

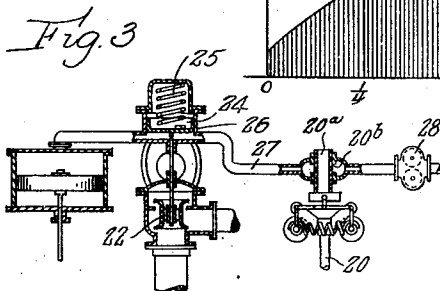
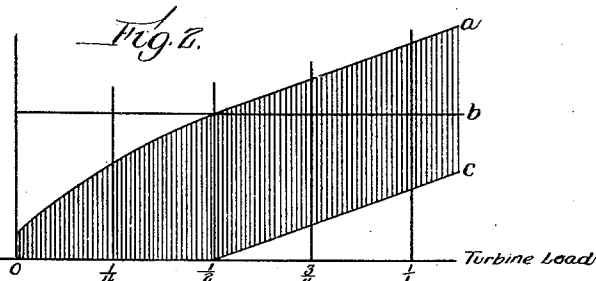
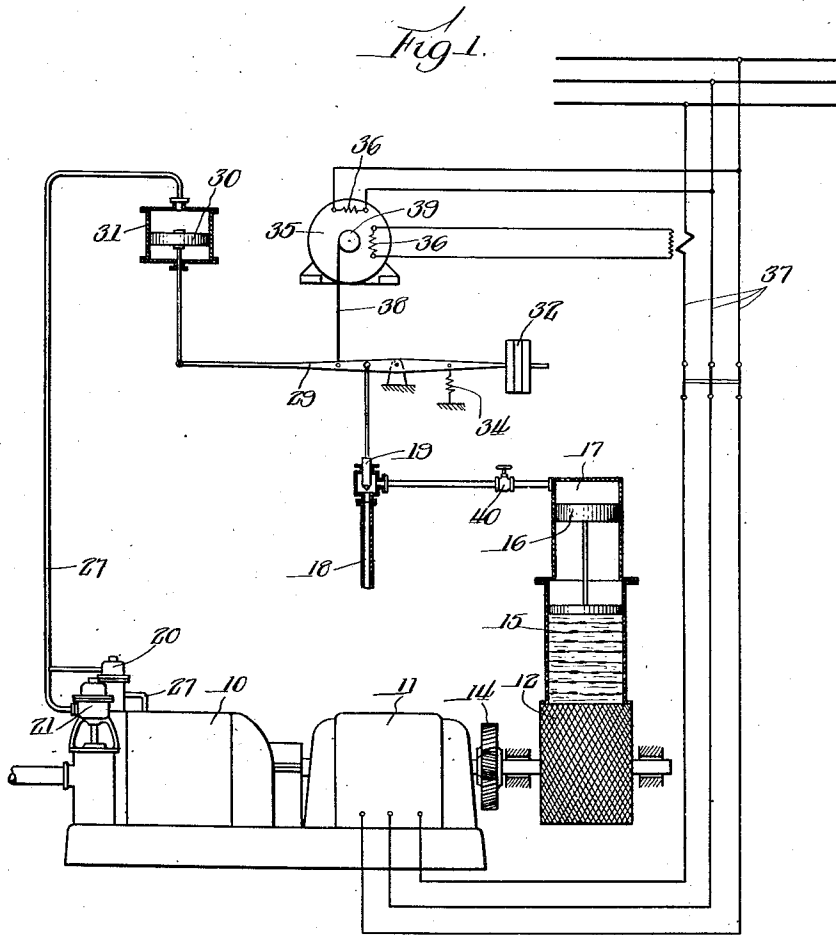
June 24, 1930.

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1,766,548

APPARATUS FOR GOVERNING DUPLEX MACHINE DRIVERS

Filed April 13, 1927



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UNITED STATES PATENT OFFICE

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APPARATUS FOR GOVERNING DUPLEX-MACHINE DRIVERS

Application filed April 13, 1927, Serial No. 183,305, and in Germany April 26, 1926.

This invention has to do with the governing of prime movers which constitute the driving means for a plurality of machines that are subject respectively to different and

5 variable load conditions.
The general object of the invention is the provision of a method for governing a prime mover which drives a plurality of machines, in conformity with the power requirements of the driven machines, in such fashion as to obtain maximum efficiency of performance.

