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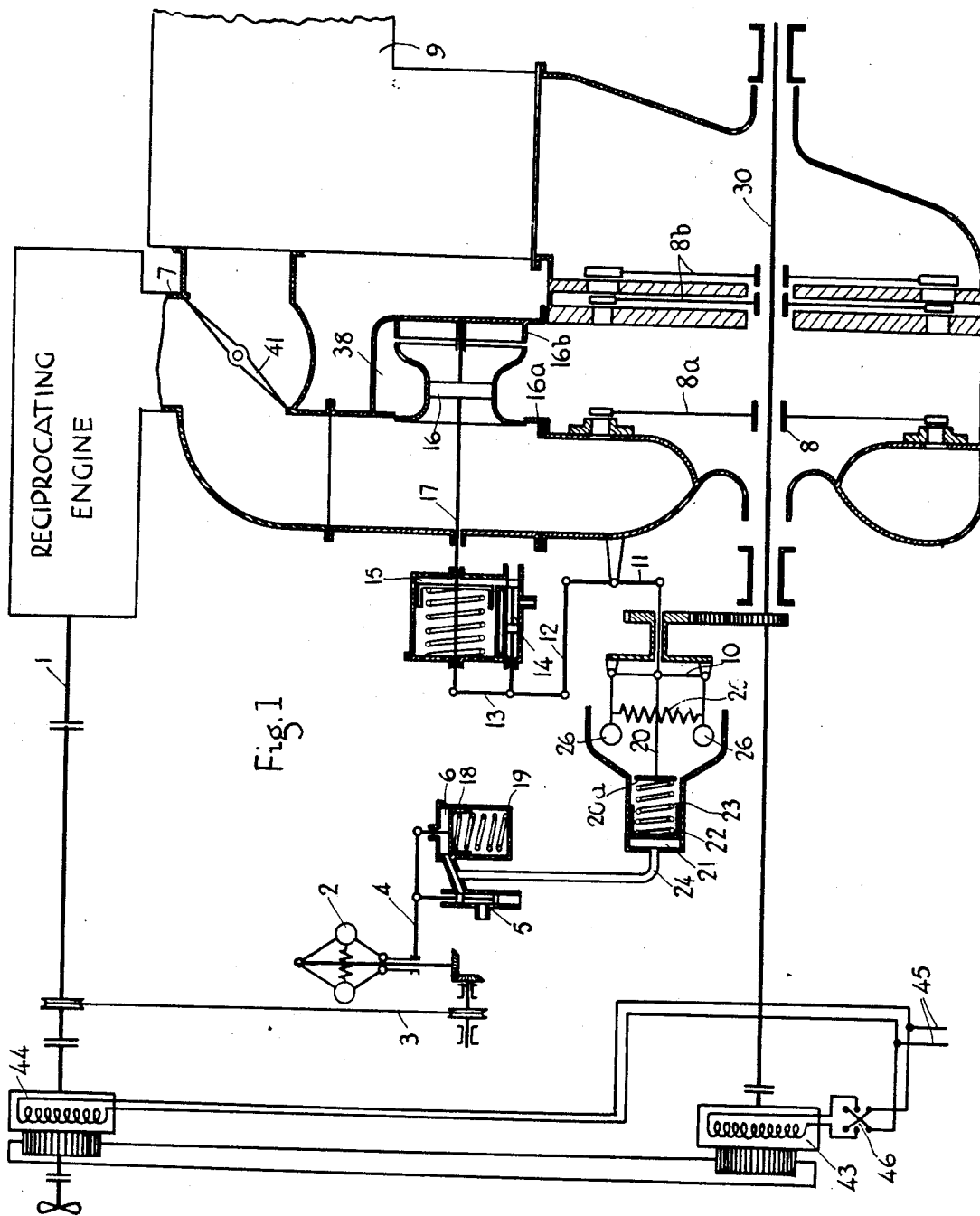
P. PREISIG

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APPARATUS FOR GOVERNING STEAM TURBINES

