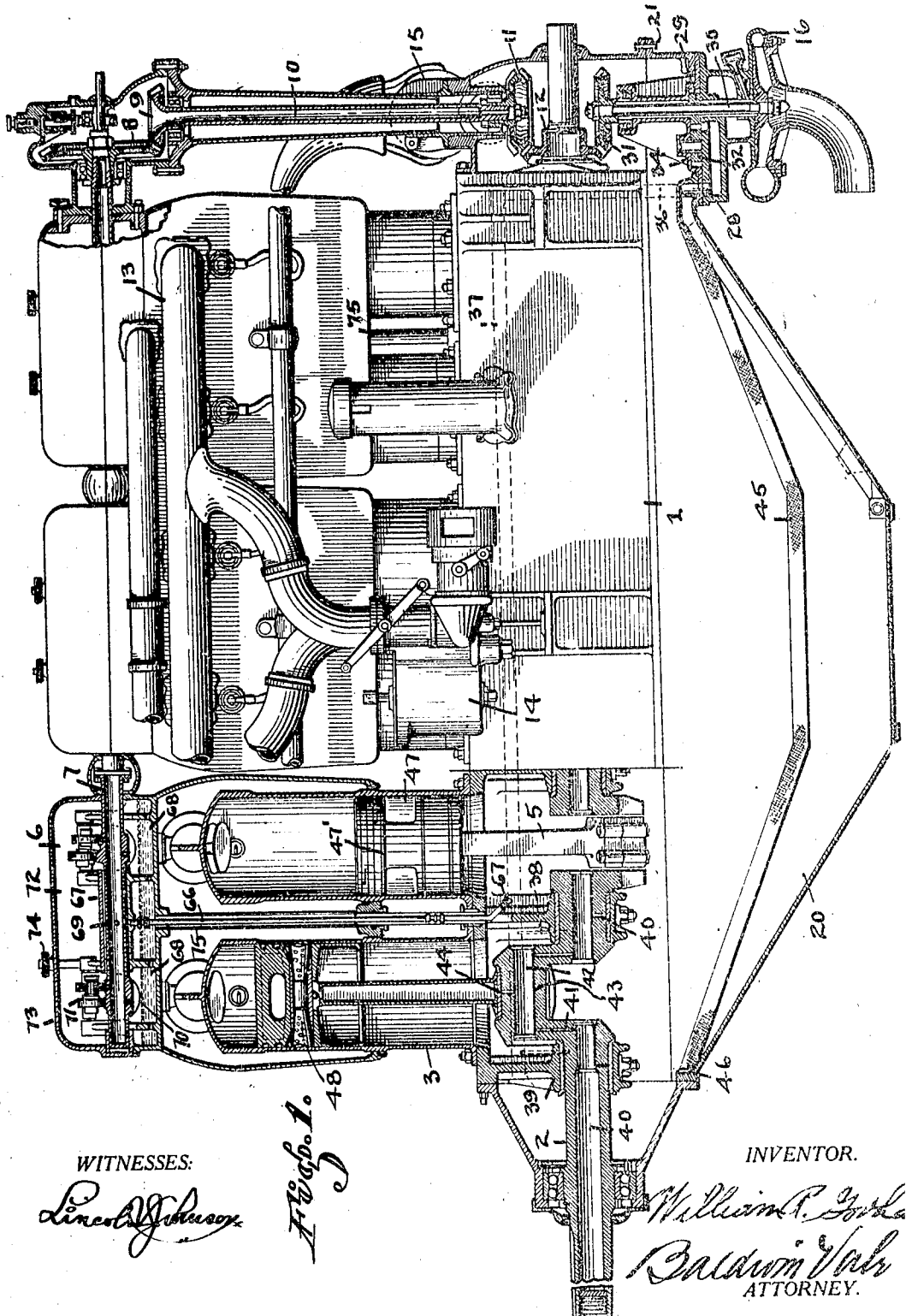


W. R. GORHAM.
INTERNAL COMBUSTION MOTOR.
APPLICATION FILED JUNE 7, 1916

1,291,839.

