

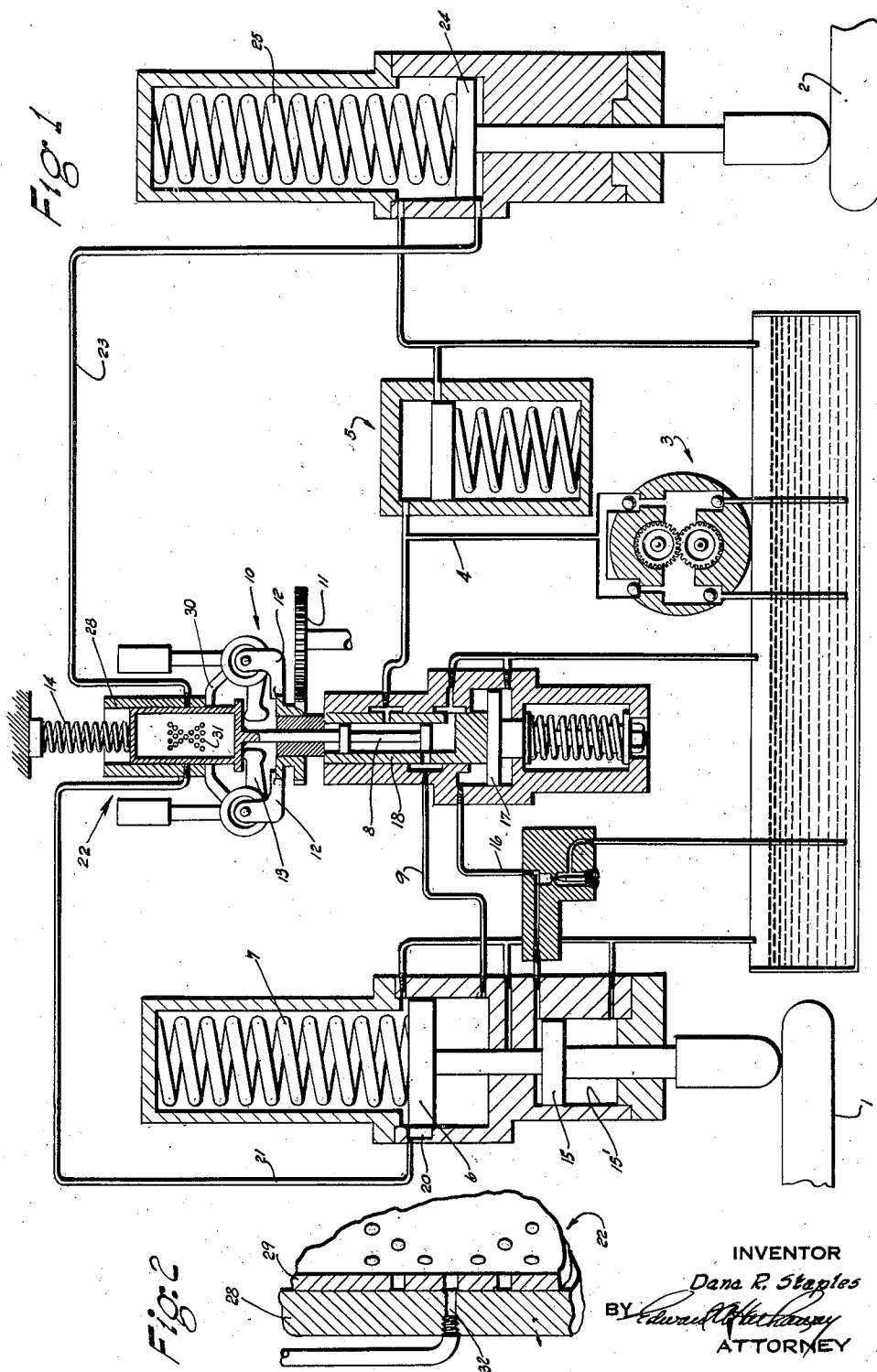
May 31, 1949.