Filed May 18, 1933

2 Sheets-Sheet 1



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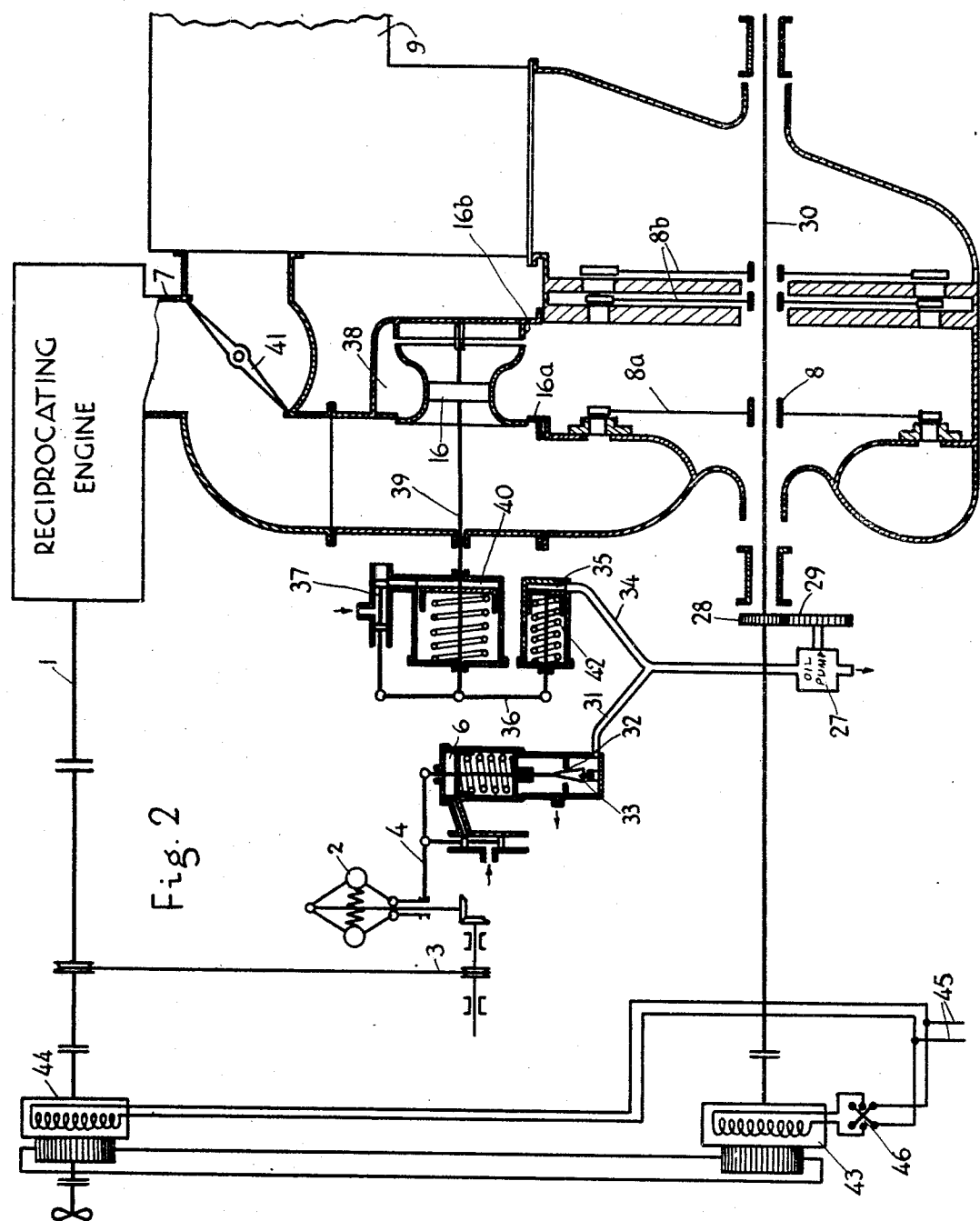
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UNITED STATES PATENT OFFICE

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APPARATUS FOR GOVERNING STEAM
TURBINESPaul Preisig, Welling, England, assignor to The
General Electric Company Limited, London,
EnglandApplication May 18, 1933, Serial No. 671,658
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5 Claims. (Cl. 172-8)

This invention relates to steam power plant of the kind comprising a reciprocating steam engine and a turbine operated by exhaust steam from the said engine and exhausting into a condenser, the turbine being coupled to an electric generator and the object of the present invention is to provide improved means for the control of such power plant. The above arrangement is particularly applicable in the case in which the generator drives an electric motor coupled to the same load, such as a propeller shaft, as the engine, and an object of the invention is to provide an improved apparatus for governing the speed of the turbine in such an arrangement.

According to one feature of the invention, in a power plant of the kind specified, comprising a main shaft adapted to be rotated by the reciprocating engine and coupled to an electric motor driven by the generator, the speed of the turbine is maintained in a definite relation to the speed of the main shaft over the full range or substantially the full range of operating speed of the latter.