10 Another object is the provision of a method for governing the operation of a prime mover and the load imposed thereon by one of a plurality of machines driven thereby, in such fashion as to maintain constant the performance of another machine driven by the prime mover.

15 Another object is the provision of apparatus whereby the governing of a prime mover, in the manners above specified, may be accomplished automatically.

20 Another object is the provision of apparatus for automatically governing the feed of work to one machine driven by a prime mover, and at the same time, governing the prime mover, in such fashion as to maintain constant the performance of another machine driven by the prime mover.

25 Other and further objects of the invention will be pointed out or indicated hereinafter, or will appear to one skilled in the art upon an understanding of the invention or its employment in use.

30 In the drawings forming a part of this specification, I illustrate certain arrangements of apparatus wherein the invention may be embodied and practiced, but it is to be understood that these are here presented for purpose of illustration only and are not to be accorded any interpretation calculated to limit the claims short of the true and most comprehensive scope of the invention in the art.

35 In said drawings,

40 Fig. 1 is a schematic representation of an assembly of apparatus including a driving turbine, a generator and a wood grinder driven by the turbine, together with governing apparatus for controlling feed of

work to the grinder and steam to the turbine, parts of the apparatus being shown in elevation and other parts in sectional elevation and still other parts in diagrammatic fashion;

Fig. 2 is a graph illustrating one example of regulating effects attainable by the use of the invention; and

Fig. 3 is a diagrammatic illustration, in the nature of a sectional elevation of portions of the governing or regulating gear.

It is frequently desirable to drive a plurality of different machines from the same engine or prime mover, which machines are subject to different conditions or variations of load or other considerations which would render the governing of the prime mover in accordance with the requirements of one machine disadvantageous with respect to the operation of another of the driven machines. For example, in a paper mill, it may be desirable to utilize the same prime mover for driving a wood pulp grinder and an electric generator, which latter supplies current for operation of paper making machines or other uses about the plant. Wood grinders require to be operated at substantially constant load in order to insure a uniform product and minimum power consumption per ton of output. Likewise, it is important that the generator be operated at as nearly constant speed as possible, so as to avoid frequency or voltage variations in its output and resulting disturbances in the operation of machines, such as paper making machines, operated by energy supplied by the generator. Moreover, the prime mover is usually designed for most efficient operation at certain speeds, wherefore it is desirable to provide speed regulation for it. Thus, for the proper governing of the apparatus, there are three factors to be brought into agreement, namely, constant load on the grinder, constant voltage for the generator and constant speed for the prime mover. The attainment of this result involves various difficulties, since the power delivered by the prime mover must conform to the demands of the two machines it drives and must be distributed between them in

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conformity with their requirements. In prior practice, wood grinders driven by steam or water turbines usually have been governed by a special speed governor whereby, in the event of a rise in the speed of the prime mover, resulting from a drop in the load on the grinder, the load would be increased by increasing the feed of work to the grinder. Such arrangements involve certain possibilities of interference between the feed governor and speed governor of the prime mover. However, even if the feed governor acts at once, a certain unavoidable delay occurs before its effect on the load becomes appreciable, as it takes a certain time for the feed apparatus to accommodate to the new conditions, particularly if the wood is poorly packed. Conversely, due to the elasticity of the compressed wood, an overload on the grinder is not immediately relieved, but a certain time is required for the grinding away of sufficient wood so as to bring the effective feed pressure back to the desired load. Substantial temporary fluctuations in speed are thus unavoidable, with the resulting undesirable effects on the generator, as above mentioned.