Patented Jan. 21, 1919.
3 SHEETS—SHEET 1.



WITNESSES:

Lincoln Johnson

Fig. 1.

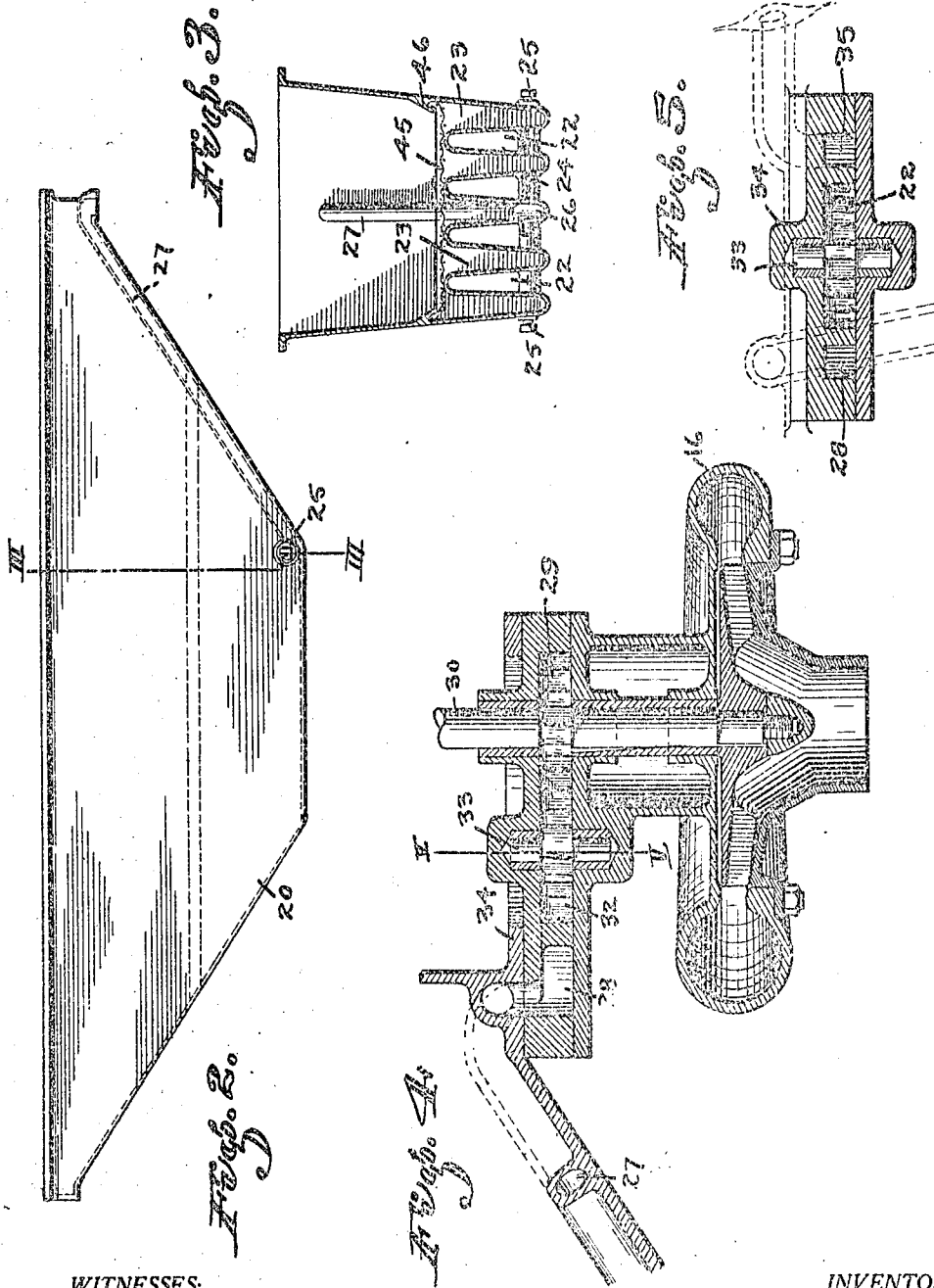
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