

June 21, 1932.

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1,864,217

DUAL DRIVE MECHANISM

Filed Jan. 16, 1929

Fig. 1.

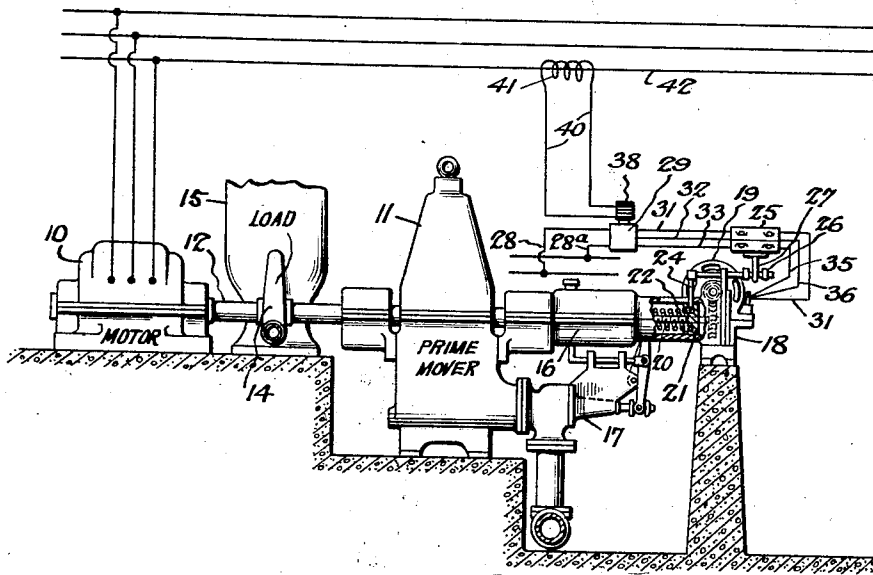


Fig. 2.

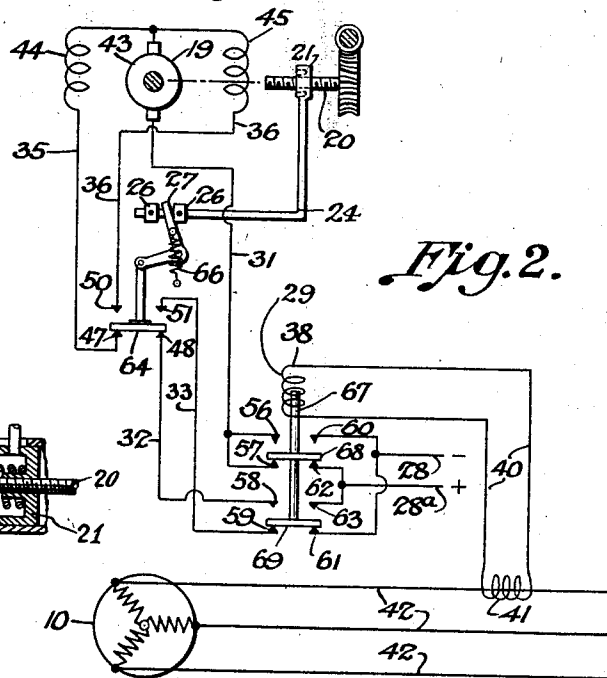
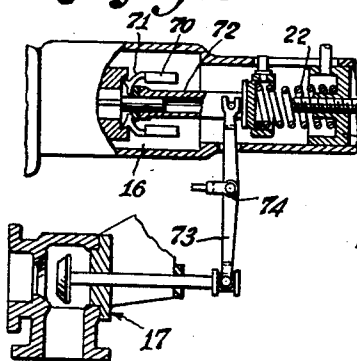


Fig. 3.



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DUAL DRIVE MECHANISM

Application filed January 16, 1929. Serial No. 332,979.

My invention relates to what is commonly termed a dual drive arrangement, that is, a prime mover, for example, a steam turbine, and an electric motor both connected to a load, the prime mover being arranged to carry the load upon failure of the motor power supply.

