

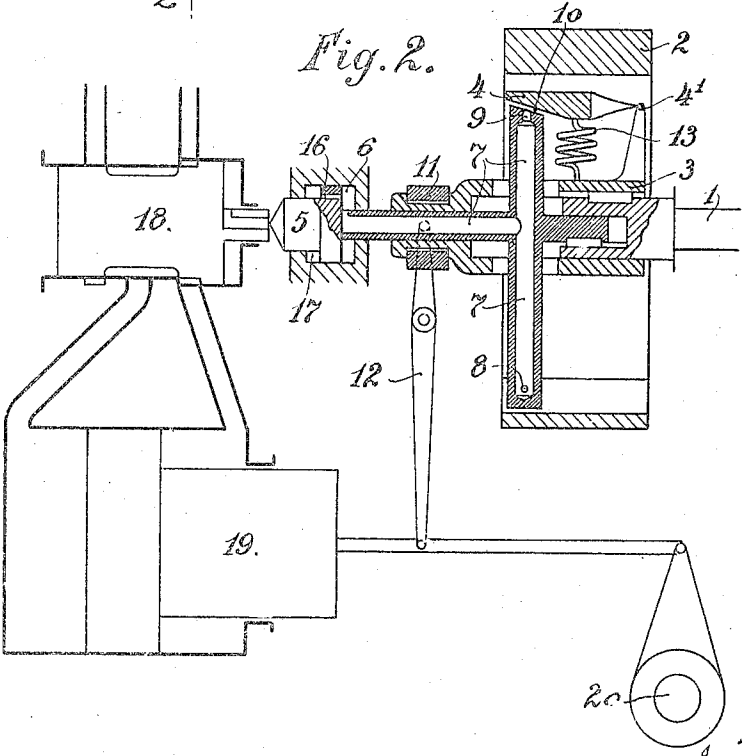
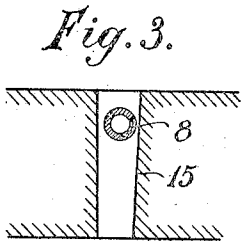
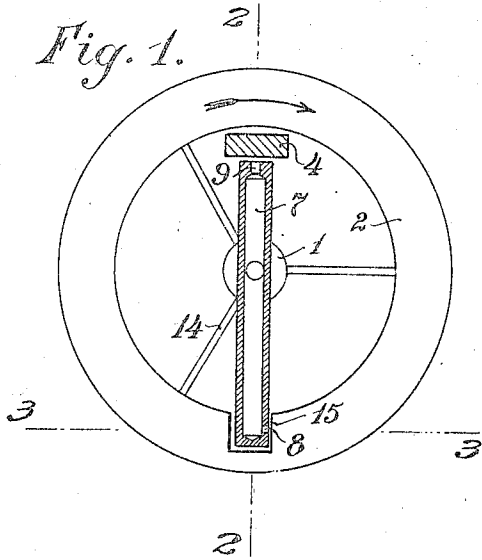
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E. VOLET

APPARATUS FOR GOVERNING PRIME MOVERS

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR GOVERNING PRIME MOVERS.

Application filed August 26, 1922. Serial No. 584,583.

To all whom it may concern:

Be it known that I, EDOUARD VOLET, a citizen of Switzerland, residing at Geneva, Canton of Geneva, in the Confederation of Switzerland, have invented certain new and useful improvements in or relating to Apparatus for Governing Prime Movers, of which the following is a specification.

The present invention relates to an apparatus for governing prime movers provided, like other known apparatus with a servo-motor controlling the admission of a motive fluid to the machine and being itself controlled by a distributor placed by means of at least one relay in dependence on a tachometer and on an accelerometer. It is distinguished therefrom by the fact that the tachometer and the accelerometer govern directly and independently of each other the supply of a fluid used in the relay.

The accompanying drawing represents diagrammatically a constructional form of the apparatus given by way of example.