D. R. STAPLES
GOVERNING APPARATUS

2,472,050

Filed Nov. 27, 1943

2 Sheets-Sheet 1



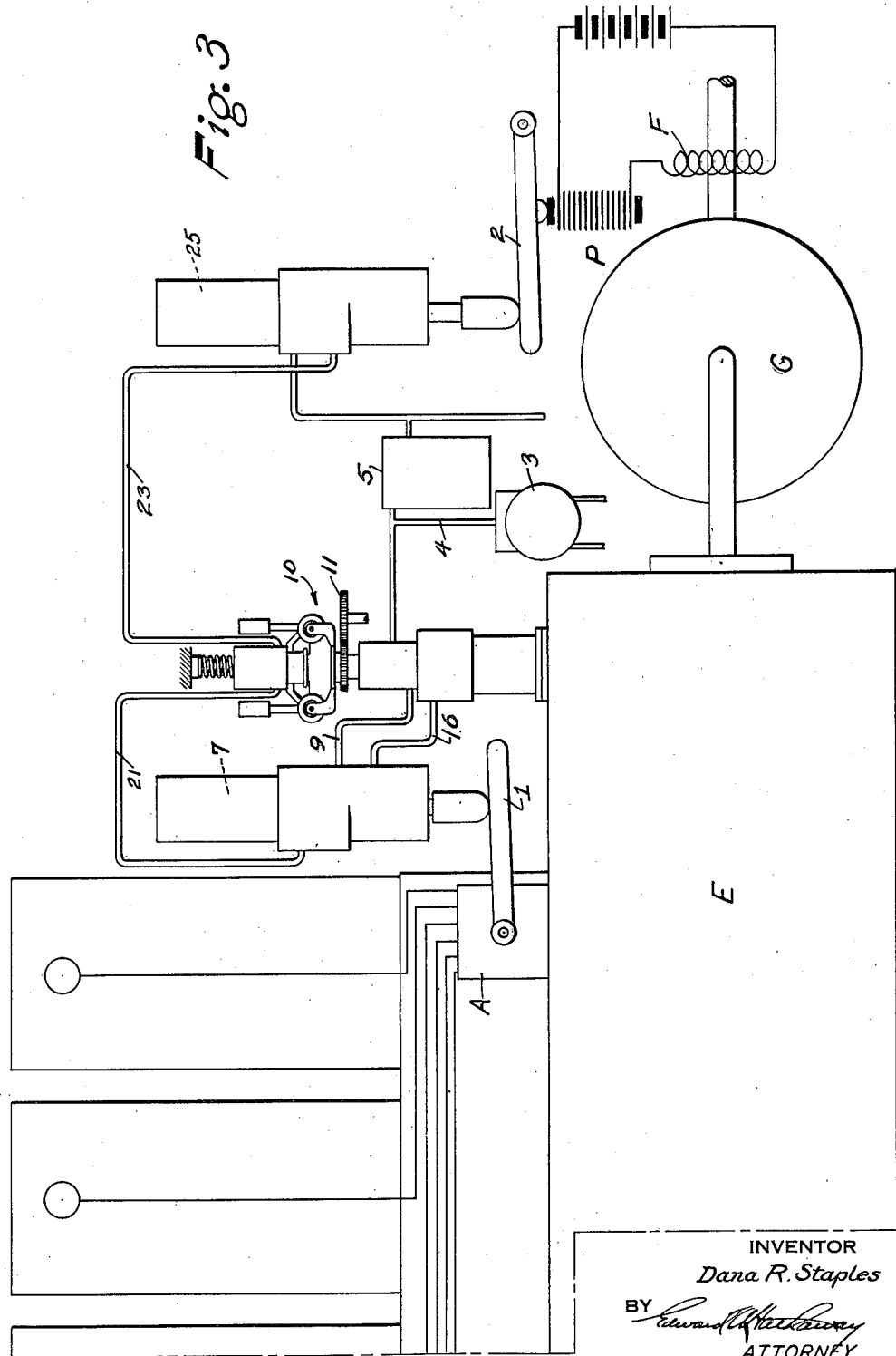
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UNITED STATES PATENT OFFICE

2,472,050

GOVERNING APPARATUS

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4 Claims. (Cl. 264—7)

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This invention relates generally to speed governing apparatus for engine-generator power units for use particularly in connection with Diesel electric locomotives.

