

May 25, 1926.

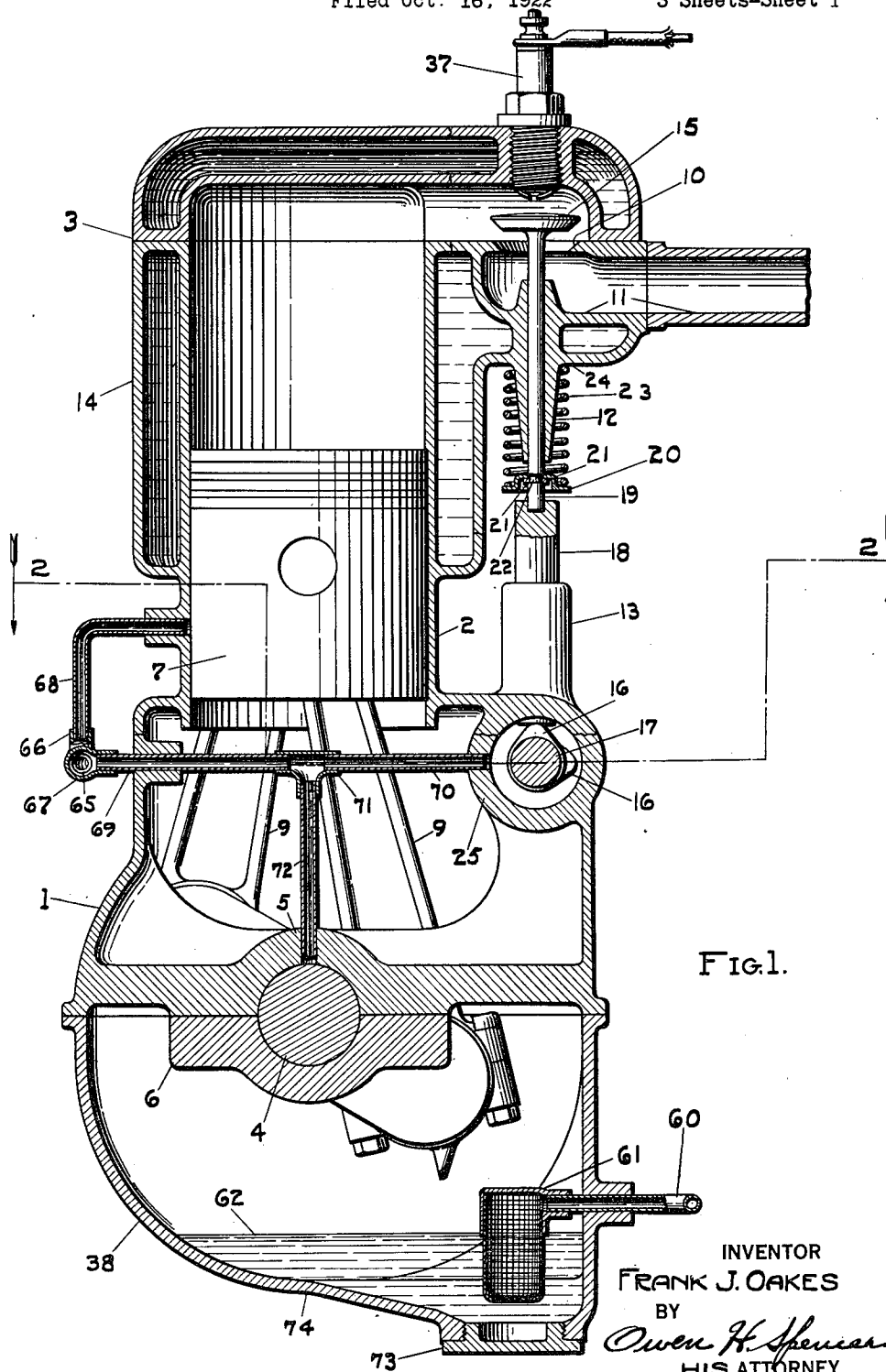
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F. J. OAKES

