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APPARATUS FOR THE REGULATION OF DRIVING ENGINES FOR ELECTRIC CURRENT GENERATORS

Filed Jan. 16, 1928

Fig. 1

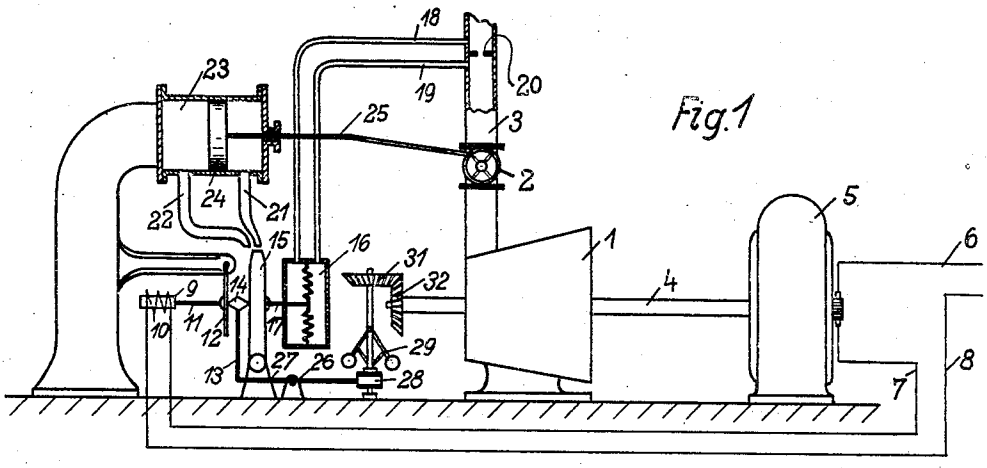
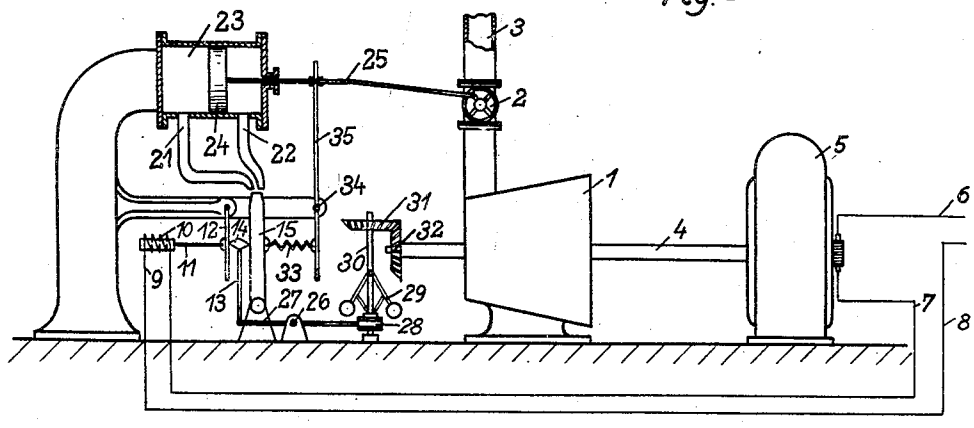


Fig. 2



Inventor:
Guido Wünsch
by Emil Bönedyche
attorney

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UNITED STATES PATENT OFFICE

GUIDO WÜNSCH, OF STEGLITZ, NEAR BERLIN, GERMANY, ASSIGNOR TO ASKANIA-WERKE AKTIENGESELLSCHAFT VORMALS CENTRALWERKSTATT DESSAU UND CARL BAMBERG-FRIEDENAU, OF KAISERALLEE, BERLIN-FRIEDENAU, GERMANY

APPARATUS FOR THE REGULATION OF DRIVING ENGINES FOR ELECTRIC-CURRENT GENERATORS

Application filed January 16, 1928, Serial No. 247,227, and in Germany January 18, 1927.

