Aug. 16, 1932. E. G. PETERSEN 1,871,733

ENGINE SHUTTER APPARATUS

Filed June 6, 1930 2 Sheets-Sheet 1

Fig. 1.

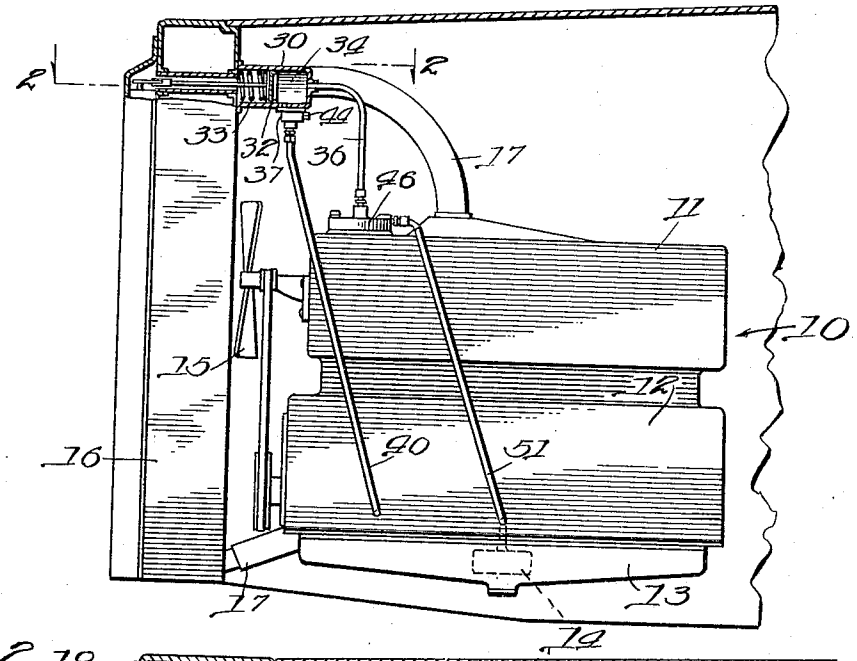
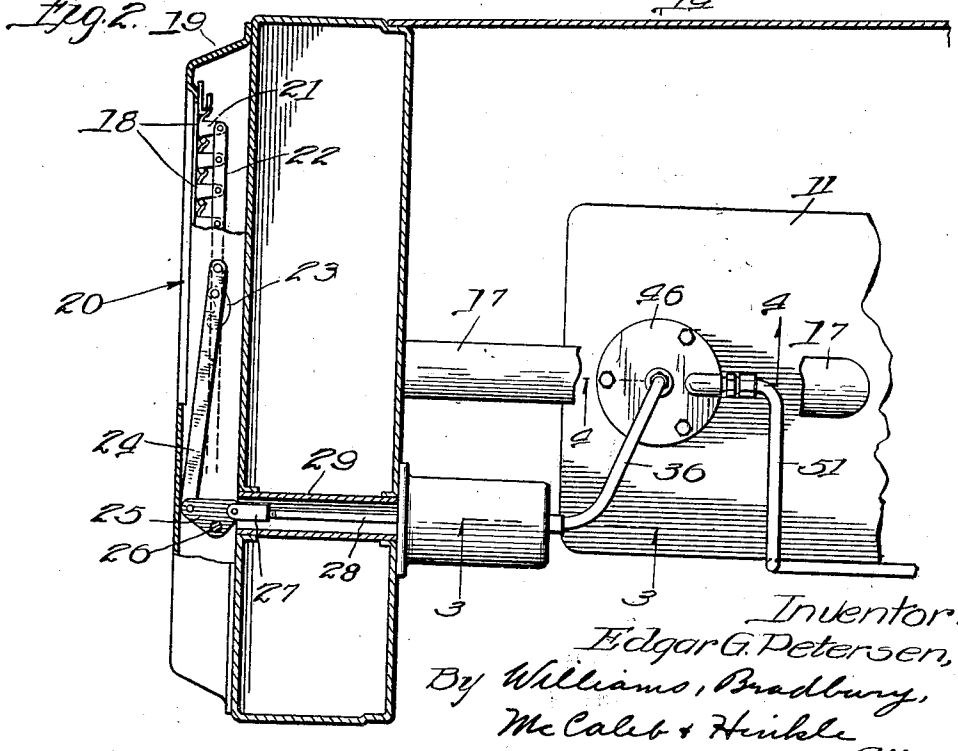


Fig. 2.