INTERNAL COMBUSTION ENGINE

Filed Oct. 16, 1922

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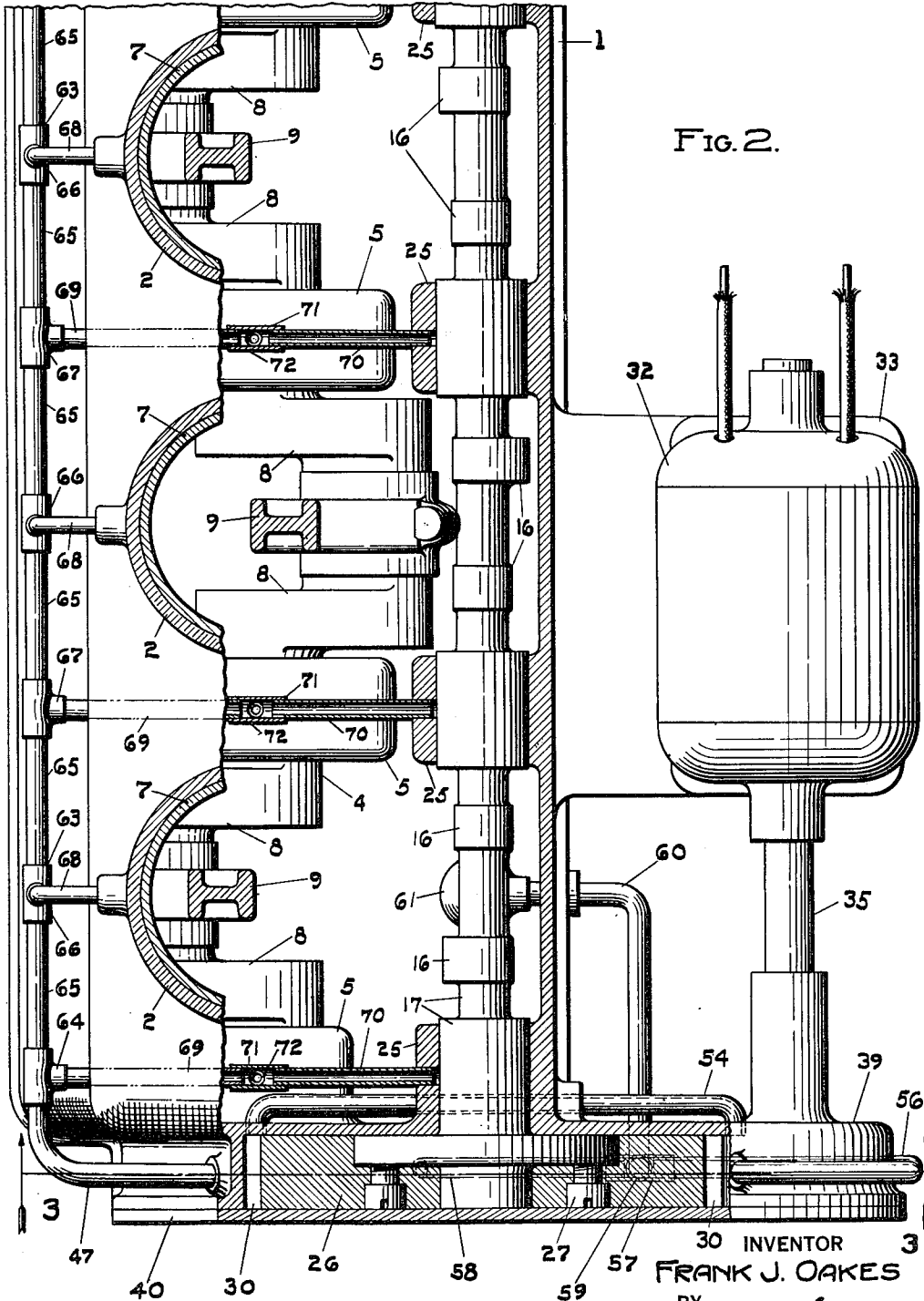
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FIG. 2.



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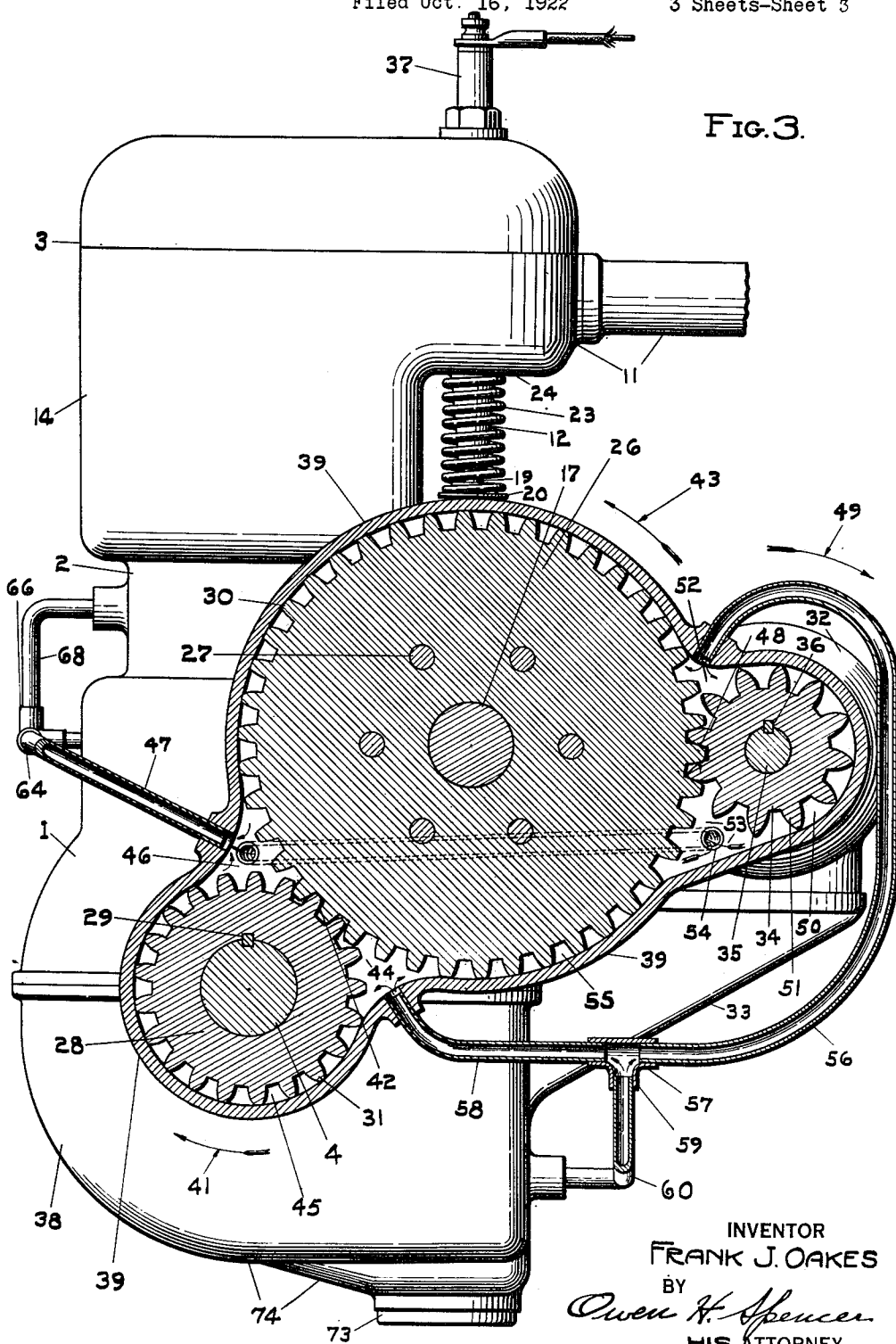
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FIG. 3.



