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FLUID PRESSURE GOVERNING SYSTEM

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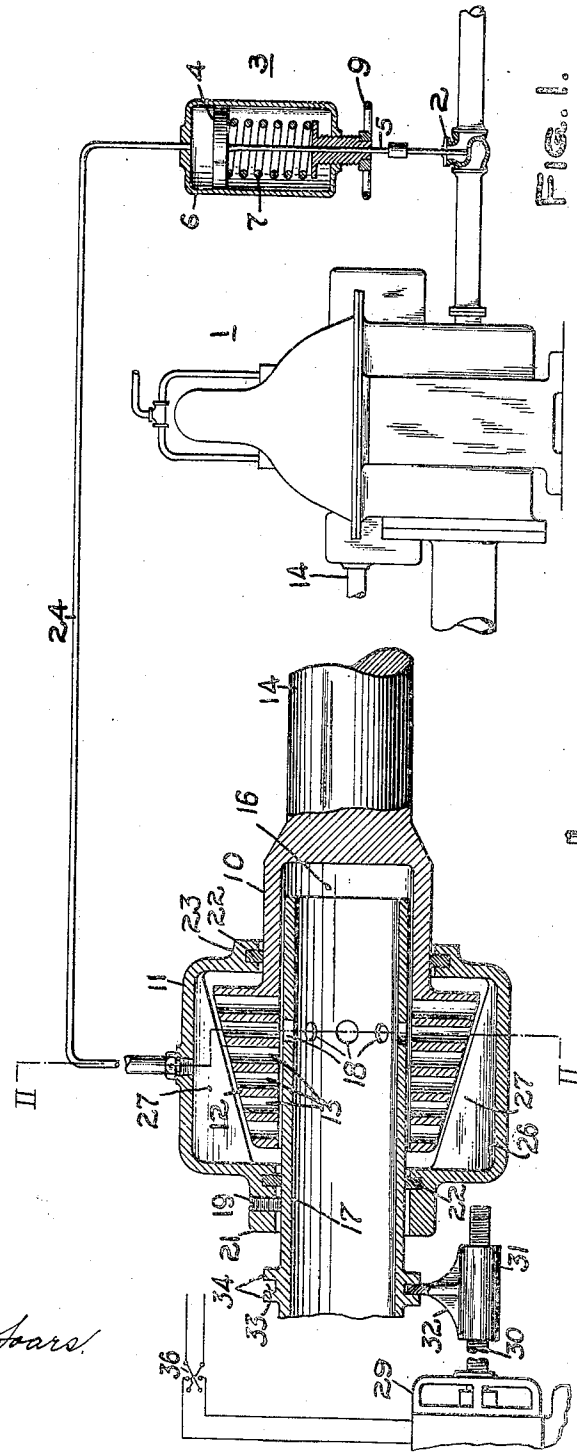


FIG. 1.

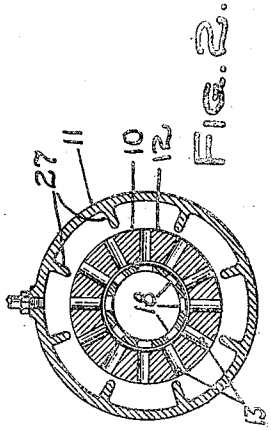


FIG. 2.

WITNESS

C. L. Hoard

INVENTOR

HENRY F. SCHMIDT.

BY

A. B. Rowe

ATTORNEY

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UNITED STATES PATENT OFFICE

HENRY F. SCHMIDT, OF LANSDOWNE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

FLUID PRESSURE GOVERNING SYSTEM

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My invention relates to a fluid pressure governing system for a prime mover, and it has for its object to provide apparatus of the character set forth capable of wide variations in the setting thereof, and the governing characteristics of which are substantially the same at all speed settings.

Satisfactory governing mechanisms have been developed for governing prime movers at a given speed setting, or at speed settings varying within a very limited range. Considerable difficulty has been experienced, however, in designing governing mechanisms capable of wide variations in the speed setting. This is due to the fact that the variations in governing force are much greater at higher speeds than at lower speeds, whereas the spring which opposes the governing force is capable of providing but one scale, which may be suitable for one speed but unsuitable for other speeds.

In accordance with my invention, I provide a centrifugal fluid impeller for providing a fluid pressure varying as a function of the speed of the prime mover, and means responsive to the fluid pressure developed by the impeller for controlling the admission of motive fluid to the prime mover. I further provide means for varying the relation of fluid pressure to the speed of the prime mover, that is, the fluid pressure developed at a given speed or the speed at which a given fluid pressure is developed. This is preferably accomplished by varying the effective diameter or the radial disposition and extent of the impelling surfaces of the impeller.

According to one form of the invention, an impeller is provided with a plurality of sets of impelling surfaces, or vanes, and means are provided for selectively admitting the fluid media, which may be either a liquid or a gas, to the vanes having the desired characteristics.