Fig. 1 is a transverse section thereof.

Fig. 2 is a longitudinal section thereof on the line 2—2 Fig. 1.

Fig. 3 is a partial longitudinal section thereof on the line 3—3 Fig. 1.

The shaft 1, the speed of which is always proportional to that of the machine to be regulated, carries round in its rotary movement a ring 2 forming a fly wheel, and a socket 3 on which is pivoted at 4, in any manner, a centrifugal mass 4 forming a governor weight. The shaft 1 also carries round in its rotation the stem 7 of an ordinary hydraulic relay 5 which is adapted to move axially. This relay controls, through the medium of a distributor 18, the servo-motor 19 which operates the shaft 20 to actuate the distributing mechanism of the prime mover, the gate or sluice mechanism of a hydraulic turbine for example. This stem 7 which is hollow, permits a chamber 6 of the relay 5, in which a variable pressure exists, to communicate with two openings 8 and 9 through the medium of passages in the stem 7. The opening of the orifice 8 is regulated by the fly wheel 2 and the opening of the orifice 9 by the governor weight 4. This latter is provided with an inclined face 10 which constitutes a regulating device for the supply of the fluid

utilized in the relay 5 and which permits a modification of the normal operating speed by a simple axial movement of the socket 3. A ring 11 mounted in the socket 3 and connected by a yoke to a lever 12 determines the axial position of the socket 3 and consequently of the governor weight 4. The centrifugal force developed by this latter is balanced by the tension of a spring 13 while the tangential force developed by the ring 2, in case of acceleration or retardation, is balanced by the elasticity of the spokes 14 which fix it on the shaft 1, it being understood that the spokes 14 are elastic in order to make the apparatus operative. The ring 2 carries also an inclined face 15 which constitutes a second regulating device for the relay 5.

The working of this constructional form of the invention is as follows:

At the normal speed of operation the acceleration is zero, the spokes 14 connecting the shaft 1 to the ring 2 are not subjected to any tangential force if it be assumed that the hydraulic reaction is negligible. Their mean relative position is therefore quite determined. The governor weight occupies a position determined by the ring 11 on the one hand, and by the tension of the spring 13 which has to balance the centrifugal force on the other hand. Under these conditions the relay 5 itself occupies its mean position when the quantity of fluid which escapes through the sum of the orifices 8 and 9 is equal to that which passes from the constant supply chamber 17 of the relay 5 through the orifice 16 into the chamber 6. This mean position corresponds to that of the distributor 18 and the servo-motor 19 is therefore stationary. The lever 12 and ring 11 merely serve to determine the variation of speed between full and no load at a determined value. In ordinary service the lever 12 moves the socket 3 toward the right, whenever the servo-motor 19 moves to the left, (a movement which corresponds to the opening). If on the other hand the servomotor 19 moves to the right, the socket 3 will be moved to the left. Since the socket 3 carries the governor weight 4, a displacement of this latter will cause for an obturation of the orifice 9, from this an acceleration of the speed will ensue, which causes the equi-

librium to be restored. When the servomotor is stopped at the extreme right position the normal speed is greater than when the servomotor is stopped at the extreme left position. This difference of speed is useful for the service in parallel of a plurality of regulators. If however a single regulator is used this difference of speed may be eliminated without causing the function to be influenced disadvantageously.

In order to simplify the description, it is assumed that this difference of speed is negligible.

If now the speed changes, for example when there is an abrupt removal of load on the prime mover, the shaft 1 is accelerated, carrying round directly in its rotation the socket 3 and consequently the governor weight 4, and also the stem 7 of the relay 5. On the contrary the spokes 14 having to transmit this acceleration to the ring 2 undergo an elastic distortion which is proportional to the value of the acceleration itself.

The effect of the removal of the load is therefore:

1. To augment the free section of the orifice 8.
2. To augment the free section of the orifice 9 the centrifugal force developed by the governor weight having augmented. These two facts both produce a movement of the movable part of the relay 5 towards the right. The relay 5 operates and controls the distributor 18 and produces by its agency a closing of the servo-motor 19.

