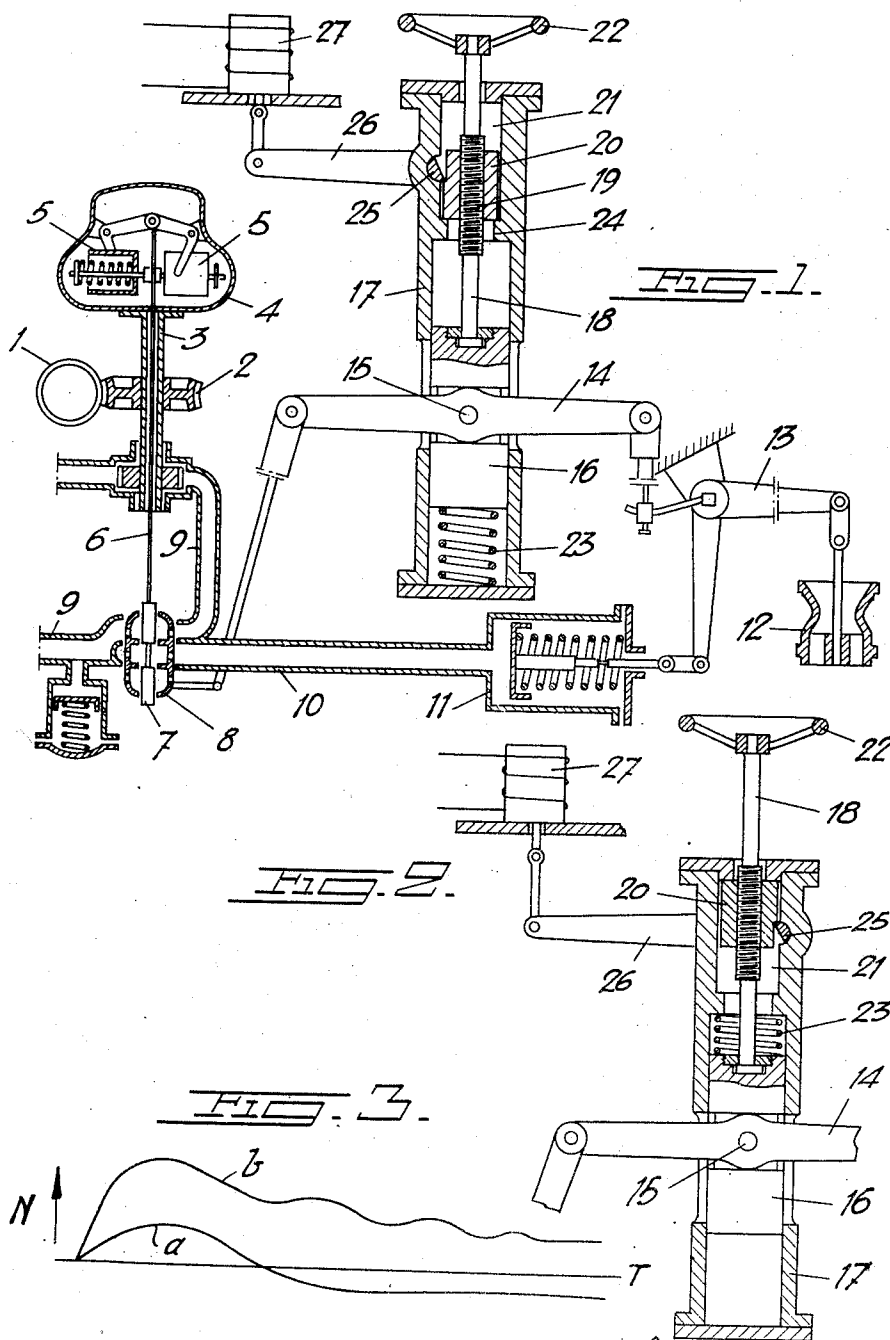


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REGULATING DEVICE WITH SPEED ADJUSTING
MECHANISM FOR POWER ENGINES
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REGULATING DEVICE WITH SPEED ADJUSTING MECHANISM FOR POWER ENGINES