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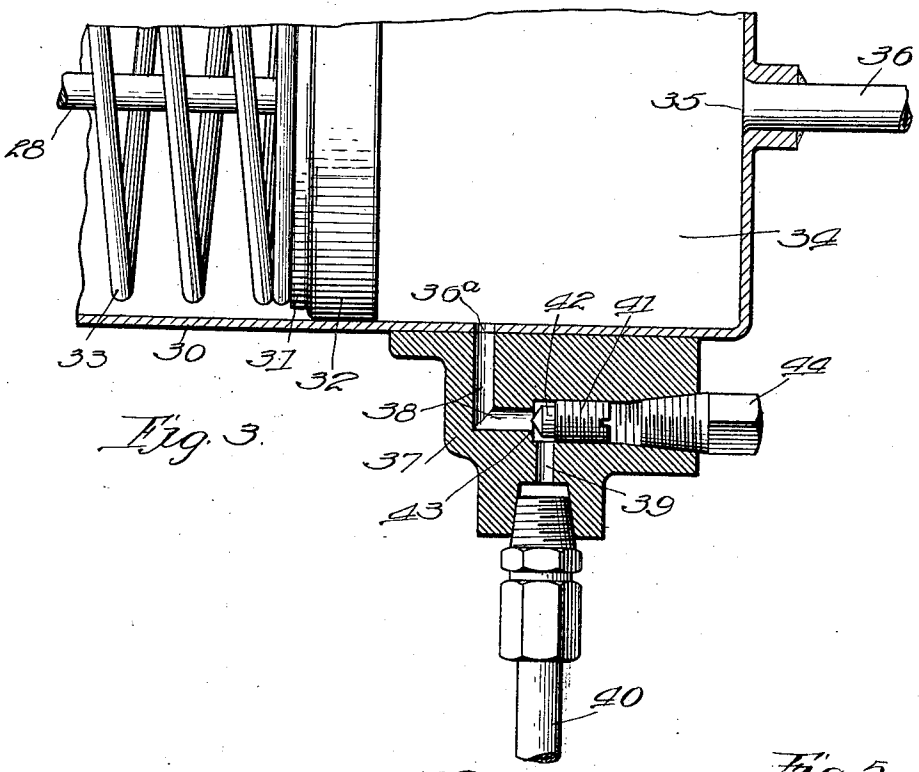


Fig. 3.

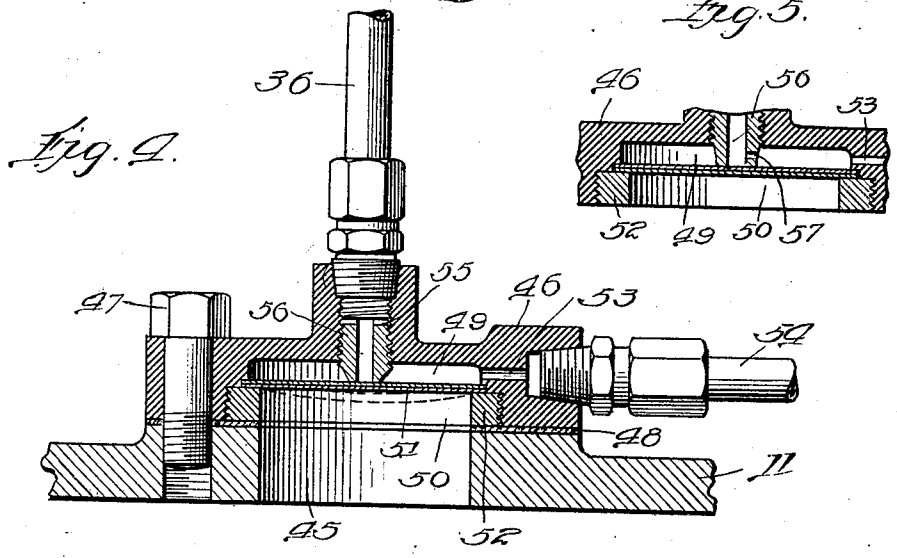


Fig. 4.

