

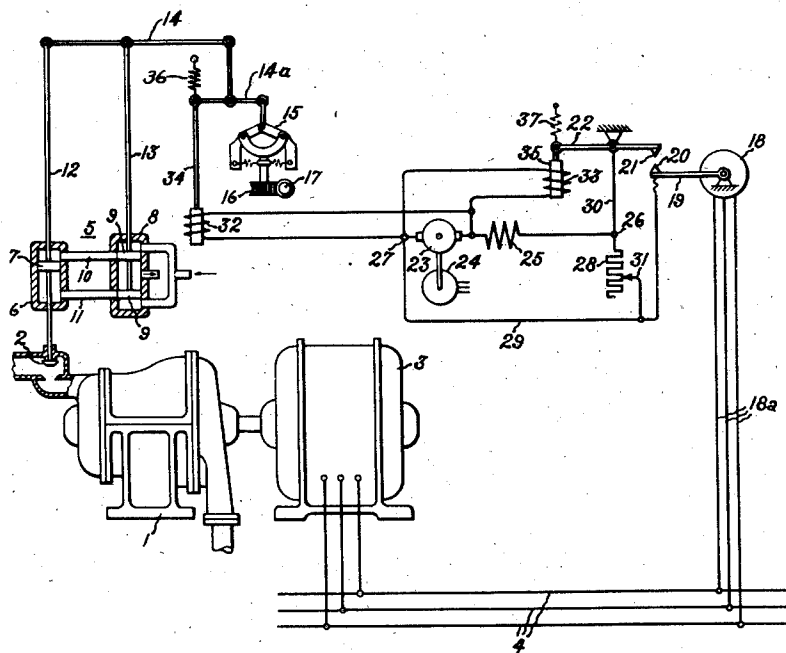
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REGULATING ARRANGEMENT FOR PRIME MOVERS

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REGULATING ARRANGEMENT FOR PRIME MOVERS

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The present invention relates to regulating arrangements for prime movers such as elastic fluid engines and more particularly to the kind of regulating arrangements which include electromechanical apparatus for controlling a prime mover driving an electric generator or like power generating engine in response to conditions in an electric line or the like.

10 The object of the present invention is to provide an improved arrangement of the above mentioned kind of regulating means.

For a consideration of what I believe to be novel and my invention, attention is directed 15 to the following description and the claims appended thereto in connection with the accompanying drawing which forms a part of the specification.

In the drawing I have shown by way of 20 example a preferred embodiment of my invention in combination with a turbo-generator set connected to an electric line. My arrangement may be applied to any prime mover driving an engine for generating energy, 25 for example, a steam engine driving a pump for conveying a liquid to a tank whereby steam has to be supplied to the prime mover in terms of level conditions in the tank. My arrangement may also be used for controlling 30 a prime mover directly in response to its load output, for instance, for controlling an elastic fluid turbine in response to its mechanical load output or in response to conditions of elastic fluid in the exhaust of such turbine.

35 In the drawing I have shown, as already stated, a turbo-generator set comprising a turbine 1 having an admission valve 2 for regulating the supply of elastic fluid to the turbine and being coupled with an electric 40 generator 3 supplying electric energy to a line 4. 5 is a motor for moving the valve comprising a hydraulic cylinder 6 having a piston 7 connected to the inlet valve of the turbine and a control means 8, in the present 45 instance shown as a pilot valve, to which fluid is supplied under pressure and which comprises valve heads 9 which normally cover conduits 10 and 11 for connecting the pilot valve with the upper and the lower parts of 50 cylinder 6 respectively. The piston 7 and

pilot valve heads 9 are pivoted by means of rods 12 and 13 respectively to a floating lever 14, the right-hand end of which is connected with another floating lever 14^a having its right hand end pivoted to a speed governor 15, in the present instance shown as an ordinary flyweight governor which may be driven through a worm gear 16 from the shaft 17 of the turbine.