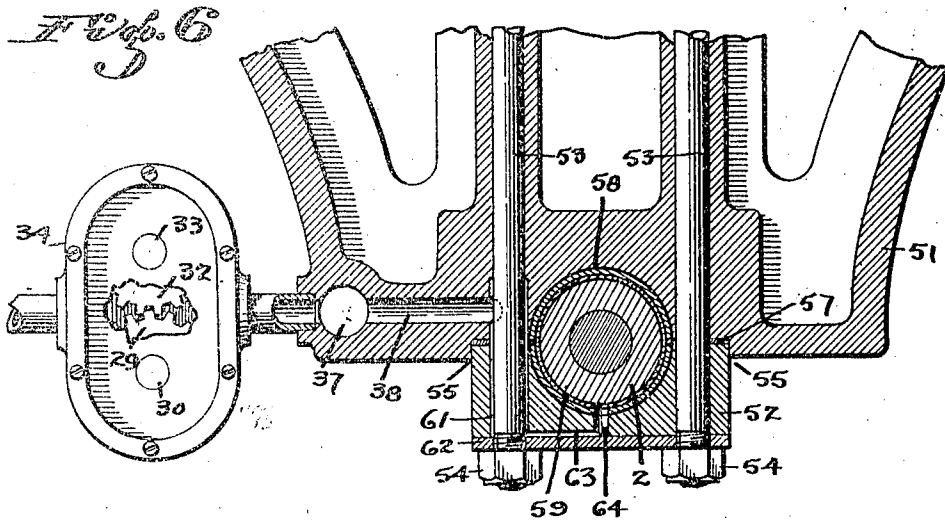
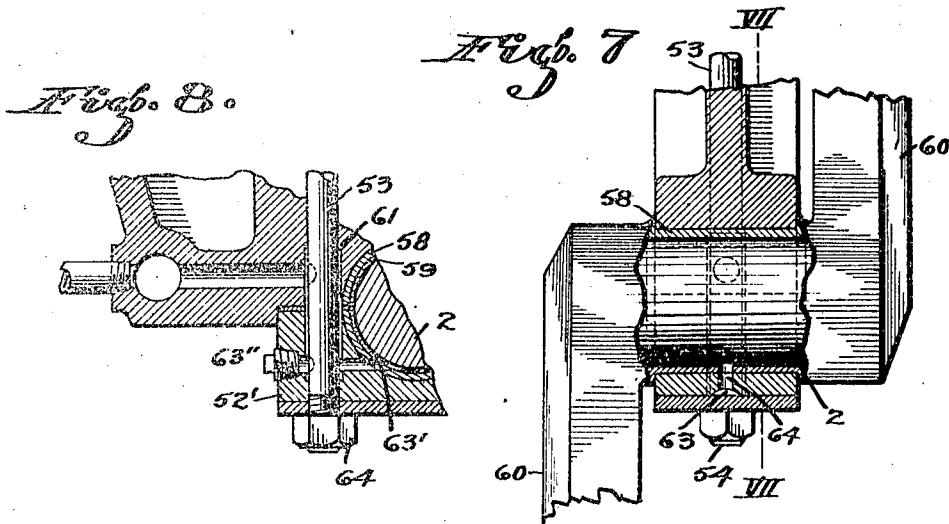
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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION MOTOR.