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The present invention relates to regulating devices for power engines which run the risk of being suddenly relieved from their load or in which it may be desired to take care of a sudden and great increase of load. Such a power engine is, for instance, a turbogenerator the turbine of which may suddenly lose its load, if the interrupter of the generator from one reason or the other should disconnect the generator from the network to which the generator delivers its electric energy. Since the steam inlet valve is open when such a sudden relief of the turbine takes place, the energy as produced by the engine due to the continued supply of steam will be converted into an increased kinetic energy of the rotary system resulting in a rapid increase of the speed of the engine to a maximum value, to then slowly sink again correspondingly as the speed governor of the engine adjusts the steam inlet valve into its no-load position. The number of revolutions at which the engine will finally be running is higher than the number of revolutions the engine had prior to the disconnecting operation. The change of speed thus taking place corresponds to the degree of irregularity of the governor.

The instantaneous increase of the speed taking place as a result of the disconnecting operation may sometimes be so high as to cause the governor adapted to operate on the racing of the engine to start operating and stop the engine. This means a severe drawback, since it will generally require a long time for the speed of the engine to again become adjusted to agree with the network. This delay may cause a corresponding interruption of the delivery of power to the consumers.

The object of this invention is to prevent stopping of the turbine under the working conditions above referred to, that is to say, to prevent the speed from increasing to such a degree that the governor adapted to operate on the racing of the engine starts acting and stops the engine. As, according to this invention, the engine continues to run it is thus possible to readily adjust it into agreement with the phase of the network and load it. It is thus seen that the power consumers need not be subjected to the drawback as represented by lasting interruptions of the operation.

The invention is characterized, chiefly, by the fact that a speed adjusting device belonging to the regulating device is provided with double controlling means, viz., on the one hand, a controlling device adapted to be operated by hand or by a motor to effect the normal adjustment of the speed and, on the other hand, a controlling de-

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vice adapted to be automatically put into operation upon the occurrence of a sudden decrease, or increase, of load to effect a rapid throttling (or interruption) or a rapid increase of the supply of driving fluid to the engine.

In the accompanying drawing the invention is illustrated by way of example. Fig. 1 is a substantially diagrammatic vertical section of a regulating device according to an embodiment of the invention. Fig. 2 is a similar section of part of a modified embodiment, and Fig. 3 shows characteristic curves of the change of speed with and without the use of a regulating device according to this invention.

With reference to Fig. 1, the numeral 1 designates a worm on the shaft of the engine, not shown, which may be, for instance, a turbogenerator, and 2 is a worm wheel engaged by the worm 1. The worm wheel 2 is keyed to a tubular carrier 3 for the casing 4 of a centrifugal governor adapted to control the speed of the engine. The governor balls 5 within said casing 4 act on a spindle 6 extending freely down through the tubular member 3 and carrying a regulating slide 7 at its lower end. The slide 7 is both longitudinally movable and rotatable within a slidably but not rotatably mounted casing 8 representing a return slide valve. The two slide valves 7 and 8 control in conjunction the connection between, on the one hand, the oil supplying pipes 9 or an outlet represented by the lowermost portion of the slide valve 8 and, on the other hand, a connecting pipe 10 leading to the cylinder 11 of a servo-motor adapted to control the steam inlet valve 12 of the engine (turbine). The connection between the piston of said servo-motor and the steam valve 12 comprises, essentially, a bell crank lever 13 which is mounted to turn on a stationary pivot and is connected by means of links to the piston of the servo-motor and to the valve body 12.