Fig. 5.

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Patented Aug. 16, 1932 1,871,733

UNITED STATES PATENT OFFICE

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ENGINE-SHUTTER APPARATUS

Application filed June 6, 1930. Serial No. 459,494.

My invention relates to engine shutter apparatus and contemplates and provides an improved thermo-hydraulic shutter operating mechanism which is properly responsive to engine temperature and which may be readily adjusted and regulated to insure opening and closing of the shutters in exact accordance with the requirements of the engine with which the apparatus is associated.

The present invention utilizes oil, circulated by the oil pump of the engine, to establish a shutter operating oil pressure when required, and provides two means, one thermostatically controlled and one manually adjusted for regulating the circulation of oil, so that oil pressure necessary to open and hold open the shutters is established and maintained whenever, but only when, the temperature condition of the engine is such as to require that the shutters be open.

In the accompanying drawings depicting an illustrative embodiment of my invention,

Fig. 1 is a side view, mostly in elevation but partially in section, illustrating an automobile power plant to which the improvements of the present invention have been applied;

Fig. 2 is a top view which may be regarded as taken on the line 2—2 of Fig. 1 and looking in the direction indicated by the arrows;

Fig. 3 is an enlarged sectional view of the pressure-responsive shutter actuating device, and its metering valve, which view may be regarded as taken on the line 3—3 of Fig. 2 and looking in the direction indicated by the arrows;

Fig. 4 is an enlarged detailed view of the thermal valve mechanism, which view may be regarded as taken on the line 4—4 of Fig. 2 and looking in the direction indicated by the arrows; and

Fig. 5 is a fragmentary view of parts like those shown in Fig. 4 and illustrating how the thermal valve mechanism may be provided with a permanently open bleed hole or its equivalent to insure that at all times there shall be a certain minimum flow of oil through the apparatus with which the present invention is concerned.

Similar characters of reference refer to similar parts throughout the several views.

Referring first to Figs. 1 and 2, it will be observed that I have shown, somewhat diagrammatically, an automobile power plant comprising an engine 10 having a liquid jacketed cylinder block 11, crank case 12, oil sump 13, oil pump 14, fan 15, radiator 16, and the conventional hose connections 17 to accommodate the flow of water or other cooling liquid from the liquid jackets of the cylinder block to the radiator and vice versa.

The oil pump 14 is indicated diagrammatically and the means for driving this pump and the customary passages for conveying oil from this pump to the engine bearings to be lubricated have been omitted entirely as being unnecessary to a complete understanding of the present invention. So far as the present invention is concerned, it is only essential that there be provided a suitably driven oil pump, either the oil pump with which engines ordinarily are equipped, or a special oil pump, which will impel a flow of oil from the engine sump through the oil circuit which the present invention contemplates, and then back to the sump.

The radiator 16, as is customary, constitutes the front wall of a hooded compartment within which the engine 10 is located. The radiator is or may be of the conventional design comprising a core having fore and aft air passages through which air may flow to cool the water or other liquid passing through the radiator. The radiator core has not been shown in the accompanying drawings, but it will be understood that there will be a flow of air through this core, due to the action of the fan 15, and the inertia of the air itself with the vehicle in motion, when the shutters 18, also somewhat diagrammatically shown, are in open position. In the present illustration the several shutters 18 are disposed vertically, each shutter being journaled for rotation around one of its longitudinal edges as an axis, the shutters being supported and journaled by a housing 19, which is suitably attached to and carried by the front face of the radiator, and which is provided with a front fenestration controlled by the shutters, the arrangement being such

that all of the air which flows rearwardly through the radiator core must pass through the fenestration 20. Of course, this can be accomplished only when the shutters are open.