Preferably, the impeller is in the form of a hollow cone in which holes are bored in circumferential rows, so that one, or more, of the rows may provide a set of impelling surfaces. A sleeve is movably mounted within the cone and it is provided with a circumferential series of openings which correspond with any one set of the holes which provide the impelling surfaces in the cone. By adjusting the sleeve axially with respect to the cone, the actuating media can be admitted to any of the various sets of impelling surfaces, and the desired pressure relation thus obtained.

The above and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a diagrammatic view showing a prime mover having my novel governing system applied thereto; and,

Fig. 2 is a transverse section taken along the broken line II—II of Fig. 1.

Referring now to the drawing in detail, I show a prime mover 1, which may be a steam turbine, having an admission valve 2 for controlling the admission of motive fluid to the prime mover. The admission valve 2 is operated by a fluid pressure governor 3. This governor may be any one of a number of well known forms of fluid pressure governors, but for the purpose of simplicity, I show the governor as a simple pressure-responsive device consisting of a piston 4 connected to the admission valve 2 by means of a stem 5, a cylinder 6 in which the piston 4 is disposed, and a spring 7 for biasing the piston 4 in valve opening direction.

To provide fluid pressure for actuating the piston 4 to control the admission of motive fluid, I provide a centrifugal fluid impeller 10 enclosed in a housing 11. The impeller and its housing are shown on the drawing on a larger scale than the turbine 1. In the form shown, the impeller proper comprises a frusto-conical portion 12 which is provided with a plurality of groups of circumferentially-arranged and transversely extending holes 13.

The frusto-conical portion 12 is preferably made integral with the shaft of the prime mover, shown at 14, and the frusto-conical portion is bored to provide an ax-

ially-extending, cylindrical recess 16, the recess extending beyond the base of the frustum and into the shaft, as shown. It will thus be seen that the holes 13 provide radial impelling vanes to which fluid may be admitted through the cylindrical recess 16.

In order to provide for selectively controlling the effective diameter of the impeller, that is, the radial extent of the impelling surfaces, and consequently the pressure of the fluid delivered thereby at a given speed, I insert a sleeve 17 into the cylindrical recess 16, and provide the sleeve with a series of circumferentially arranged openings, such as the holes 18, which correspond in size with the radial holes 13 of the impeller. The holes 18 may be made large enough to admit fluid to two or more of the circumferential groups of the radial holes, or to only one group as shown, depending on the operating requirements.

Furthermore, the circumferential groups of holes 13 may be arranged to have fundamentally different characteristics. For example, one circumferential group may have radial holes, so as to provide radial vanes, while another group may have curved holes, or passages, to provide either forwardly or backwardly tipped vanes, and various degrees of curvature may be embodied in different circumferential groups of vanes.

In order to provide for manually adjusting the sleeve 17 and for holding it in the various adjusted positions, I mount one or more set screws 19 in the boss 21, of the housing, through which the sleeve is inserted. Obviously, however, any suitable holding arrangement, other than the set screws 19, may be employed. I also provide suitable packing 22 between the boss 21 and the sleeve 17, and between the boss 23, which receives the shaft 14, and the shaft.

The sleeve 17 may also be adjusted by a reversible motor 29, having a screw threaded stem 30 for moving an internally threaded sleeve 31. The latter has a fork 32 engaging a groove 33 formed by two spaced collars 34 on the sleeve 17. The motor 29 may be controlled from a remote point by a reversing switch 36.

Fluid may be admitted through the openings 18 to the inlet of the impeller in any suitable manner, preferably through the passage provided by the sleeve 17. A suitable number of longitudinally-extending vanes 27 are secured to the inner walls of the chamber 26 and are arranged contiguous to the tapered surface of the impeller for the purpose of preventing a whirling motion of the fluid in the chamber 26. In this manner, it is assured that the pressure of the fluid provided in the chamber 26 will be the pressure created by the particular group of holes 13 which is in communication with the openings 18 of the sleeve 17 and that this pressure will not be affected by any whirl due to the rotation of the other impelling vanes.

A conduit 24 is provided for conveying the pressure of the fluid in the chamber 26 to the cylinder 6 of the governor.

The operation of the above described apparatus is as follows:

Each circumferential group of holes 13 provides a different speed setting, the shorter holes 13 providing the higher speed settings and the longer holes providing the lower speed settings. To operate, for example, at the speed setting next to the lowest, the sleeve 17 is moved to the position shown on the drawing, placing the openings 18 in communication with the group of holes 13 which are next to the longest.

The mechanism now operates in the usual manner of a fluid pressure governor, the impeller providing a fluid pressure varying as the square of the speed. Upon decrease in load on the prime mover, the speed thereof tends to increase, providing an increase in fluid pressure developed by the impeller. The increased fluid pressure effects a downward movement of the piston 4 against the force of the spring 7, and a closing movement of the admission valve 2. The admission of motive fluid is restricted to prevent further increase in speed.

Upon an increase in load, the speed begins to decrease. The fluid pressure developed by the impeller also decreases and the spring 7 moves the piston 4 of the governor upwardly. This moves the admission valve 2 in opening direction, providing additional motive fluid for carrying the load and preventing further decrease in the speed of the prime mover.