Provided between the bell crank lever 13 and the return slide valve 8 is a return connection the main element of which comprises a rocking lever 14 connected by means of links or the like, on the one hand, to the bell crank lever 13 and, on the other hand, to the slide valve 8. The pivot 15 of the rocking lever 14 is mounted to slide vertically in order to permit adjustment of the speed of the engine. A lowering of said pivot effects in the embodiment shown a lowering of the left hand end of the lever 14, inasmuch as the right hand end thereof stands still due to its connection to the system controlled by the servo-motor. The lowering of the left hand end of the rocking lever

depresses the return slide valve 8 with the result that the servo-motor 11 receives oil under pressure which acts to force the piston of the servo-motor to the right, thereby effecting an increased opening of valve 12. Similarly, a raising of the pivot 15 will cause a raising of the left hand end of the rocking lever which in its turn raises the slide valve 8 to bring the pipe 10 into communication with the lowermost chamber of valve 8 which acts as an outlet for the oil and removes the oil pressure from the servo-motor. The piston of the servo-motor is now moved to the left by the action of its spring load and effects a throttling of the supply of steam to the turbine by raising the valve body 12.

The pivot 15 of the rocking lever 14 is mounted in a piston-like slide block 16 movable up and down in a cylinder 17. The upper end of the slide block 16 is pivotally engaged by the lower end of a vertical spindle 18, the middle portion of which is formed with screw-threads, as shown at 19, engaging a nut 20 slidably mounted in an upper chamber 21 of the cylinder 17, and the upper end of which projects through the cover of the cylinder 17 and carries a hand wheel 22. The piston-like slide block 16 is supported by a coiled spring 23 resting on the bottom of the cylinder 17 which tends to raise the piston 16. Normally, the nut 20 rests on a shoulder 24 formed in the cylinder 17 and is held in this position by means of a locking member 25. In the embodiment shown said locking member comprises a segment of the pivot pin of a lever 26 the outer end of which is connected by means of a link to the vertically movable armature of an electromagnet 27. Let it be assumed that the electromagnet be normally energized and when energized keeps the locking member 25 in operative position. Of course, however, the arrangement may be the reversed one, so that the electromagnet is de-energized in the operative position of member 25. The circuit of the electromagnet is, preferably, controlled by the means provided for effecting the connection and disconnection of the load of the engine. In the case under consideration in which the engine comprises a turbo-generator, it is preferred that the circuit of the electromagnet be controlled by the interrupter of the turbo-generator in such a way that the electromagnet will be energized at the very moment at which the engine is disconnected from the network.

As long as the nut 20 is held locked by the member 25, as shown in the drawing, the adjustment of the pivot 15 of the rocking lever 14 is effected by turning the hand wheel 22. If, however, the engine should be suddenly relieved from its load for any reason, as for instance, by being disconnected from the network, the electromagnet will receive current so as to attract its armature and release the nut 20. At the same moment the spring 23 raises the piston 16 together with the pivot 15 and the spindle 18 with the nut 20 to their uppermost position, that is to say, in the case shown, until the nut 20 strikes the cover of the cylinder 17. This will cause the rocking lever 14 to effect a rapid raising of the slide valve 8 by a corresponding amount causing it to connect the cylinder of the servomotor 11 to the outlet and reduce the supply of steam to the turbine to a minimum. As a result, the speed of the engine will be reduced to a low value, allowing an adjustment of the speed to agree with the phase of the network immediately after the engine is again put under load.

Fig. 2 shows an embodiment of the speed ad-

justing device which comes under consideration when it is desired rapidly to cut in a great load without changing the construction of the speed governor. In such a case the spring 23 acts on the upper end of the piston-like slide block 16 and the stop member 25 keeps the slidably mounted nut 20 in its extreme upper position in the chamber 21. Let it be assumed that the magnet 27 is energized (or deenergized) when the said great increase of the load takes place and acts to turn the lever 26 in such a way as to cause the stop member 25 to release the nut 20. The spring 23 is now allowed to depress the piston 16 together with the control spindle 18 and the nut 20 as far as circumstances allow. The return slide valve 8 is thus correspondingly set to a low position in which it opens for a supply of pressure oil to the servo-motor 11 which is sufficient to effect an increased opening of valve 12 corresponding to the increased load.

By combining the features of this embodiment with those of the embodiment shown in Fig. 1 a rapid adjustment of the supply of steam may be obtained both in case of a sudden great reduction of the load and in case of a sudden great increase of the load.