In the particular arrangement shown, each shutter is provided with an operating arm 21 which is pivoted to an operating bar 22, there being two of these operating bars 22, one for the shutters on each side of the medial vertical line of the housing 19, these bars 22 being connected by a suitable link 23. Having one end pivoted to one of the shutter operating bars 22, and thus being operatively connected with all of the shutters, is a link 24 having its other end pivotally attached to a bell crank 25. The fulcrum pivot of the bell crank is at 26, its power arm being adjustably connected by the element 27 with the adjacent end of a rod 28 which passes freely through a tube 29 extending across the upper liquid chamber of the radiator.

I wish to have it understood that all of the parts of the apparatus thus far described are or may be of any suitable and well known design.

I shall now proceed with the description of those parts of the apparatus with the details of which the present invention is more particularly concerned.

Located within the hood of the vehicle power plant and conveniently mounted upon the rear face of the upper chamber of the radiator, as shown, is a cylinder 30 provided with a piston 31 including a cup leather 32, said piston being provided with a piston rod, namely the rod 28 which is connected with the shutter operating bell crank 25, as previously described. Located within the cylinder 30 and conveniently disposed around the piston rod 28 is a spring 33, which at all times tends to move the piston 31 to the right (Figs. 1 and 3). The spring 33, of course, also normally tends to hold the several shutters 18 in their closed positions.

The cylinder 30, its piston 31, piston rod 28 and spring 33 constitute an oil pressure-responsive device having a chamber 34 which will enlarge when the pressure existing in said chamber is greatly increased and will ensmall to the degree shown in the drawings when the oil pressure in the chamber is diminished. Enlargement of the chamber 34 by movement of the piston, of course, results in an opening of the shutters, and ensmallment of the chamber results in the corresponding closing of the shutters.

The chamber 34 of the oil pressure-responsive device is provided with an inlet port 35 connected by tube 36 with the outlet port of a thermal valve mechanism presently to be described. The chamber 34 also is provided with an outlet port 36*a* communicating with a metering valve, the housing 37 of which may be mounted upon the cylinder 30, if desired. The metering valve housing is provided with passages 38, 39, the former communicating with the outlet port 36*a* and the latter communicating through a tube 40 which discharges to the crank case of the engine.

The rate of oil outflow from the chamber 34 may be regulated to a nicety by a threaded valve member 41, having a conical end 42, adapted to be adjusted toward and from a seat 43 past which all communication between passages 38 and 39 occurs. If desired, a threaded taper plug 44 may be provided to protect the adjustable valve member 41 and additionally prevent the escape of any oil which possibly might be forced past the threads of the member 41.

I shall now described the thermostatic valve which regulates the inflow of oil to the chamber 34 of the oil pressure-responsive device.

Mounted upon the engine block 11 and communicating with its water jacket through an opening 45 is the housing 46 of the thermostatic valve, this housing being held firmly in position in any suitable manner, as for instance by a plurality of screws 47. A gasket 48 preferably is inserted between the housing 46 and a suitable annular seat formed on the engine block 11 as shown. The space within the housing 46 is divided into two chambers 49 and 50 by a circular diaphragm 51, the periphery of this diaphragm being firmly clamped between an annular shoulder on the housing 46 and a clamping ring 52, which has threaded engagement with the housing, as shown. The diaphragm 51 is of metal, that is to say of any suitable bi-metal type which is adapted to change from the flat disc form shown in full lines (Fig. 4) to the concavo-convex form, shown in dotted lines, under the influence of heat. The lower face of the diaphragm 51 is, therefore, in contact with the liquid occupying the water jackets of the engine block.

The chamber 49, above the diaphragm, is provided with an inlet port 53 which communicates through a tube 54 with the pressure side of the oil pump 14.