In the operation just described, assume the speed setting to have been 400 R. P. M., and the governing mechanism to be designed for a 4% governing range above the speed setting, providing a speed range between 400 R. P. M. and 416 R. P. M. Assuming a pressure of 60 lbs. per square inch at 400 R. P. M., the fluid pressure at 416 R. P. M. is 64.896 lbs. per square inch, since the pressure varies as the square of the speed. The governor 3 is, therefore, designed to effect movement of the piston 4 throughout its travel in response to variation in the fluid pressure between 60 and 64.896 lbs. per square inch in the manner described.

To operate at the minimum speed setting, the sleeve 17 is moved to bring the openings 18 in registry with the circumferential group of the longest holes 13. The holes 13 being longer, the fluid pressure produced at a given speed is greater, which means that a lower speed is required to produce a fluid pressure of 60 lbs. per square inch. Assume this speed to be 300 R. P. M., which is

the speed setting provided by this group of holes.

A speed range of 4% above this setting again provides a range of fluid pressure between 60 and 64.896 lbs. per square inch, in response to which the piston 4 moves between the ends of its travel. The governing mechanism now operates in exactly the manner described above, the speed range in this case being between 300 R. P. M. and 312 R. P. M.

To operate at a higher speed setting, for example, at the maximum speed setting, assumed to be 800 R. P. M., the sleeve 17 is moved to the left to provide admission of fluid to the group of the shortest holes 13. A considerable higher speed is now required to produce a fluid pressure of 60 lbs. per square inch, for example, 800 R. P. M. The range of speed required to effect the pressure range in response to which the governor 3 operates is again 4%, that is, the speed range is between 800 R. P. M and 832 R. P. M.

The speed setting produced by any one of the circumferential groups of holes 13 may be varied within relatively narrow limits by varying the setting of the spring 7, this being accomplished by turning the hand wheel 9.

By the expression "varying the effective diameter of the impeller", I include variations in redial disposition as well as variations in radial extent of the impelling surfaces, since both of such variations change the pressure produced at a given speed or the speed at which a given pressure is produced.

From the above description, it will be seen that I have provided a governing mechanism capable of operating at widely varied speed settings and having similar governing characterists at said speed settings, thereby providing equally stable governing.

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 changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only 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:—

1. The combination with centrifugal fluid impelling means and a governor responsive to fluid pressure developed by said impelling means, of means whereby the radial extent of the impelling surfaces providing the fluid pressure imposed on the governor may be changed.

2. The combination with centrifugal fluid impelling means having a plurality of effective diameters and a governor responsive to fluid pressure developed by said impelling means, of means for selectively changing the effective diameter of the impeller.

3. In a fluid pressure governing mechanism, the combination of centrifugal fluid impelling means having a plurality of radial extents of impelling surfaces to provide a plurality of pressure-to-speed relations, a governor responsive to fluid pressure developed by said impelling means, and means for rendering any one of said radial extents of impelling surfaces effective to provide the fluid pressure to the governor, whereby the speed setting of the governing mechanism may be varied.

4. The combination with a fluid impeller having a plurality of sets of impelling surfaces and a governor responsive to fluid pressure developed by said impeller, of means for rendering any one of said sets effective, and the other, or others, ineffective.

5. The combination with centrifugal fluid impelling means having a plurality of effective diameters and a governor responsive to fluid pressure developed by said impelling means, of means for changing the effective diameter of the impelling means from a station remote from the impeller.

6. The combination of a fluid pressure governor, an impeller for developing fluid pressure for controlling the governor, said impeller having a central inlet and a plurality of fluid impelling passages arranged in circumferential groups of varying radial extent, and means for selectively controlling the flow of fluid through the circumferential groups of the respective passages.

7. The combination of a fluid pressure governor, an impeller for developing fluid pressure for controlling the governor, said impeller having a central inlet and a plurality of impelling passages of varying radial extent, and means for selectively permitting flow through some of said passages and closing off the flow through other passages.

8. In a governing mechanism for a prime mover having an admission valve, the combination of pressure-responsive means for controlling the admission valve, centrifugal fluid impelling means driven by the prime mover and developing fluid pressure varying as a function of the speed of the prime mover, means for subjecting the pressure-responsive means to the pressure of fluid developed by the impelling means, and speed changer means for varying the speed setting of the governor mechanism comprising means for changing the effective diameter of the impelling means providing the fluid pressure.

9. In a governing mechanism for a prime mover, the combination of pressure-responsive means for controlling the speed of the prime mover, centrifugal fluid impelling means mounted on a shaft of the prime mover for providing a fluid pressure varying as

a function of the speed thereof, means for applying the fluid pressure developed by the impelling means to the pressure-responsive means, and means for varying the speed setting of the governing mechanism over a wide range of speeds of the prime mover comprising means for changing the radial extent of the impelling surfaces of the impelling means providing the fluid pressure, whereby substantially the same range of governing fluid pressure is provided for all speed settings.

In testimony whereof, I have hereunto subscribed my name this 10th day of January, 1930.

HENRY F. SCHMIDT.