As is well known, in most engines, for instance in steam turbines, the supply of power must be regulated in such a manner that the number of revolutions shall remain as constant as possible at all loads that may occur. This condition is more particularly essential in the case of engines for driving electric current generators, such as alternating current generators, and the like. The regulation of the power supply is generally effected here by means of speed regulators or governors which, on the number of revolutions dropping or rising, automatically produce an increase or a reduction of the power supply. Such an arrangement has however the considerable drawback that the regulator or governor becomes operative only after a change in the number of revolutions has already taken place, so that in the cases in which only very slight fluctuations of the number of revolutions are admissible, the regulation is imperfect and unreliable. According to the present invention, this drawback is eliminated by the control of the power supply being effected not under the influence of the number of revolutions, but under the influence of the power delivered from the engine and from the working machine driven by it. This ensures that the power delivered and the quantity of power supplied, will be always in equilibrium at any load, apart from the change in the efficiency, so that a change in the number of revolutions will be avoided in advance. The throttle valve of the power supply is therefore so influenced according to the invention that the quantity of steam supplied is directly proportional to the power or out-put delivered. This influencing could be effected for instance by means of a well known jet pipe regulator on which acts on the one hand an impulse proportional to the output delivered and on the other hand a counter-impulse dependent on the motive fluid supplied or also on the position of the throttle valve. When the output changes, also a change in the efficiency takes place for instance in the case of a smaller output a relative higher power supply is requested than at a higher output. In order to take into account this fact, according to the invention means are further provided by which the ratio of the two impulses acting on the jet pipe or on any other regulating device can be modified for instance under the action of a governor.

The accompanying drawing shows diagrammatically by way of example in Figures 1 and 2 two constructions of a regulating device acting in accordance with the invention for a steam turbine coupled to turbo-generator.

In the drawing, 1 is a steam turbine to which steam is supplied through a pipe 3 provided with a throttle valve 2. The steam turbine 1 drives a turbo-generator 5 mounted on the joint shaft 4 and supplying the current generated, to the mains 6. Into one of said mains 6 a solenoid winding 10 placed around a core 9 is inserted, the said main being connected with the ends of said winding by two current conductors 7 and 8. The core 9 is connected by a rod 11 to a lever 12 rotatable about a fixed point, so that, according to the electric energy produced by the generator 5, a greater or smaller force is exercised by said core on the lever 12. This force is transmitted through a sliding part or slide 14 secured to the end of a rod 13, to one side of a jet pipe 15 constantly traversed by a suitable pressure medium, for instance oil under pressure. To the other side of the jet pipe 15 in the construction according to the invention shown in Figure 1, a push rod 17 is pivoted, the other end of this rod being secured to a diaphragm 16. A pressure difference produced in the steam supply pipe 3 by a throttling edge 20, is transmitted to the diphragm 16 through pipes 18 and 19.

In front of the orifice of the jet pipe 15 are arranged two pipes 21 and 22 which lead to the two ends of a cylinder 23 in which travels a piston 24, the piston rod 25 of which is connected to the throttle valve 2 of the steam pipe 3. The rod 13 of the slide 14 arranged between the lever 12 and the jet pipe 15 is pivoted to one end of a double armed lever 27 rotatable about a fixed point 26, the other end of which is connected to the governor sleeve 28 of a centrifugal governor 29, the spindle 30 of which is rotated by the engine

shaft 4 by means of two bevel wheels 31 and 32.

The construction shown in Figure 2 differs from the regulating device construction described in the foregoing, by the fact that to the side of the jet pipe 15 opposite to the point of application of the electric impulse, is transmitted no longer the pressure difference produced in the steam pipe 3, but an impulse depending on the position of the valve 2 or of the piston 24. To that end, the jet pipe 15 in Figure 2 is connected, at the side opposite to the slide 14, with the interposition of a spring 33, to one end of a double armed lever 35 rotatable about a fixed point 34, the other end of which is connected to the piston rod 25 controlling the valve 2.