As soon as the excess speed has reached a certain value the orifice 9 is opened wide and remains in this state until the excess speed after having reached its maximum has returned to this same value. During the whole of this period the variation of speed has no influence on the governing and this latter becomes purely accelerometrical. The fly wheel then plays the same part as a governor weight in a direct acting ordinary governor with this difference that the governing will establish not a constant speed but rather a constant acceleration of determined value. If the free section of the orifice 9 did not change from normal the governing would establish corresponding acceleration, that is to say the zero acceleration. But as the opening of the orifice 9 has been brought to a greater value than its normal value it is therefore necessary, in order that the relay may occupy its position of equilibrium, that the opening of the orifice 8 shall have been brought to a lower value than its normal value, that is to say that the acceleration shall be negative. In other words the accelerometric governing will establish a constant acceleration but a negative one. In consequence after having passed through its maximum, the speed diminishes in following a linear law.

When the excess speed has diminished sufficiently the governor weight resumes its influence and a combined control by the governor weight and the fly wheel is again produced.

The closing of the orifice 9 when the governor weight 4 approaches the normal position, that is to say when the excess speed tends towards zero, produces a movement of the movable part of the relay 5 such that the movement of the servo-motor which it determines simultaneously causes the acceleration to tend towards zero thus re-establishing equilibrium.

During the latter period to each value of the excess speed (that is to say to each position of the governor weight 4) corresponds a value of acceleration (that is to say a position of the fly wheel 2) such that the simultaneous realization of these two values causes the relay 5 to take up its position of equilibrium. The excess speed which just produces the maximum opening of the orifice 9 and the negative acceleration of equilibrium of the preceding period constitute a first pair of corresponding values. The zero excess speed and the zero acceleration is another pair. Between these two limiting pairs there is naturally a series of others, according to a well defined law. If during this period the simultaneous variations of the acceleration and of the excess speed depart from this law, the relay acts instantly to bring them back again, that is to say the speed as well as the acceleration tends without oscillation to its normal value whatever the deviation may be.

In case of an abrupt load on the prime mover the governing is at all points similar, although in the reverse direction and the speed, after having reached its minimum value, increases following a linear law and then reaches its normal value without oscillation.

In the foregoing description it is clearly shown that the tachometer and the accelerometer both govern directly and independently the passage of the fluid in the relay.

I claim as my invention:

1. In an apparatus of the class described, the combination with a relay, a servomotor and devices for controlling the admission of a motive fluid to a prime mover of a shaft, a fly wheel mounted on the shaft, a fluid conductor leading from the relay and connected to and revoluble with the said shaft, and a weight member carried by the shaft and adapted to control the flow of a fluid through an opening in the said conductor.

2. In an apparatus of the class described, the combination with a relay, a servomotor and devices for controlling the admission of a motive fluid to a prime mover of a shaft, a fly wheel on the said shaft, a

hollow stem leading from the said relay and connected to the shaft so as to turn therewith, there being an opening in the said hollow stem for the outlet of a liquid passing through the hollow stem, and a governor weight revoluble with the shaft and adapted to control the flow of the liquid through the said opening in the hollow stem.

3. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover of a shaft, a fly wheel mounted on the said shaft, a hollow stem connected at one end to the said relay and at the other to the said shaft so as to turn therewith, a socket slidable on the said shaft, and a governor weight carried by the said socket and adapted to cooperate with a portion of the said hollow stem to control the flow of a liquid through an opening in the same.

4. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover of a shaft, a fly wheel carried by the said shaft, a hollow stem connected at one end in the said relay and at the other in the said shaft so as to turn therewith, the said hollow stem having a branch extending into the fly wheel, a socket movable on the said shaft, a governor weight connected to the said socket, and means for normally maintaining the governor weight in position to coact with the end of the branch of the hollow stem to control the flow of liquid through an opening in the extremity of the said branch of the hollow stem.

5. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover of a shaft, a fly wheel carried by the said shaft, a hollow stem connected at one end in the said relay and at the other in the said shaft so as to turn therewith, the said hollow stem having a branch extending into the fly wheel, a socket movable on the said shaft, a governor weight non-rigidly connected to the said socket, means for normally maintaining the governor weight in position to coact with the end of the branch of the hollow stem to control the flow of liquid through an opening in the extremity of the said branch of the hollow stem, and means operated by the devices for controlling the admission of the motive fluid to the prime mover for actuating the said socket and thereby determining the position of the governor weight relatively to the end of the branch of the hollow stem.

6. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of

a motive fluid to a prime mover of a shaft, a fly wheel carried by the shaft, a hollow stem at one end leading from the said relay and at the other connected to the said shaft to turn therewith, the said stem having a branch extending to a face of the fly wheel, said face being adapted to control the flow of the liquid passing through the orifice adjacent the extremity of the said branch of the hollow stem.

7. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover, of a shaft, a fly wheel comprising a rim and elastic spokes connecting the same with the shaft, a hollow stem leading at one end from the said relay and at the other connected to the said shaft so as to turn therewith, and a branch extending from the said hollow stem to the fly wheel, there being an opening adjacent the end of the branch of the hollow stem the flow of a liquid being controlled by the face of the fly wheel.

8. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover, of a shaft, a fly wheel mounted on the shaft, a hollow stem leading at one end from the said relay and the other connected to the shaft to turn therewith, branch arms extending from the said hollow stem to the fly wheel with openings at the ends thereof, the opening at the end of one of the branch arms lying adjacent a face of the fly wheel to which this branch arm of the hollow stem extends, and a governor weight revoluble with the fly wheel and adapted to cooperate with the extremity of the other branch arm to control the flow of a liquid through the said opening therein.

9. In an apparatus of the class described, the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover, of a shaft, a fly wheel mounted on the said shaft, a hollow stem leading at one end from the said relay and connected at the other end in the said shaft so as to turn therewith, branch arms extending from the hollow stem in opposite directions to the fly wheel and each having an opening at the end thereof, a socket member slidable on the said shaft, a governor weight carried by the socket member and adapted to cooperate with the extremity of one of the branch arms of the hollow stem to control the flow of a liquid to the opening therein, the extremity of the motor branch arm extending to the fly wheel with an inclined face coacting with the extremity of this branch arm to control the flow of the liquid through the opening therein, and means operated by the devices for controlling the admission of the motive

fluid to the prime mover for determining the position of the socket member and associated parts on the shaft.

10. In an apparatus of the class described, 5 the combination with a relay, a servo-motor and devices for controlling the admission of a motive fluid to a prime mover, of a shaft, a fly wheel comprising a rim and elastic spokes connecting the same to the shaft, a 10 hollow stem with branch arms extending at right angles from the said hollow stem to the said fly wheel, and each having an opening at the ends thereof, the hollow stem leading at one end from the relay to said 15 openings, a socket member revoluble with and slidable upon the said shaft, a governor weight mounted on the said socket member and adapted to cooperate with the extremity of one of the branch arms of the hollow stem 20 to control the flow of the liquid through the

opening therein, a spring for maintaining the normal relationship between the said governor weight and the extremity of the branch arms of the hollow stem, the other branch arm of the hollow stem extending 25 to the fly wheel and coacting with an inclined face to control the flow of the liquid through the opening in the end of this branch arm of the hollow stem, and means coacting with the devices for controlling the 30 admission of the motive fluid of the prime mover for shifting the said socket member and the parts associated therewith on the said hollow shaft.

In testimony whereof I have affixed my 35 signature in presence of two witnesses.

EDOUARD VOLET.

Witnesses:

MAURICE THUEY,

EDOUARD EMMANUEL.