, for example, are governed. The shell  
of the distributor is provided with four holes  
29, 30, 31, and 32, arranged in steps and con-  
nected by pipes to the different cylinders of  
the blades. A piston 33 moves in the shell 100  
and can uncover one, two, three, or four holes,  
according to its position. The steam under  
pressure passes in beneath the piston through  
the tube 34, while the other face of the piston  
is in connection with the exhaust through 35. 105  
The pin on the lever of the speed-measurer  
presses upon the end of the piston-rod 4,  
when the speed of the machine becomes less.  
The progressive displacement of the pin causes  
the inlet to the blades to be successively 110  
opened. It will be observed that in this case  
the auxiliary motive fluid which aids the  
speed-measurer to open or close the inlet to  
the distributing-blades is the steam itself.

Returning now to the first arrangement of 115  
a rotating obturator for closing the distribu-  
ter-blades, the piston working the obturator  
and the piston working the surcharge-valve  
may, if desired, be governed by the pin on the  
lever of the speed-measurer—that is to say, 120  
the displacement of the piston may be made  
to be exactly proportional to that of the pin.  
For this purpose to each of the pistons is  
added a supplementary lever 36, Fig. 4, one  
end 37 of which is jointed to the lever of the 125  
speed-measurer—that is to say, to the pin 15,  
Fig. 1<sup>a</sup>, made double, as is necessary for the  
special case in question—while the other, 38,  
is rigidly connected by suitable mechanism  
to the pistons of the relay to be operated 130  
upon—that is to say, in this case to the piston  
of the cylinder 19, Fig. 1<sup>a</sup>, by the rod *a*, Fig. 4,  
and to the piston of the cylinder 22, Fig. 1<sup>a</sup>, by  
the rod *b*, Fig. 4. When the pin and the pis-



ton have corresponding proportional displacements, the middle point *c* or *d* of the lever remains stationary. This point is placed in front of the head of the piston 3 or 4 of the distributing-piston of the relay. By this well-known arrangement of governing the piston connected to the point 38 is made to follow exactly the movements of the end 37, for, in effect, when the piston does not move neither does the point 38, which is rigidly connected to it. This point then serves as a center of rotation for the lever 36 when the pin on the lever of the speed-measurer is moved. The distributor-piston 3, which follows the movements of the point *c* of the lever 36, therefore opens the admission to the cylinder 19, Fig. 1, in such a manner that the piston which is in the cylinder is moved and takes a position corresponding to that of the end 37. As soon as the piston has arrived at this position the end 38 of the lever 36 is so placed with respect to the end 37 that the point *c* comes to its central position, in which the piston 3 closes all the distributing-orifices at the same time. The same operation takes place with the other lever 36, which by the rod *b* is connected to the motor-cylinder 22, Fig. 1<sup>a</sup>, and which by the point *d* governs the distributing-piston 4. The points *c* and *d* of the levers are provided with screw-studs in such a manner that their position can be regulated very exactly.

In the drawings there is shown a system of closing the distributing-blades. The obturator is in the form of a circular slide, Fig. 1, and there is also described in the preceding portion of the specification an obturator in the form of a piston. My system is of course also applicable to any other type of obturator, and hence is not limited to a particular type of obturator, but to an arrangement of placing obturators under the control of the gov-

ernor, which is at the same time connected to a valve located at the inlet of the steam. The obturators may also be worked by means of a mechanical relay; but in consequence of the great speed of rotation of the turbine it is preferable to employ a fluid-motor.

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

1. In a mechanism for automatically governing steam or gas turbines, a governor or speed-measurer, a throttle-valve controlling the steam or motive fluid inlet to the turbine and controlled by said speed-measurer, one or more obturators controlling the distribution of the motive fluid in the turbine, and means controlled by the speed-measurer and arranged to operate said obturators.

2. In a mechanism for automatically governing steam or gas turbines, a governor or speed-measurer, a main inlet for the motive fluid into the turbine, a throttle-valve located in said inlet and controlled by the speed-measurer, a surcharge-pipe leading motive fluid from the source to one of the turbine-blades higher in position than the blade receiving motive fluid from the main inlet, an obturator arranged in said surcharge-pipe, means controlled by the speed-measurer and arranged to operate said obturator of the surcharge-pipe, one or more obturators arranged in the turbine and controlling the distribution of motive fluid therein, and means controlled by the speed-measurer and arranged to operate the obturators within the turbine.

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

AUGUSTE CAMILLE EDMOND RATEAU.

Witnesses:

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EDWARD P. MACLEAN.