The chamber 49 of the thermostatic valve is also provided with an outlet port 55 located above and centrally of the diaphragm 51, this port communicating with the tube 36 which leads to the chamber 34 of the oil pressure-responsive shutter-actuating device previously described. Threaded for adjustment in the outlet port 55 is a hollow plug 56 having a conical lower end constituting a seat with which the diaphragm 51 co-operates as a valve member. When the engine is idle and when the engine is operating at relatively low temperature, the diaphragm 51 occupies the full line position shown in Fig. 4 to prevent the passage of oil from the cham-

ber 49 to the chamber 34 of the oil pressure-responsive device.

I wish to have it understood, however, that the plug 56 may, if desired, have a permanently open bleed hole 57 in order that there may always be a minimum circulation of oil through tube 51, thermostatic valve, tube 36, oil-pressure-responsive device, metering valve and tube 40 when the engine is operating. When the bleed hole 57 is employed, its effective area must be less than the effective area for the escape of oil from chamber 34 which is determined by the metering valve.

When the engine is operating, but not at a temperature sufficiently high to make the opening of the shutters desirable, the diaphragm 51 will occupy the position shown in Fig. 4. Under these conditions, no oil pressure will build up in the chamber 34 of the oil pressure-responsive device (even though the small bleed hole 57 be formed in the conical plug 56). But after the temperature of the water within the engine water jackets has reached a certain temperature, the diaphragm 51 will move from the full line position of Fig. 4 to the dotted line position of the same figure, thereby affording substantially unrestricted communication between the oil pump 14 and the chamber 34 of the oil pressure-responsive device, that is to say, an oil communication which has an effective area considerably greater than the effective area of the outlet for the chamber 34, as determined by the metering valve. When this condition is established, oil is pumped into the chamber 34 faster than it can escape past the metering valve, with the result that the chamber 34 is enlarged by movement of the piston 31, and the shutters are opened. During the time that the diaphragm remains in its dotted line position it is, of course, subjected on its upper face to the temperature of warm oil from the engine sump, and is subjected on its lower face to the temperature of the water within the cylinder jackets.

When and if the temperature of the engine, as reflected by the temperatures of the oil and water in contact with the diaphragm, falls below a certain point, the diaphragm will reassume the full line position of Fig. 4. Pressure within the chamber 34 of the oil pressure-responsive device thereupon will dissipate and the shutters will return to their closed position under the influence of spring 33.

It will be noted that movement of the diaphragm from the full line position to its dotted line position (Fig. 4) is to some degree aided by the pressure of oil existing in the chamber 49, this being of advantage particularly on starting the engine after a long period of idleness, in which case there may be some tendency for the diaphragm to stick to the plug 56 in the event that the oil circulated by the pump is not clean, free flowing oil.

The combination of parts herein described is particularly advantageous because it may be readily adjusted to meet the heat requirements of any engine, or to compensate for the peculiarities of the particular thermostatic valve employed. It is well known that the thermal characteristics of engines, even engines of the same design and make, vary within appreciable limits, and that characteristics of thermal discs and other thermostatic devices, even though they be of uniform design, are apt to vary to a considerable extent. The metering valve forming part of the apparatus of the present invention enables me to regulate the opening of the shutters to just the proper time in the temperature rise of the engine, despite the fact that the precise thermal characteristics of the thermostatic valve employed be not known. If with a given setting of the metering valve it be discovered that the shutters open too early, the metering valve is slightly opened, and if it be found that the shutters are opening too late, the metering valve is moved slightly toward the closed position.

After the metering valve has been once adjusted to suit the peculiarities of the particular engine, and the particular thermostat employed, it need be given no further attention unless, perchance, some radical change in the weather, or some change in the fuel used in the engine, or some change made in the character of the cooling liquid of the engine, should make an earlier or later opening of the shutters, in relation to the temperature rise of the engine, desirable.