The arrangement so far described may be considered as typical of any speed governor regulating system for an elastic fluid turbine driving a generator connected to an electric line. Assuming that the left hand end of lever 14^a is maintained in a fixed position, the operation of the mechanism is as follows: 60 If the demand for load in line 4 decreases it will cause an increase in speed to the effect that the weights of the speed governor move outwardly and cause a downward movement of the right hand ends of levers 14 and 14^a and a corresponding downward movement of the pilot valve heads 9. The latter thereby uncover the ports to conduits 10 and 11 and permit the supply of fluid to the upper part of the hydraulic cylinder and the draining off 65 of fluid from the lower part thereof, resulting in a downward movement of piston 7 and closing of admission valve 2 of the turbine. If the demand for electric energy increases it will cause a decrease in speed to the effect that a similar actuation of the apparatus described above takes place, but in the opposite direction and resulting in an opening movement of admission valve 2. 70 75 80 85

According to my invention I provide electromechanical means for controlling the prime mover. The speed governor may be set for pre-emergency control. This means has been shown in the present instance as including a device 18 having a movable arm 19 and being responsive to a condition of the means to which energy is supplied. In the illustrated example this device is connected by lines 18^a to line 4 and it may be a watt, frequency, voltage or current responsive device. Preferably I use an astatic instrument which is not affected by external magnetic fields. Arm 19 of this device is in a definite position under balanced condition of the system, that 100

is, when the instantaneous condition of the system is equal to the desired condition thereof, and the arm moves in either direction when conditions in line 4 change. Provided on the end of arm 19 is a contact 20 which is periodically engaged by a contact 21 provided on a lever 22. The contacts form a part of a vibratory type regulator, which also comprises an exciter or electric generator 23 of any suitable type and being driven by any suitable means, in the present instance indicated as a motor, preferably a synchronous motor 24 connected to a line of constant frequency, not shown. 25 designates the field of the generator which is shunt wound, the left hand end of the field being directly connected to one terminal of the armature of the exciter and the right hand end of the field indicated at 26 being connected to terminal 27 of the generator through an adjustable resistance or rheostat 28 and line 29. The resistance 28 is short circuited when contacts 20 and 21 engage each other. For this purpose I connect one end of the resistance with contact 21 through lever 22 and line 30 and the sliding contact 31 of the resistance or rheostat is connected to contact 20.

Connected in parallel to the exciter 23 are electromechanical or electromagnetic means indicated as electromagnets 32 and 33, the first of which having a core secured to a rod 34 which in turn is pivoted to the left hand end of the lever 14^a, and the second comprising a core 35 which is connected to the left hand end of fulcrumed lever 22. The pull exerted on lever 14^a by electromagnet 32 is under normal conditions balanced by a restraining means indicated as a spring 36. A similar restraining spring indicated at 37 may be provided for restraining the pull of electromagnet 33 exerted on the left hand end of lever 22.

The operation of the regulator is as follows: Let us assume that contact 20 is in a fixed position for a certain period and that generator 23 is being driven by motor 24 at constant speed. It will then produce a definite voltage at its terminals. Spring 37 under this condition overcomes the downward pull of electromagnet 33 and thereby causes the contact 21 to move downward until it engages contact 20. This causes short circuiting of resistance 28 which is connected in series with the field of the generator to the effect that the terminal voltage of the generator rises. This rise in generator voltage causes an increase in pull of electromagnet 33 which thereby overcomes the restraining force of spring 37 and moves the left hand end of fulcrumed lever 22 downward to the effect that contacts 20 and 21 are separated and the short circuit of resistance 28 is broken and the resistance accordingly again inserted in the field circuit of the generator. The voltage of the generator or exciter then de-