In Fig. 3 the reference character *a* designates the characteristic curve representing the change of speed due to a great variation of load in case of an engine to which the invention is applied, while curve *b* represents the change of speed as taking place due to a similar variation of load in case of an engine to which the invention is not applied.

What we claim is:

1. In regulating mechanism for power plants, an engine having an admission valve for driving fluid, a lever mechanism having a stationary fulcrum arranged to move said valve, a driving fluid operated servomotor arranged to move said lever mechanism towards an increased opening of the admission valve on an increased supply of driving fluid to the servomotor, a pilot valve arranged to regulate the supply of driving fluid to said servomotor, a speed governor responsive to the speed of the engine arranged to set said pilot valve to supply or exhaust driving fluid to or from the servomotor in response to governor movement, a connection between said lever mechanism and said pilot valve arranged to act as a follow-up mechanism to shut off flow of driving fluid through the pilot valve in its different positions of adjustment, said connection including a lever having an adjustable fulcrum, a reciprocable plunger arranged to carry said fulcrum, a manually operable stem arranged to move said plunger by small steps, holding means for said stem arranged to support the stem for relative movement therebetween and to be released to effect conjoint movement of the holding means and stem, and means under the control of the load of the engine arranged to release said holding means in response to a sudden increase of load beyond a predetermined value.

2. In regulating mechanism for power plants, an engine having an admission valve for driving fluid, a lever mechanism having a stationary fulcrum arranged to move said valve, a driving fluid operated servomotor arranged to move said lever mechanism towards an increased opening of the admission valve on an increased supply of driving fluid to the servomotor, a pilot valve arranged to regulate the supply of driving fluid to said servomotor, a speed governor responsive to the speed of the engine arranged to set said pilot

valve into position to supply or exhaust driving fluid to or from the servomotor in response to governor movement, a connection between said lever mechanism and said pilot valve arranged to act as a follow-up mechanism to shut off flow of driving fluid through the pilot valve in its different positions of adjustment, said connection including a lever having an adjustable fulcrum, a reciprocable plunger arranged to carry said fulcrum, a cylinder for guiding said plunger, a spring arranged to act on the plunger in a direction to cause it to move said adjustable fulcrum towards position of closing of the admission valve, a manually operable threaded stem and a nut engaged thereby arranged to move the plunger by small steps, said nut being slidably mounted in the cylinder, a catch arranged to hold the nut against movement, and means for releasing said catch from the nut in response to a sudden increase of the load on the engine beyond a predetermined value, in order to allow the spring to displace the plunger and the fulcrum carried thereby to a position for reducing the supply of driving fluid to the engine to a minimum.

3. In regulating mechanism for power plants, an engine having an admission valve for driving fluid, a lever mechanism having a stationary fulcrum arranged to move said valve, a driving fluid operated servomotor arranged to move said lever mechanism towards an increased opening of the admission valve for regulating the supply of driving fluid to the engine, a pilot valve arranged to regulate the supply of driving fluid to said servomotor, a speed governor responsive to the speed of the engine arranged to set said pilot valve into position to supply or exhaust driving fluid to or from the servomotor in response to governor movement, a connection between said lever mechanism and said pilot valve arranged to act as a follow-up mechanism to shut off flow

of driving fluid through the pilot valve in its different positions of adjustment, said connection including a lever having an adjustable fulcrum, a reciprocable plunger for carrying said fulcrum, a cylinder arranged to guide said plunger, manually operable means including a threaded stem rotatably connected with the plunger at its one end and having a handle at its other end outside the cylinder and a nut slidably mounted in the cylinder arranged to move the plunger by small steps, a spring arranged to act on the plunger in a direction to cause movement of the admission valve towards closed position, a catch arranged to hold the nut and the associated stem and plunger in position against the action of said spring, and electric means under the control of the load on the engine arranged to release said catch in response to a sudden increase of the load beyond a predetermined value, in order to allow the spring to displace the plunger and the fulcrum carried thereby to a position for reducing the supply of driving fluid to the engine to a minimum.

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