The working of the devices is as follows: As long as the output taken from the generator 5 corresponds, at the required number of revolutions, to the quantity of steam supplied to the steam turbine 1, the electric impulse acting on one side of the jet pipe 15 and dependent on the output of the generator 5, and the counter impulse acting on the other side of the jet pipe and corresponding to the quantity of steam admitted or to the position of the valve 2, will be in equilibrium, that is to say there will be no change in the position of the jet pipe 15. As the voltage of the generator 5 remains constant as soon as the load on the generator 5 for instance increases the electric impulse transmitted to the solenoid core, will be greater, owing to the greater output of energy by the generator 5, than the counter impulse of the diaphragm 16 or the spring 33, dependent on the quantity of steam supplied or on the position of the valve 2. Consequently there will take place already before a change in the number of revolutions of the engine shaft 4 takes place a deflection of the jet pipe 15 in the counter-clockwise direction, so that a greater quantity of oil under pressure or the like will be admitted into the pipe 21 than into the pipe 22. The pressure difference thus produced at the two ends of the cylinder 23 will result in a movement of the piston 24 to the left, and the valve 2 will be opened wider, and the quantity of steam supplied to the turbine, will be increased. The opening of the valve 2 will continue until, owing to the increase of the differential pressure caused by the greater steam quantity and acting on the diaphragm 16, or to the increase in the tension of the spring 33 caused by the movement of the piston rod 25, the forces acting on the two sides of the jet pipe 15, will be balanced again.

The arrangement of the slide 14 operated by the centrifugal governor 29 makes it possible in the regulating process described in the foregoing, to make a correction of the regulation taking into account the change in the efficiency, or in the steam consumption per kilowatt, with the load. If for instance in the case of a reduced load the steam consumption per kilowatt is a little higher, the centrifugal governor will produce, owing to the generally small change in the number of revolutions of the shaft 4 due to it, a movement of the slide 13 and therefore a modification of the ratio of transmission of the force transmitted by the push rod 11 to the jet pipe 15, namely in the sense that an equilibrium at the jet pipe 15 will be produced only at a correspondingly higher quantity of steam. The centrifugal governor 29 has as a rule to make only a small additional regulation, the main regulation of the supply of power being effected in the manner described in the foregoing directly in accordance with the output given by the generator 5.

In the case in which the variation of the efficiency with the output is known, it is of course possible to ensure also by means of a mechanically variable gear that to every output shall correspond the corresponding quantity of steam. The governor will have to act then only when unforeseen changes take place, for instance in the steam pressure.

The process forming the basis of the invention could be used of course not only for the regulation of steam engines coupled to generators, but also for the regulation of any desired other engines or sets of engines, for instance of Diesel engines, generating sets and the like. The process offers special advantages for the regulation of alternating or three phase turbo-generators working in parallel as the power is approximately uniformly distributed then even in the event of a somewhat irregular setting of the single governors.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. An apparatus for the regulation of driving engines for electric current generators which must constantly operate at approximately the same number of revolutions comprising, in combination with a driving engine, a generator and a power supply, means for regulating the supply of power to the driving engine, a regulator controlling said means and comprising two elements influenced by the output taken at the time from the electric current generator and by the power supply respectively, and a setting device inserted between said elements and adapted to set the ratio of transmission of the said two influences on the regulator for the purpose to suit the change in the efficiency of the entire plant.

2. An apparatus for the regulation of driving engines for electric current generators which must constantly operate at approximately the same number of revolutions comprising, in combination with a driving

engine, a generator and a power supply, means for regulating the supply of power to the driving engine, a jet pipe regulator controlling said regulating means for the power supply and comprising means controlling the jet pipe on the one hand according to an impulse dependent on the output delivered from the generator and a pressure difference gauge controlling the jet pipe on the other hand according to an impulse dependent on the power quantity supplied to the engine, and a setting device inserted between said jet pipe and one of its controlling means and adapted to set the ratio of transmission of the two impulses on the jet pipe regulator.

3. An apparatus for the regulation of driving engines for electric current generators which must constantly operate at approximately the same number of revolutions comprising, in combination with a driving engine, a generator and a power supply, means for regulating the supply of power to the driving engine, a regulator controlling said means and comprising two elements influenced by the output taken at the time from the electric current generator and by the power supply respectively, a setting device inserted between said elements and adapted to set the ratio of transmission of the said two influences on the regulator for the purpose to suit the change in the efficiency of the whole plant, and a power regulator for adjusting said setting device.

In testimony whereof I have affixed my signature.

GUIDO WÜNSCH.