The present invention provides a method of governing, and automatic governing gear, whereby the load on the grinder is maintained, at all times, equal to the difference between the power output of the prime mover and the power requirements of the generator. The nature of the invention may be ascertained by reference to the arrangement of apparatus illustrated in the drawing. Here the reference numeral 10 designates the prime mover, in the form of a steam turbine, which drives the generator 11 and the grinder 12, the latter through the medium of reduction gearing 14. The work, 15, is fed to the grinder 12 by work feed apparatus comprising a piston 16 which is driven by pressure fluid in cylinder 17 to press the work against the grinder. This pressure fluid is supplied from a suitable hydraulic accumulator, or other source, by the way of the pipe 18, and the effectiveness of its pressure on piston 16 is controlled by a regulating valve 19. The turbine is provided with a speed governor 20 which controls the valve operating mechanism 21, operable to vary the supply of steam to the turbine. This governing and valve operating gear is illustrated in Fig. 3, wherein the inlet valve for the turbine is designated 22. This valve is connected to a piston 24 loaded by a spring 25 and operating in a cylinder 26 to which oil is supplied under pressure from a servo line 27 supplied by a pump 28. As the pressure in line 27 rises, piston 24 is forced upwardly against the pressure of spring 25, thus opening valve 22 to admit more steam to the turbine. The reverse of these operations takes place upon a fall of

the pressure in servo line 27. The governor 20, driven by the turbine, controls the pressure in servo line 27 through the medium of an adjustable sleeve 20^a having an aperture 20^b through which pressure oil may escape from the servo line, the effective area of said aperture being variable by a longitudinal shifting of sleeve 20^a in proportion to the speed variations of the turbine. As the speed of the turbine increases, the centrifugal governor shifts the sleeve to increase the effective area of the aperture 20^b, resulting in a relief of pressure from line 27, and a closing movement of valve 22. In the event of a decrease in the speed of the centrifugal governor, the sleeve is shifted to decrease the escape of pressure oil from the line 27, with the result that the pressure under piston 24 is increased, and valve 22 given an opening movement. In the arrangement illustrated, the feed regulating valve 19 is also rendered subject to the pressure variations in servo line 27. This valve 19 is responsive to movements of a lever 29 which may be actuated from a piston 30 operating in a cylinder 31 in communication with servo line 27 behind the piston. A weight 32, which may be varied in accordance with the desired normal feed pressure on the grinder 12, counterbalances the weight of the piston and operates against the pressure of the oil in cylinder 31. Movement of the lever 29 is controlled also by a spring 34. As a result, when pressure in cylinder 31 overcomes the influence of weight 32 and spring 34, valve 19 is given a closing movement, cutting down the effectiveness of fluid pressure in feed cylinder 17, and consequently reducing the load on the grinder 12. It will be observed that this increase in pressure in cylinder 31, and the resulting decrease in feed pressure on the grinder, occur automatically in response to a drop in speed of the turbine. Conversely, an increase in speed of the turbine results in a decrease of oil pressure in cylinder 31, and opening movement of regulating valve 19 and an increase in load on the grinder.

As pointed out above, there is a third factor which must be taken into consideration in governing the prime mover and the grinder load, namely, the voltage of the generator, which must be maintained constant. The generator output is rendered effective to influence the regulating function of valve 19, and through it the operation of the turbine and the grinder feed mechanism, through the medium of a rotary magnet 35 having its coils 36 energized from the mains 37 supplied by the generator 11. This magnet is operably connected with the lever 29 by means of a flexible band 38 which winds on a drum 39 on the magnet, and the magnet is so designed that the torque exerted by it is proportional to the power delivered to the mains

by the generator. The power of this torque is exerted upon lever 29 in opposition to the oil pressure in cylinder 31, i. e. in a relationship tending to produce an opening movement of regulating valve 19. Consequently, an increase of the generator output tends to produce an increase in the feed pressure in feed cylinder 17, and an increase in the load on the grinder and a decrease in the speed of the turbine.

The governing of the prime mover is carried on, therefore, by operation of the apparatus as follows. On starting up the turbine, the valve 40 being closed, a certain oil pressure is produced in cylinder 31, not sufficient, however, to displace piston 30 from its extreme upper position. The valve 40 is then opened, thus applying load to the grinder, with a resulting decrease in speed of the turbine and rise of pressure in the servo line. When the oil pressure rises sufficiently to overcome the counter-torque exerted by weight 32, the valve 19 will be given a closing movement, thus reducing the load on the turbine with a resulting increase in speed of the turbine. Thereupon the oil pressure, under regulation of the governor 20, falls, and the piston 30 takes up a position corresponding to the grinder load, which is determined by the weight 32. If now a load is applied to the generator 11, the pull of the rotary magnet 35 first causes the valve 19 to open further, whereupon the increased load on the turbine causes the oil pressure in the servo system to rise, resulting in the increase of the speed of the turbine to meet the requirements of the generator, before the load on the grinder is appreciably affected. The apparatus now being in the normal operating condition, the operation is kept stable by automatic adjustment of the load on the grinder in response to variations of the generator output or variations of the turbine speed, which latter is, in turn, subject to the load on the grinder. Thus, the turbine speed generator voltage and the grinder load are maintained constant, and the turbine is operated at its best efficiency.