creases to its former value. Thus it will be seen that lever 22 performs a vibratory movement and periodically short circuits the field rheostat of the generator. The voltage of the latter reaches a maximum value during the closing period of the contacts and a minimum value during the opening period of the contacts. The average voltage produced at the terminals of the generator depends upon the duration of these periods as will be readily understood, that is, the average voltage of the exciter will be higher if the duration of the closing period is increased. The periods of closing and opening may be changed by changing the position of one of the contacts, for instance contact 20. In the present case contact 20 which is connected to a device responsive to conditions in line 4 is moved in response to such conditions. If, for instance, device 18 is responsive to the load on line 4, contact 20 will be moved upward when the load decreases. This upward movement causes a decrease in duration of the opening period and a corresponding increase in duration of the closing period to the effect that the average voltage of the exciter or generator increases. This increase of the average exciter voltage causes a corresponding increase of the average pull of magnet 32 to the effect that the left hand end of floating lever 14^a is moved somewhat downward against the force of the restraining spring 36 whereby the left hand end of lever 14 and the pilot valve heads 9 are also moved downward and fluid such as oil is supplied to the upper part and drained off from the lower part of the hydraulic cylinder 6. Piston 7 thereby moves downward and causes closing of the admission valve 2. The downward movement of piston 7 also causes through the floating lever 14 a similar downward movement of the pilot valve heads 9 whereby the latter resume their original position. The closing of valve 2 causes a decrease in mechanical load output of the turbine and a corresponding decrease in electrical load output of generator 3.

If the demand for electric energy in line 4 increases it will cause through the watt responsive device 18 a downward movement of contact 20 whereby the duration of the opening period is increased and that of the closing period decreased, which effects a decrease of the average excited voltage. The decrease in exciter voltage causes a corresponding decrease of the average pull of magnet 32 to the effect that restraining spring 36 moves the right hand end of floating lever 14^a upward and thus causes through the intermediary of floating lever 14 the hydraulic motor 5 to open admission valve 2 of the turbine.

Whereas I have described the regulation of a prime mover by the arrangement shown in response to external conditions it will be understood that a change of load output of

the prime mover may be readily effected by changing the position of sliding contact 31 of rheostat 28. The adjusting of the rheostat has no influence on the relative duration

rheostat, and an electromagnet actuated by the exciter for controlling said motor.
In witness whereof, I have hereunto set my hand.

RICHARD DIETZE. 70

5 of the closing and opening period but it changes the minimum voltage of the exciter, that is, the voltage which is produced during the opening period. For instance, a decrease of the resistance 28 will cause an increase of the exciter voltage during the opening period, effecting an increase of the average voltage of the exciter, resulting in a closing movement of valve means 2.

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10 Having described my invention, together with the apparatus which I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

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15 What I claim as new and desire to secure by Letters Patent of the United States, is:—

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1. In combination with a prime mover, a device responsive to the demand for load output, a vibratory type regulator cooperating with the load responsive device and including an exciter, and an electromagnetic means connected to the exciter for regulating the prime mover.

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2. In combination with a prime mover, an engine driven thereby, a means to which energy is supplied by the engine, a regulating device responsive to conditions of said means, a vibratory type regulator cooperating with the regulating device and including an exciter, and electro-mechanical means operated by the exciter for regulating the prime mover.

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3. In combination with an elastic fluid engine, a generator driven thereby, a line to which the generator supplies electric energy, a device responsive to conditions in the line, a vibratory type regulator cooperating with the device and including an exciter, and electromagnetic means excited by the exciter for regulating the elastic fluid engine.

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4. In combination with an elastic fluid engine having an admission valve means for elastic fluid supplied thereto, a generator driven by the engine, a line to which the generator supplies electric energy, a device responsive to conditions in the line, a vibratory type regulator cooperating with the device and including an exciter, an electromagnet connected to the exciter for regulating the admission valve means, and a restraining means for the electromagnet.

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5. In combination with an elastic fluid engine having an admission valve means for elastic fluid supplied thereto, a motor for moving the valve, a generator driven by the engine, a line to which the generator supplies electric energy, an astatic device responsive to conditions in the line, a vibratory type regulator cooperating with the device and including an exciter having a variable field

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