With apparatus of the character just referred to, where the electric motor is ordinarily depended upon to carry the load, speed responsive means is utilized to prevent the admission of motive fluid to the prime mover; and, when failure of power to the motor occurs, the speed of the installation drops until such a time as the speed-responsive means may open the admission valve for the prime mover, whereupon the prime mover operates through a governing speed range from no load to full load, this speed range being lower than that of the motor. Where the speed of the load is critical and variation should be kept at a minimum, as, for example, with removal pumps of jet condensers, experience shows that it is desirable to provide means whereby the prime mover governing speed range may be raised upon failure of the motor supply. Accordingly, therefore, it is the object of my invention to provide dual drive mechanism of the character referred to including a governor having speed changing mechanism together with controlling mechanism for the speed changer mechanism, the controlling mechanism serving, upon failure of the motor supply, to secure an adjustment of the governor such that the prime mover will carry the load at a governing speed range close to that of the normal speed of the motor and to secure further adjustment, when power is again supplied to the motor, so that the governor is set to govern at a speed range below the normal speed of the motor so that the governor will close the admission valve when operated by the motor.

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

Fig. 1 is an assembly view showing a por-

tion of the speed changer apparatus in section;

Fig. 2 is a diagrammatic view of electrical connections employed for controlling the speed changer; and,

Fig. 3 is an enlarged sectional view of the governor.

Referring now to the drawing more in detail, I show an electric motor 10 and a prime mover, for example, a steam turbine 11, both connected to a shaft 12 which carries a power load. For example, the load may be the centrifugal pump 14 of a jet condenser 15.

With a jet condenser, the removal pump must take away the condensate as well as the condensing water otherwise the water will rise in the condenser to such a point as to operate the vacuum breaker. A constant rate of removal of water from the condenser should be maintained so as to permit a constant rate of water supply to the condenser and the maintaining of a constant submergence level above the pump shaft. This is accomplished by maintaining practically constant speed of the pump and this latter result is best assured by minimizing the difference in the respective speeds of the electric motor 10 and the prime mover 11.

The prime mover or turbine 11 includes a governor, at 16, controlling an admission valve, at 17. The governor 16 may be of any construction which includes speed changer mechanism for changing the speed setting of the governor, several forms of which are well-known in the art. For the purpose of the present disclosure, a construction of governor has been disclosed which is substantially the same as shown in the patent of F. Hodgkinson, 900,852 of October 13, 1908. The governor includes governor weights 70, which are carried on weight arms 71 and rotated by the turbine shaft. The centrifugal force of the weights is transmitted by the weight arms to a tubular member 72, biasing the same to the right against the force of a compression spring 22. The other end of the spring 22 abuts against a follower 21. The member 72 is connected to the valve 17 by a lever 73 fulcrumed at 74.

The governor operates in the well-known

manner of a centrifugal governor to maintain the turbine at the governing speed. Upon increase in speed of the turbine, the weights 70 are moved outwardly by the increased centrifugal force and move the tubular member 72 to the right against the force of the spring 22. The member 72 moves the admission valve in closing direction through the lever 73 to restrict further increase in speed. Upon decrease in speed, the centrifugal force of the weights 70 decreases, permitting the spring 22 to expand an amount proportional to the decrease in centrifugal force. The member 72 moves the admission valve 17 in opening direction to restrict further decrease in speed.

In this manner, the governor serves to maintain the turbine at the governing speed. In the present case, the governing speed varies throughout a limited range, since a small change in speed is necessary to cause operation of the governor for moving the admission valve.

The governing speed to which the governor is set is determined by the position of the follower 21. The governor is adjusted for increased governing speed by moving the follower 21 to the left, providing increased compression of the spring 22. The turbine then operates at an increased governing speed to provide sufficient centrifugal force to oppose the increased spring compression. By moving the follower 21 to the right, decreased spring compression for each position of the governing mechanism is provided, and the governor operates through a lower speed range.

The governor is provided with a speed changer mechanism 18 for adjusting the governing speed, or speed setting, of the governor. The speed changer mechanism includes an electric motor 19, and operates through suitable gearing to rotate a screw 20. The latter is screw-threaded within the follower 21 and serves to move the follower for providing increased or decreased spring compression.

As already pointed out, when the load is carried by the electric motor 10, the speed changer 18 is so set that the governor 16 operates to close the admission valve 17; and, if the power supplied to the motor 10 should fail, two effects follow, namely, the speed of the installation tends to drop permitting the governor 16 to open the admission valve 17, and, concurrently with this, the motor 19 is rendered effective to change the setting of the speed changer 18 to increase the governing speed range of the governor 16 so that the governing speed from no load to full load of the prime mover 11 is very close to that of the electric motor 10. The control mechanism for the speed changer also incorporates means, whereby, when the normal power supply to the electric motor 10

is again resumed, the speed changer is automatically operated to readjust the governor 16 to govern at a speed range below that of the motor 10, whereby the governor operates to close the admission valve 17.