The speed governing is, as will be understood from the following descriptions of arrangements according to the invention, achieved by varying the exhaust pressure of the engine, that is, by varying the inlet pressure of the turbine thus transferring load from the engine to the turbine and vice-versa. The speed control of the turbine in relation to the speed of the main shaft may by suitable choice of governors be conveniently selected to suit the electric part of the equipment.

The invention will now be described by way of example with reference to the accompanying diagrammatic drawings Figures 1 and 2 of which show different embodiments of the invention as applied to a steam power plant such as may be used for ship propulsion.

In the drawings, the propeller shaft 1 drives a centrifugal governor 2, by belting or chain 3, the sleeve of this governor being connected by means of a floating lever 4 with the spindle ends of an oil pilot valve 5 and a power cylinder 6. Steam from the reciprocating engine exhausts normally through a pipe 7 and through the high and low pressure stages of an exhaust steam turbine 8, of which 8a represents a rotor disc of the high pressure stage and 8b rotor discs of the lower stage. Steam leaving the turbine enters a condenser 9. The turbine 8 is provided with a steam by-pass valve 16 provided with seats 16a and 16b in the valve chest 38.

The turbine 8 drives an electric generator 43 which feeds an electric motor 44 coupled to the propeller shaft 1. The field windings of the generator 43 and the motor 44 may conveniently be excited by a separate supply (not shown)

through lines 45, a reversing switch 46 being provided for the generator field circuit.

Referring more particularly to Figure 1 of the drawings the turbine is fitted with a speed governor 10, the sleeve of which is coupled through lever and link members 11 and 12 to a floating lever 13 and through a link member 20 to a slidable plate 20a in power cylinder 21. The floating lever 13 is connected with an oil pilot valve 14 and the piston of a power cylinder 15, the power piston of which operates the steam by-pass valve 16 of the turbine through link member 17. The cylinder 21 is joined with the cylinder 6 by tube 24, so that change in oil pressure in cylinder 6 is transmitted to cylinder 21.

The operation of this speed governing arrangement is as follows:—When the speed of the propeller shaft 1 is decreased, the sleeve of the centrifugal governor 2 is lowered and the consequent movement of the associated floating lever 4 causes the oil pilot valve 5 to move downwards so that pressure oil can escape from the cylinder 6, thereby allowing the piston 18 to move upwards under the action of spring 19 to close the pilot valve 5. The oil pressure in cylinder 6 is now lower than before the decrease in speed of the propeller shaft. This decrease in oil pressure is transmitted simultaneously to cylinder 21, thereby enabling piston 22 to move to the left in the drawings. This movement of the piston 22 causes the pressure on spring 23 of the cylinder 21 to decrease and to provide less resistance to the thrust in link 20 due to the centrifugal force of the governor weights 26 causing the weights to move further apart and, through the consequent movement of lever 13, the oil pilot valve 14 to be moved to the right in the drawings, to admit pressure oil to the cylinder 15. The admittance of oil under pressure to the cylinder 15 causes the power piston of this cylinder to move to the left and with this movement of the piston the steam by-pass valve 16 is opened to admit steam from the pipe 7 to the lower stage of the turbine, thus lowering the inlet pressure of the steam to the turbine and reducing the speed of the turbine.

When the turbine speed tends to rise due to decrease in load of the electric generator 43 coupled to the shaft of the turbine, the weights 26 of the turbine speed governor move apart and a governing operation similar to that described above takes place causing the by-pass valve 16 to open, thereby transferring part of the steam expansion from the turbine to the engine.

Should the engine speed rise, the movement of the governor 2 will cause the pilot valve 5 to move so as to introduce pressure oil into the cylinders 21 and 6. This increase of pressure

in cylinder 21 alters the setting of spring 23 and through link or lever members 20, 11, 12 and 13 causes the pilot valve 14 to move to allow pressure oil to escape from cylinder 15; through the consequent motion of the piston associated with this cylinder the by-pass valve 16 is closed, and the speed of the turbine rises.

It may happen that the speed of the turbine tends to fall and in this case the governor weights 26 move together and through the movement of link or lever members 11, 12 and 13 the pilot valve 14 moves to allow pressure oil to escape from cylinder 15 and by-pass valve 16 closes as described above, and thus counteracts the tendency of the turbine to reduce speed.