1,291,839.

Specification of Letters Patent.

Patented Jan. 21, 1919.

Application filed June 7, 1916. Serial No. 102,300

To all whom it may concern:

Be it known that I, WILLIAM R. GORHAM, a citizen of the United States, residing in the city of Alameda, county of Alameda, State of California, have made a new and useful invention—to wit, an Improvement in Internal-Combustion Motors; and I do hereby declare the following to be a full, clear, concise, and exact description of the same.

This invention relates more particularly to the lubricating system of internal combustion motors designed particularly for use in aeroplanes, and includes the novel construction, arrangement and combination of parts for the distribution, circulating and cooling of the lubricating medium in said motors.

In this specification and the annexed drawings, I illustrate the invention in the form that I consider the best, but it is to be understood that I do not limit myself to this form, because the said invention may be embodied in other forms, and it is also to be understood that in and by the claims following the description I desire to cover the invention in whatever form it may be embodied.

In the accompanying two sheets of drawings:

Figure 1 is a side elevation of an internal combustion motor constructed in accordance with this invention, shown partially in fragmentary cross section so better to disclose portions of the internal mechanism.

Fig. 2 is a side elevation of the oil pan or reservoir adapted to be located under the crank case of the motor.

Fig. 3 is a cross section of the same on the line III—III Fig. 2.

Fig. 4 is a vertical cross section of the combined centrifugal water circulating pump for the cooling system and the gear pressure pump of the oil circulating system.

Fig. 5 is a vertical cross section of the oil pump taken on the line V—V Fig. 4, illustrating the inlet and outlet ports cored in the oil pump casing.

Fig. 6 is a transverse section of a crank shaft bearing constructed and lubricated in accordance with this invention, the oil pump being diagrammatically associated therewith.

Fig. 7 is a longitudinal section of the same, the shaft being shown in full lines.

Fig. 8 is a fragmentary detail similar to Fig. 1 illustrating a modified form of applying lubricant to the bearing in accordance with this invention.

In detail the construction illustrated in the drawings includes the crank case designated in its entirety by the numeral 1, having the crank shaft 2 journaled therein in suitable bearings. The cylinders 3, six in number, are bolted to the crank case and have the pistons 4 reciprocable therein and connected to the crank shaft by the connecting rods 5 in the usual manner. The cylinders are provided with inlet and outlet valves common to the four cycle type of internal combustion motors. These valves are operated by the rocker arms 6. These arms are actuated by the cams on the cam shaft 7 journaled in suitable bearings mounted over the cylinders. This cam shaft is driven synchronously with the crank shaft by the gear 8 fixed thereon and meshed with the pinions 9 on the vertical shaft 10, having a pinion 11 on the opposite end thereof meshing with the driving gear 12 fixed on the crank shaft to time the opening and closing of the valves synchronously with the reciprocation of their respective pistons.

The motor is equipped with fuel distribution manifolds 13 between the carburetor 14 and the cylinders; with ignition means 15 driven from the crank shaft, and also with a water circulation pump having its rotor fixed on the shaft 30, geared to the crank shaft as described, and adapted to circulate a cooling medium about the various cylinders in the usual manner. Certain novel features in the design and construction of the motor disclosed herein and not germane to the lubricating system will be covered in separate applications for patent.

The oil circulating system includes the oil tank or reservoir 20, fixed beneath the crank case 1 by an oil tight flange connection as at 21. Because of the frictional heat absorbed by the lubricating medium, the reservoir 20 is designed and constructed to present the maximum amount of radiating surface consistent with the necessary oil capacity. This is accomplished as best illustrated in Fig. 3 by corrugating the bottom of the reservoir, forming the longitudinal channels 22 extending well up into the reservoir. The oil pockets 23 formed between these channels are cross connected by the transverse by-passes 24 extending entirely across the reservoir and closed at each end by the plugs 25, which permits access to the by-passes 24 for the purposes of cleaning or examination. By thermal circulation the cooler oil will descend to the bottom of the

reservoir into the thin longitudinal pockets 23, wherein it will be subjected to the radiating action of the wind passing through the channels 22, effectively cooling the lubricant.

5 The lubricant is pumped from the reservoir at the lowermost point 26 communicating with the by-passes 24, through the tube 27 communicating with suction port 28 of the circulating pump, preferably of the gear type as illustrated in Fig. 4. The main gear 29 of the pump is fixed on the shaft 30, suitably journaled in the pump case, and having the gear 31 fixed thereon and enmeshed with the gear 12 on the crank shaft 2. The rotation of the gear 29 is transmitted to the idle gear 32 having its trunnion 33, suitably journaled in the pump casing 34. The action of such pumps is sufficiently well known to render description unnecessary.