Referring now to the control mechanism more in detail, the electric motor 19 for operating the speed changer is of the reversible type, for example, it may be of the split field type. The motor operates to secure rotation of the screw shaft 20 either in one direction or the other as already referred to to secure movement of the follower 21 either in one direction or the other. The follower 21 is secured to an arm 24 arranged to operate a limit switch 25, the arm 24 having adjustable collars 26 thereon cooperating with a tiltable switch lever 27. Current for operating the motor 19 comes from the leads 28 and 28a, such current passing through the solenoid switch 29 and the limit switch 25, the solenoid switch having outlet leads 31, 32 and 33, of which 32 and 33, for example, go to the limit switch 25 and 31 goes directly to the motor 19. The limit switch has outlet leads 35 and 36 going to the motor 19.

The limit switch 25 not only serves the purpose of disconnecting the motor 19 from its power source when the governor has been adjusted to a predetermined amount but it also serves to establish the necessary connections to secure operation of the motor 19 when the next movement of the solenoid control switch 29 takes place.

The switch 29 is moved in one direction due to energization of its solenoid winding 38 and in the other direction by any suitable means, for example, by gravity. The winding 38 is arranged to be energized when power is supplied to the motor 10; and, to this end, I show the winding 38 provided with leads 40 connected to an inductive winding 41 associated with one of the leads 42 of the motor 10.

If the power of the motor 10 should fail, the speed of the installation would tend to drop and, at the same time, the switch 29 would operate so as to establish such a circuit for the speed changer motor 19 that the latter would operate to adjust the speed changer so that the turbine would have a governing range somewhat higher and approximating that of the motor, operation of the speed changer motor 19 continuing until the circuit established by the operation of the switch 29, as just referred to, is broken by the limit switch 25 responsive to movement of the speed changer mechanism; and, not only does the limit switch serve to break the circuit in this manner but it also serves to establish suitable connections so that when the switch 29 is operated in the other direction incident to energization of the winding 38, the speed changer motor 19 will be operated in the other direction to reduce the governing speed of the tur-

bine, thereby causing the governor to close the admission valve. The latter operation of the speed changer motor 19 continues until the limit switch 25 is operated whereupon the circuit is broken and connections are made for operation of the speed changer motor 19 in the opposite direction upon movement of the switch 29 in the opposite direction.

In Fig. 2, I show by way of example, a suitable arrangement of circuits and switch details which may be employed in carrying out the operations just referred to. In this view, I show the motor 19 including an armature 43 and split fields 44 and 45. The armature 43 has the lead 31 connected thereto. The field 44 is connected to the lead 35 which terminates in contact 47 opposite to the contact 48 of the lead 32. Similarly the field 45 is connected to the lead 36 terminating in a contact 50 opposite to the contact 51 of the lead 33.

The solenoid switch includes contacts associated with the leads 28 and 28a and with the leads 31, 32 and 33. The lead 31 has upper and lower contacts 56 and 57, the lead 32 has an upper contact 58, and the lead 33 has a lower contact 59. The lead 28 terminates in contacts 60 and 61 arranged opposite to the contacts 56 and 59, respectively, and the lead 28a terminates in contacts 62 and 63 arranged oppositely to the contacts 57 and 58, respectively.

The limit switch 25 includes a contact element 64 connected to the rock lever 27. If the rocker 27 is tilted to the left, the lead 32 is connected to the lead 35. If the tiltable member 27 is moved toward the right, the contact 64 will connect the contacts 50 and 51, thereby connecting the leads 36 and 33. If it is assumed that current is being supplied to the motor 19 with the limit switch in the position shown in Fig. 2, then such current would pass through the leads 32 and 35 to the field 44, the circuit being completed through the armature 43 and the lead 31; and, the motor 19 would then operate, this operation resulting in adjustment of the speed changer and turning the screw 20 to traverse the arm 24 and engage an adjustable collar 26 thereof with the lever 27 causing the latter to swing toward the right. In this way, the circuit for the motor 19, just referred to, is broken.

The lever 27 is snapped over to the right due to any suitable snap-over means, for example, I show a spring 66 arranged to move the member 27 to the limit of its movement in either direction just as soon as it has passed beyond central position. Due to this snap-over action, the contact 64 is moved so as to connect the field 45 in circuit when the next operation of the solenoid switch 29 takes place. Therefore, the limit switch not only serves to limit the extent of operation of the motor 19 in a given direction but it also serves to establish connections necessary for oper-

ation of the motor 19 in the other direction when such operation is permitted by the switch 29.