Referring now to the second embodiment of the invention as shown in Figure 2 of the drawings, a positive oil pump indicated at 27 is coupled by gearing 28, 29 to the shaft 30 of the turbine 8, the delivery of the oil pump passing by way of tube 31, through an orifice 32 the area of which is controlled by a conical stop 33 moved with the piston of the power cylinder 6. Oil from the pump 27 is also supplied through branch tube 34 to a power operated cylinder 35 and actuates the piston, against the action of the spring 42, associated with this cylinder, to which piston is connected a floating lever 36.

When the speed of the propeller shaft 1 is decreased the spring controlled piston associated with power cylinder 6 moves upwards with the escape of oil from cylinder 6 due to the downward movement of pilot valve 5 under the action of the centrifugal governor 2. The stop 33 moves upwards with the piston and decreases the area of the orifice 32 and the oil pressure on the delivery side of the pump 27 rises and forces the piston associated with power cylinder 35 to the left in the drawings. The consequent movement of the floating lever 36 moves the pilot valve 37 to admit oil under pressure to power cylinder 40, and forces the piston associated with this cylinder together with link rod 39 to the left, thus opening the by-pass valve 16 to admit steam from pipe 7 to a lower stage of the turbine; the steam inlet pressure of the turbine is thereby reduced and the speed of the turbine eventually reduced.

When the turbine speed tends to rise due to decrease in load of the electric generator 43, coupled with the turbine shaft 30, the delivery pressure of the pump 27 increases and a governing operation similar to that described above takes place causing the by-pass valve 16 to open thereby transferring part of the steam expansion from the turbine to the engine.

Under certain conditions a changeover valve 41 may be operated to cause all steam to be diverted from the engine exhaust pipe 7 direct to the condenser 9.

I claim:—

1. A power plant comprising in combination a reciprocating steam engine, a turbine operated by exhaust steam from said engine, an electric generator driven by said turbine, an electric motor driven by said generator and coupled to the same load as said engine, a valve for by-passing steam from a part of the turbine, a device responsive to the speed of the turbine and tending to open the valve as the turbine speed

rises, a device responsive to the speed of the engine and tending to close the valve as the engine speed rises, whereby the amount of steam by-passed from a part of the turbine is varied automatically to maintain the speed of the turbine in a definite relation to the speed of the engine.

2. A power plant comprising in combination a reciprocating steam engine, a turbine operated by exhaust steam from said engine, an electric generator and motor forming a coupling between the turbine and the load driven by the engine, a valve for varying the ratio of the power developed by the turbine to that developed by the engine, means for operating said valve in joint dependence upon the speed of the turbine and the speed of the engine so as to maintain the turbine speed in a definite relation to the speed of the engine.

3. A power plant comprising in combination a reciprocating steam engine, a turbine operated by exhaust steam from said engine, an electric generator driven by said turbine, an electric motor driven by said generator and coupled to the same load as said engine, a device responsive to the speed of the engine comprising an hydraulically operated piston, a second device responsive to the speed of the turbine and comprising an hydraulically operated piston, an hydraulic coupling between said pistons, whereby as the speed of the engines changes, said second speed responsive device is adjusted for a suitable predetermined speed of the turbine.

4. A power plant comprising a reciprocating steam engine, a turbine operated by exhaust steam from said engine an electric generator driven by said turbine, an electric motor driven by said generator and coupled to the same load as said engine, a device responsive to the speed of said engine, a second device responsive to the speed of said turbine, an hydraulic coupling between said two speed responsive devices, a valve for by-passing steam from a part of said turbine, an actuating device for said valve comprising an hydraulically operated piston, a floating lever coupling between said actuating device and said second speed responsive device such that the fluid pressure applied to said piston is varied in accordance with a change in speed in said turbine and in accordance with a change in speed of said engine, whereby steam is by-passed from a part of the turbine to a different extent to maintain the speed of said turbine in a constant relation to that of the engine.

5. A power plant comprising in combination a reciprocating steam engine, a turbine operated by exhaust steam from said engine, an electric generator and motor forming a coupling between said turbine and said engine, a pump driven by said turbine, a valve for by-passing steam from a part of the turbine, an actuating device for said valve comprising a piston responsive to the fluid pressure generated by said pump, a device responsive to the speed of said engine and adapted to vary the relation between the speed of said pump and the fluid pressure applied to said piston of said actuating device whereby the speed of said turbine is maintained in a definite relation to that of the engine.

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