15 The lubricant is discharged under pressure into the outlet port 35 communicating with the passage 36, preferably cored in the crank case and indicated in dotted lines in Fig. 1 and communicating with the horizontally cored manifold 37, extending the length of the crank case. The pressure at which the oil is discharged from the force pump will vary with circumstances, ranging from low-pressure to pressure as high as 150 pounds to the square inch.

From the manifold 37 the oil flows through the by-passes 38 indicated in dotted lines in Fig. 1, and communicating with the main bearings 39, in which the crank shaft is journaled. The by-passes 38 communicate with the usual oil groove in the main bearings 39, the flood of oil effectually lubricating each bearing, then passing through the by-passes 40 drilled transversely into the crank shaft and communicating with the interior bore 20 therein, from whence it passes through the by-passes 41 drilled in the throw of each crank and communicating with the chamber 42, forming the hollow center of each crank pin 43, from whence it flows through the by-passes 44 in the crank pin to the crank bearings, discharging into the usual oil groove therein and effectually lubricating the crank pin bearing. Spraying from the main bearing 39 and the crank pin bearing the surplus oil drains back into the reservoir 20, passing through the screen 45 resting on top of the channels 22 and having its edges secured under the lug 46 formed interiorly on the walls of the reservoir 20. The screen 45 is intended to keep particles of carbon or obstructive matter from entering the lubricant circulating system.

60 The cylinder walls are lubricated by the spray squirting from the crank pin bearings as they rise toward the cylinders, the lower edge of the pistons being chamfered to accumulate the oil as they descend. The oil is picked off by the depressions 47 in the

sides of the pistons and distributed on the surface of the cylinder and the piston by the wiping action of the reciprocating piston. The depressions 47 are connected by an annular groove 47' around the piston. The surplus oil finds its way from the depressions 47 into the hollow perforated wrist pins 48 connecting the piston with the connecting rods 5, from whence the surplus oil drains back into the reservoir 20.

In detail the crank shaft bearing construction illustrated in the drawings includes the supporting bracket 51 of the general type found in internal combustion motors provided in the crank case for the main bearing of the crank shaft. The bearing block 52 is bolted to this bracket 51 by bolts 53—53 having the nuts 54—54 threaded thereon. The block 52 is gained into the bracket 51 at 55—55 to insure the proper concentricity of the bearing opening supporting the shaft 2. The interposed shims 57 provide for taking up the wear of the bearing in the usual manner. The bearing is provided with the brass bushing 58 with an inter-lining of anti-friction metal 59 sweated thereto.

In the case of crank shaft bearings in internal combustion motors, the ends of each bearing are closed by the cranks 60—60 properly placed to bear against the ends of the bushings 58 to render the bearing sufficiently oil tight to maintain the pressure of the oil therein, to the desired extent.

It is common practice to introduce oil to a bearing from the top, depending upon the rotation of the shaft to distribute the lubricant throughout the area of the bearing.

Introducing oil at the top of the bearing is wrong in theory as well as practice, because the weight supported by the shaft bears against the lower portion of the bearing, compressing the film of oil surrounding the shaft and impeding its circulation or capillary attraction between the surface of the shaft and the inclosing bearing.

In the present invention the oil is supplied to the bearing under pressure by the force pump as described, at the lowermost point of the bearing, introducing the supply of lubricant at the point where the film is most attenuated, insuring a supply at the point of greatest stress. The by-passes 38 communicate with the annular passage 61 surrounding the bolt 53 and extending to the plate 62. From the space 61 a groove 63 is formed in the block 52 communicating with the by-pass 64 leading into the bearings beneath the shaft 2, the whole oil conduit being pressure tight between the pump and the bearing. Ideal lubrication maintains a film of oil between the wearing surfaces of uniform cross-section to prevent the contact of the shaft with its surrounding bearing. To insure the nearest possible approach to this ideal condition, the oil is