In Fig. 2, the position of parts is that existing after failure of the supply of power to the motor 10, after operation of the speed changer motor 19 to the desired extent and after the limit switch 25 is operated so as to bring the contact 64 in the proper position to cause the motor 19 to operate in the other direction when the switch 29 is again energized.

With switches in the position shown in Fig. 2, when power is again supplied to the motor 10, the solenoid winding 38 will be energized, thereby resulting in the core 67 being raised until the contact member 68 engages the contacts 56 and 60, thereby connecting the armature lead to the negative side 28 of the auxiliary supply line. The lower contact member 69 connects contacts 58 and 63, thereby connecting the positive side 28a of the line to the lead 35 and the field 44. The motor 19 then operates to adjust the speed changer for a lower governing speed, this adjustment continuing until interrupted by the limit switch 25, the latter operating to break the connections between the leads 35 and 32 of the field 44 and to establish connections between the contacts 50 and 51 of the field 45. With failure of the supply to the motor 10 and with the contact 65 connecting the contacts 50 and 51, the member 67 would drop, thereby connecting the negative lead 28 to the field 45 and the positive lead 28a to the armature, whereupon the motor 19 operates in the other direction to increase the governing speed, this continuing until interrupted by the limit switch 25 at which time the rocker 27 is tilted to the position shown in Fig. 2, connecting the leads 32 and 35 in readiness for operation of the motor 19 in said first direction as soon as the power supply to the motor 10 is renewed.

It will, therefore, be seen that I have devised a speed changer control mechanism for the governor of a prime mover of an organization including a power load connected both to an electric motor and to the prime mover such that, upon failure of the power supply to the motor, the prime mover will become effective and the speed changer will be rendered operative to increase the prime mover governing speed close to the normal speed of the motor and such that, upon renewal of the motor supply, the speed changer will be operated to reduce the prime mover governing speed, thereby resulting in the governor closing the admission valve of the prime mover.

While I have described my novel control mechanism as applied to a turbine mechanically connected both to a driven machine and to an electric motor and as effecting complete closing of the admission valve as long as power is supplied to the electric motor, I desire it to be understood that the invention is

not so limited in its broader aspects, as the broad principles of the invention may be utilized wherever a prime mover is connected both to a load and a second power supply which normally controls the speed of the apparatus and where it is desired to maintain substantially the same speed in case of failure of the second power supply.

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 an electric motor, a prime mover and a power load connected to the electric motor and to the prime mover and normally driven by the motor, the prime mover including a governor valve and a governor effective while the motor is operating to close the valve, of means responsive to failure of the motor power supply to increase the governing speed of the governor.

2. The combination with an electric motor, a prime mover and a power load connected to the electric motor and to the prime mover, the prime mover having a governor valve and a governor, of a speed changer for the governor and means responsive to failure of the motor power supply to adjust the speed changer for an increased governing speed.

3. The combination with an electric motor, a prime mover and a power load connected to the electric motor and to the prime mover, the prime mover having a governor valve and a governor, of a speed changer for the governor, means for setting the speed changer when the motor is effective so that the governor closes the governor valve, and means responsive to failure of the motor power supply to adjust the speed changer for an increased governing speed.

4. The combination with an electric motor, a prime mover and a power load connected to the electric motor and to the prime mover, the prime mover having a governor valve and a governor, of a speed changer for the governor, means responsive to power supplied to the motor to adjust the speed changer to cause the governor to close the governor valve whenever the motor is effective, and means responsive to failure of the motor power supply to adjust the speed changer so that the governing speed is increased.

5. A prime mover set including a prime mover and a driven machine connected thereto, said set being connected with means providing a second power supply which controls the speed of the set, a governor for said prime mover, and means responsive to failure of said second power supply for adjusting the

speed setting of the governor to substantially the speed effected by said second power supply.

6. A prime mover set including a prime mover and a driven machine connected thereto, said set being connected with means providing a second power supply which controls the speed of the set, a governor for said prime mover, a speed changer for the governor, an electric motor for operating the speed changer, and means operating in response to failure of said second power supply to adjust the speed changer substantially to the speed effected by said second power supply.

In testimony whereof, I have hereunto subscribed my name this 11th day of January, 1929.

JOHN P. RATHBUN.