The conditions under which a locomotive operates vary greatly in accordance with the number of cars being pulled or the grade over which a train is traveling. Inasmuch as these train and grade conditions are beyond the control of the operator, it is evident that a usual governor cannot necessarily hold the engine speed constant at all times as is usually desirable in the operation of a Diesel engine. If the generator should demand more power than the engine is capable of producing, the engine will either stall or slow down its speed with consequent falling off in power, which simply aggravates the operating conditions. Prior attempts to overcome these adverse operating conditions have included various combinations of generator and exciter fields whereby the generator can demand only a substantially constant horsepower from the engine. However, if the electrical equipment is adjusted to obtain such operating characteristics at normal operating temperatures, then when the electrical equipment is below this temperature the generator demand can be excessive with the result that the Diesel engine is overloaded and the governor cannot hold the speed constant. This, in turn, has been partially overcome by applying load regulating devices that are of an auxiliary nature attached to and supplementing the Diesel engine governor. Such auxiliary devices usually include means for engine fuel control as well as means to control the electric load such as a rheostat, a carbon pile resistor, or a brush-shifting device. Inasmuch as these auxiliary means are generally hydraulically operated there have been attempts to control the flow of hydraulic fluid to the operating devices in order to minimize the possibility of hunting or of otherwise picking up a resonant vibration transmitted from the engine and hydraulic pumping unit. Such hydraulic control means are usually in the nature of a metering valve but the limitations of such a metering valve as heretofore used have not been conducive to the most effective control of the electrical equipment and hence the effectiveness of the elaborate combination of elements heretofore developed has been materially nullified.

It is an object of my invention to provide an improved metering valve that not only will insure smooth operation of the electrical control equipment but will also bring about an improved functional cooperation between the control of the electrical equipment and the engine speed.

Other objects and advantages will be more apparent to those skilled in the art from the following description of the accompanying drawing in which:

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Fig. 1 is a diagrammatic outline of a governing system embodying my invention;

Fig. 2 is an enlarged fragmentary section of my improved metering valve; and

Fig. 3 diagrammatically illustrates the relation of applicant's controlling system to an engine and generator.

In the particular embodiment of the invention such as disclosed herein for the purpose of illustrating one specific form among possible others that the invention might take in practice, I have shown a lever 1 for normally controlling the fuel supply pump A to an engine E while a second lever 2 normally controls the rheostat brush-shifting device, carbon pile P, etc., of an electric generator G for controlling the generator field F. The engine and generator, as well as the fuel supply and electrical means are well-known in the art and hence a detailed description thereof is not necessary to an adequate understanding and disclosure of my present invention. An oil pump of any suitable type generally indicated at 3 is driven either from the engine or from an independent source of power so that the pressure in a discharge line 4 is maintained substantially constant usually by the aid of a pressure regulating valve generally indicated at 5. The fuel lever 1 is controlled by a plunger 6 biased downwardly by a spring 7 while upward movement of the plunger is controlled by fluid pressure supplied from pump 3 through a governor valve 8 and pipe 9. The governor valve in turn is controlled by a speed governor such as a centrifugal governor 10 driven from the engine by any suitable shaft and gearing 11. A governor flyball head 12 rotatably drives and carries flyball arms 13 so that upon a decrease in engine speed below normal the valve 8 moves downwardly under the action of a biasing spring diagrammatically indicated at 14. Thereupon fluid is supplied to the under side of piston 6 to raise the same and allow fuel control lever 1 to increase fuel supply to the engine.

As the piston 6 rises it lifts a compensating piston 15 to force oil out of the top of the compensating cylinder 15' through a pipe 16 to the upper side of a piston 17 to force the latter in a downward direction. Secured to piston 17 is sleeve 18 which moves downwardly, tending to follow up the downward movement of valve 8 and accordingly ultimately closing off the valve port communicating with pipe 9. This is a well-known restoring or follow-up action in speed governors and it is completed only after the engine has been restored substantially to its normal speed.

However, if the engine is already delivering full load and should the generator demand still more power, the fuel control piston 6 will now be moved to its uppermost position so as to uncover a port 20 whereupon oil will flow from pipe 4 through

governor valve 8 (by reason of the engine speed having further decreased due to the increased generator demand) and thence through pipe 9 to a pipe 21 and a metering valve 22 from which the fluid continues to flow through a pipe 23 to the under side of an electric load control piston 24 which is normally biased downwardly by a spring 25. When piston 24 moves upwardly lever 2 will accordingly effect suitable adjustment of the electric equipment to reduce the generator demand and accordingly aid in allowing the engine speed to be restored to normal.