The conditions are graphically represented in Fig. 2. The ordinates represent the torque on lever 29 and the abscissæ the load on the turbine, divided into quarter, half, three-quarter and full load. Curve *a* represents the torque produced by the oil pressure which opposes the added torques of the counterweight 32 and rotary magnet 35. These latter are represented by the straight lines *b* and *c*, the former being the constant torque of the counterweight, and the latter the magnet torque which is proportional to the electrical load. The magnet must be adjusted so that the inclination of *c* is the same as that of the straight part of curve *a*, which may be accomplished in known fashion by suitable proportioning of resistances

and dimensioning of the magnet coils. In the condition represented in Fig. 2, it is assumed that the grinder load corresponds to fifty per cent of the rated output of the turbine, and that with full load on the turbine, the other fifty per cent is absorbed by the generator, which is then also fully loaded. As the load on the turbine rises from zero to its full value, the oil pressure follows the curve *a* and exerts a corresponding moment on lever 29, in opposition to the weight 32. The valve 19, therefore, will not commence to close until the one-half load point is reached. On applying the load to the generator, the moment due to the oil pressure continues to rise in accordance with the portion of curve *a* lying to the right of the half-load point. This further increase is balanced, however, by the moment *c* developed by the magnet 35, and the grinder load, which corresponds to the shaded portion between the two curves, will be maintained constant.

What I claim is:

1. The combination with a prime mover and machines driven thereby, of regulating means for varying the load of one of the driven machines, and governing means responsive to speed variations of the prime mover and output variations of the other driven machine for operating said regulating means.

2. The combination with a prime mover and two machines driven thereby, of a speed governor for the prime mover, a feed regulator for one of the driven machines, and operating means for said feed regulator, said operating means being responsive to the speed governor and the output of the other driven machine.

3. The combination with a prime mover and two machines driven thereby, of governing apparatus responsive to speed variations of the prime mover, feed mechanism for loading one of the driven machines, regulating means for the feed mechanism, and control mechanism for operating the regulating means, said control mechanism being responsive to the governing apparatus and the operation of the other driven machine.

4. The combination with a prime mover and two driven machines having mechanical driving connection therewith, of feed mechanism for loading one of the driven machines, regulating mechanism for controlling operation of the feed mechanism, governing means responsive to speed variations of the prime mover for operating said regulating mechanism, and means controlled by the other driven machine for operating said regulating mechanism.

5. The combination with a prime mover, of a grinder and a generator driven thereby, a speed governor for the prime mover, and a regulator for varying the load on the

grinder, said regulator being responsive to the speed governor and the generator output.

5 6. The combination with a prime mover, of a grinder and a generator driven thereby, and means governed by speed variations of the prime mover and output variations of the generator for regulating the load on the grinder.

10 7. The combination with a steam turbine, of a grinder and generator driven thereby, a governor operated by the turbine, and a regulator for controlling the load on the grinder, said regulator being responsive to speed variations of the governor and output variations of the generator.

15 8. The combination with a steam turbine and a machine and a generator driven thereby, of a governor operated by the turbine, a device operably responsive to variations of the generator output, feed mechanism for applying load to the machine, and regulating means under control of said device and said governor for controlling said feed mechanism.

20 9. In apparatus of the character described, a prime mover, a plurality of machines driven thereby, means for controlling operating conditions of certain of said machines, and means responsive to operating conditions of said prime mover and certain other of said machines and operable to regulate said control means.

25 10. In apparatus of the character described, a prime mover, a plurality of machines driven thereby, governing mechanism for said prime mover, means responsive to operating conditions of certain of said machines, and means common with respect to said governing mechanism and said first-named means and operable to provide for regulation of operating conditions of certain other of said machines.

30 In testimony whereof I have hereunto subscribed my name at Zurich, Switzerland, this 29th day of March, A. D. 1927.

RICHARD SCHNITZER.

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