forced into the bearing under pressures varying with the load upon the bearings. For example, say the load upon a given bearing is 100 pounds, the oil is pumped in at a pressure sufficient to lift this weight and float the shaft and its load by the volume of oil pumped into the bearings, the pressure being proportioned to the superficial area of the bearings. It is obvious that as the bearing wears, the leakage of oil will be greater, particularly at the ends of the bearing and it will therefore be necessary to supply a greater volume or a higher pressure to the oil entering the bearing, to maintain the proper support for the shaft therein. This type of lubrication is particularly valuable in internal combustion motors, more particularly in such motors used in aeroplanes, in which the constant change of inclination tends to throw the strain on different parts of the bearings rendering any type of gravity lubricated bearings impractical. In Fig. 8 a slightly modified form of bearing is illustrated, in which the groove 63 is substituted by the hole 63' drilled into the blocks 52 and closed by the plug 63'.

The cam shaft mechanism is supplied with lubricant through the vertical tube 66 communicating with the manifold 37 at the point 67 between each set of cylinders. The oil forced through the tube 66 is discharged into the main bearings 67 in which the hollow cam shaft 7 is journaled. From the oil grooves in the bearings 67 the surplus oil passes through the by-passes 69 in the cam shaft to the hollow center thereof from which it escapes through the by-passes 70 in the cam shaft at each cam. The oil flowing through the by-passes 70 is thrown against the rollers 71 on the rocker arms that operate the valves of the respective cylinders, the escaping oil being splashed into the chamber 72, sealed by the covers 73 held in place by the knurled nuts 74, the surplus oil draining back into the wells 68—68 beneath the cams which splash into it in their rotation beneath the rocker arm, insuring a thorough distribution of oil through the inclosing chamber 72. The oil in the wells 68 drains back through the tube 75 surrounding the supply tube 66, into the crank case and then back into the oil reservoir 20, and through the circulating system described. These return tubes 75 are repeated between each set of cylinders. The cam shaft 7 being hollow throughout its length and closed at each end, insures a thorough distribution throughout the cam operating system from end to end of the motor irrespective of its inclination. This condition is likewise maintained through the hollow crank shaft and the rest of the force feed lubricating system described, fully

meeting the adverse conditions met with particularly in aeroplane flight, the motive power of which this motor is particularly designed to supply.

Particular value is attached to the combination of the water circulating and the oil circulating pumps disclosed herein. The combination of these two elements results in a great saving of space, reduction of operating parts, and general strength and simplicity. By the direct connection of these two circulating means, their operation is more directly synchronized with the operation of the motor. In addition to the mechanical and economic advantages described, bringing the lubricating medium into proximity with the cooling medium passing through the pump 16, tends to reduce the temperature of the lubricating medium by reason of the thermo-conductivity of the combined pump casings, the water passing through the pump 16 absorbing the heat given off by the lubricating medium in its passage through its circulating pump.

Having thus described this invention, I claim:

1. In an internal combustion motor, a bearing supporting a shaft, such bearing being composed of separable parts bolted together; an oil passage communicating with the space between one of said bolts and the surrounding bearing part and terminating in said bearing beneath said shaft; and means for forcing oil under sustained pressure into said space surrounding said bolt.

2. In an internal combustion motor, a bearing supporting a shaft and composed of separable parts bolted together; an oil passage communicating with the space between one of said bolts and the surrounding bearing part and terminating in said bearing beneath said shaft; an oil manifold cored in the crank case of said motor; and means for forcing oil under sustained pressure into said manifold.

3. In an internal combustion motor, a crank case having an oil manifold with a by-pass cored therein; a bolt projecting from said crank case through a hole larger than said bolt and communicating with said by-pass; a block having a hole registering with said hole in the crank case, and an oil groove in said block communicating with said bearing; a plate engaging said bolt beneath said block; and means for forcing oil into said manifold.

In testimony whereof, I have hereunto set my hand at San Francisco, California, this 31st day of May, 1916.

WILLIAM R. GORHAM.

In presence of—

BALDWIN VALE,
A. J. HENRY.