My improved metering valve 22 consists of a stationary cylinder or valve housing 28 and a preferably hollow cylindrical valve 29 mounted upon the upper end of the stem of governor valve 8 so as to move axially upwardly and downwardly therewith in response to variations in engine speed. The metering valve is also rotatably driven by a mechanical connection with the governor head 10 diagrammatically shown as arms 30. The metering valve has several rows of ports 31, the number of ports in each successive row increasing as the rows are spaced further away, upwardly or downwardly, from the normal speed position of the governor. The triangular arrangement of ports is duplicated on the opposite side of the valve so that when inlet port 32 is connected to pipe 21 the corresponding outlet port is connected to pipe 23. Hence when the valve is in its normal speed position as shown, the single port row is adapted to periodically supply a limited quantity of fluid from pipe 21 to pipe 23, whereas upon an increase or decrease of speed above or below normal, the metering valve 22 will be raised or lowered to bring a larger number of ports into a position so that they may successively register with the valve housing ports during rotation of the metering valve. This larger number of ports will allow a greater rate of fluid flow to or of discharge of fluid from the electrical control piston 24, as the case may be, and accordingly effect a reduced demand of the generator. The metering valve ports may be spaced around the valve circumference to any desired extent depending upon the number of fluid impulses to be transmitted to the piston 24 for a given speed. While the ports 31 are shown in a generally triangular formation, yet any other arrangement of the same may be employed so long as they accomplish the following intended function. By breaking up the fluid flow to the piston 24 in the form of impulses the transmission of resonant vibrations to or hunting of the piston 24 is reduced to a minimum. Hence, it is seen that the metering valve controls fluid flow there-through in accordance with the speed of rotation of the engine and the change in speed of rotation thus providing a doubly effective and sensitive operation of the electric control.

From the foregoing disclosure it is seen that I have provided a very effective control of the electric generator through a variable metering valve which not only operates in response to the speed of the engine but also operates in response to variations of speed, while at the same time insuring flow of controlling fluid through a series of impulses for minimizing the possibility of hunting or adverse resonant effects.

It will of course be understood that various changes in details of construction and arrangement of parts may be made by those skilled in the art without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. A metering apparatus for allowing transmission of periodic impulses of controlling fluid to control the power output of a speed governor controlled engine-generator unit comprising a metering valve operative to allow transmission of only periodic impulses of a controlling fluid at any time during normal operation, means controlled by the rotation of the engine for actuating said valve so that the frequency of said controlling impulses is in accordance with the speed of the unit, and said valve having means controlled by the governor for also varying the capacity of the periodic impulses of the metering valve in accordance with the unit speed.

2. The combination set forth in claim 1 further characterized in that the metering valve comprises a rotatable cylindrical member adapted to be axially moved by the speed governor, a housing for said valve having parts through which the periodic hydraulic fluid is transmitted under the control of said valve member, and said valve member having a variable port area adapted to variably connect said housing ports in accordance with the axial position of said valve member.

3. A metering apparatus for allowing transmission of periodic impulses of controlling fluid to control the power output of a speed governor controlled engine generator unit comprising, a rotatable metering valve having provision to allow a graduated pulsating flow of controlling fluid at any time during normal operation, and speed responsive means for varying the rate of rotation of the valve so as to vary the frequency of the pulsations and for controlling said valve to vary the graduations of flow therethrough.

4. A metering apparatus for allowing transmission of periodic impulses of controlling fluid to control the power output of a speed governor controlled engine generator unit comprising, a metering valve having relatively rotatable and axially movable inner outer members and one of which has a plurality of axially spaced ports and the other of which has a fluid transmission opening, said ports increasing in number circumferentially at successive axial distances along the valve axis whereby said circumferentially spaced ports and said transmission opening are successively in and out of communication with each other thereby to effect a pulsating flow of fluid which is transmitted through said valve elements during relative rotation thereof and which is graduated in its quantity in accordance with the relative axial position between said elements, and speed responsive means for controlling the relative axial position of said elements thereby to effect a variable quantity of pulsating flow in accordance with speed of the unit.

DANA R. STAPLES.

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Certificate of Correction

Patent No. 2,472,050.

May 31, 1949.

DANA R. STAPLES

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 20, claim 2, for the word "parts" read *ports*;
and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 15th day of November, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.