Having thus shown and described an illustrative embodiment of my invention, what I claim is new and desire to secure by Letters Patent of the United States is:

1. In combination with an engine provided with an oil pump and shutters controlling the flow of air to cool the engine, a circuit through which oil circulates from and to the pump, a pressure-responsive shutter-actuating device in said circuit, regulable means independent of the temperature of the engine for controlling the rate of oil outflow from said pressure-responsive device, and means responsive to the temperature of the engine for varying the rate of oil inflow to said pressure-responsive device.

2. In combination with an engine provided with an oil pump and shutters controlling the flow of air to cool the engine, a circuit through which oil flows to and from the pump, a pressure-responsive shutter-actuating device in said circuit having an outflow passage of pre-determined area, and means responsive to the temperature of the engine for varying the rate of oil inflow to such pressure-responsive device.

3. In combination with an engine provided

with an oil pump and shutters controlling the flow of air to cool the engine, a circuit through which oil at all times flows to and from the pump, but at varying rates, during the operation of the engine, an oil pressure-responsive device in said circuit, instrumentalities connecting said oil-pressure-responsive device of the shutters to actuate the latter, said oil pressure-responsive device having an oil outflow passage of constant area, and means responsive to the temperature of the engine for varying the rate of oil inflow to said oil pressure-responsive device.

4. In combination with an engine having an oil pump and shutters controlling the flow of air to cool the engine, an oil circuit including said pump, an oil pressure-responsive device in said circuit, instrumentalities connecting the oil pressure-responsive device with the shutters to actuate the latter, a metering valve in said circuit determining the rate of oil outflow from said pressure-responsive device, and means responsive to the temperature of the engine for varying the rate of oil inflow to such oil pressure-responsive device.

5. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive-device having an outflow passage of an effective area constant during the operation of the engine, and means responsive to the temperature of the cooling liquid of the engine for varying the inflow rate of oil to such pressure-responsive device.

6. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive device having an outflow passage of an effective area constant during the operation of the engine, and means responsive to the temperature of the cooling liquid of the engine and to the temperature of oil flowing through said circuit for varying the inflow rate of oil to said pressure-responsive device.

7. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive device having an outflow passage of an effective area constant during the operation of the engine, and means responsive to the temperature of the cooling liquid of the engine and responsive to both the temperature and pressure of the oil flowing in said circuit for varying the inflow rate of oil to such pressure-responsive device.

8. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive device having an outflow passage of an effective area constant during the operation of the engine, and means responsive to the temperature of the cooling liquid of the engine and to the pressure of the oil flowing in said circuit for varying the inflow rate of oil to said pressure-responsive means.

9. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive device having an outflow passage of an effective area constant during the operation of the engine, and automatic means for varying the rate of oil flow to such pressure-responsive device in accordance with the temperature of the engine.

10. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive device having an outflow passage of an effective area constant during the operation of the engine, and automatic means for varying the rate of oil flow to such pressure-responsive device in accordance with the temperature of the engine, said automatic means comprising a movable thermal diaphragm having one surface exposed to the liquid of the engine cooling system and its other surface exposed to the oil flowing in said circuit and a member co-operating with said diaphragm through which oil may flow to said pressure-responsive device at a rate depending upon the relative positions of said member and said diaphragm.

11. In combination with an engine comprising an oil pump, a liquid cooling system and adjustable means for controlling the flow of air admitted to the cooling system, an oil circuit including said pump, an oil pressure-responsive device in said circuit operatively connected with said air flow controlling means to actuate the latter, said pressure-responsive

device having an outflow passage of an effective area constant during the operation of the engine, and automatic means for varying the rate of oil flow to such pressure-responsive device in accordance with the temperature of the engine, said automatic means comprising a chamber having a movable thermal diaphragm as one wall thereof, said diaphragm being responsive to the temperature of the cooling liquid of the engine, means for admitting oil to said chamber from the oil pump and means for passing liquid from said chamber to the pressure-responsive device comprising an outlet member having its end opposed to the center of said diaphragm, whereby passage of oil through said tube is determined by said diaphragm.

In witness whereof, I hereunto subscribe my name this 4th day of March, 1930.

EDGAR G. PETERSEN.