INVENTOR  
FRANK J. OAKES  
BY  
*Owen H. Spencer*  
HIS ATTORNEY

## UNITED STATES PATENT OFFICE.

FRANK J. OAKES, OF INDIANAPOLIS, INDIANA.

## INTERNAL-COMBUSTION ENGINE.

Application filed October 16, 1922. Serial No. 594,942.

My invention relates to internal combustion engines of the four cycle type and more particularly to engines, the firing and gaseous control of which are actuated by gearing driven by the main engine shaft, usually known to those familiar with the art, as the crank shaft, and consists substantially in the construction, combination and arrangement of parts hereinafter set forth and pointed out more particularly in the claims.

An object of my invention is to provide a simple, quiet, efficient, and compact means for actuating the gaseous and electrical apparatus of, and simultaneously lubricating the various parts of such engine.

It is a primary object of my invention to enclose or incase the usual timing gears of an internal combustion engine in such a manner that these identical gears will also serve as pump gears, by which the lubricated parts of said engine may be amply supplied with oil by tributary passages branching out from the timing gear casing as desired; by which arrangement the gearing heretofore used only for timing, serves also as a force feed lubricating pump, thus eliminating the additional lubricating pump members heretofore required to be a part of such an engine.

It is an object of my invention to construct an internal combustion engine comprising a set of gears which serve as timing gears and simultaneously as lubricating pump gears.

It is also an object of my invention to so construct, arrange, and encase, the timing gears of an internal combustion engine, that the normal operation of such gears will hydraulically circulate an oil supply about and to the frictional surfaces of said gears by which said gears are kept lubricated and quieted, and also to the various other frictional surfaces of such motor, for lubricating same.

The above and other objects are attained by the structure illustrated in the accompanying drawings, in which Fig. 1 is a fragmentary sectional side elevation of my invention transverse to the axial line thereof. Fig. 2 is a fragmentary sectional plan view in the proximity of line 2-2 of Fig. 1. Fig. 3 is a sectional elevation on line 3-3 of Fig. 2 and shows the gearing of my invention.

Referring to the characters of reference, 1 designates the crank case or frame member of my invention, which forms on its upper portions a plurality of cylinders 2, upon which is mounted the cover 3 which forms a common cylinder head for the cylinders 2. The crank shaft 4 is revolvably mounted in the crank case 1 by the journals 5 being held in this relation by the journal caps 6. The pistons 7 are slidably disposed within the cylinders 2 each of said pistons being connected to its respective crank arm 8 of the crank shaft 4 by its respective connecting rod 9 by which arrangement the pistons 7 are adapted to travel up and down in the cylinder 2 the length of which travel is in accordance with the length of throw of the arms 8 of the crank shaft 4.

The valve seats 10 and the gaseous passages 11 are formed on the cylinders 2, the valve stem guides 12 being formed on the gaseous passages 11 in concentric alinement with the valve seats 10. The push rod guides 13 are formed on the crank case 1 and are also in concentric alinement with the valve seats 10. A usual water cooling jacket 14 is formed on and about each of the cylinders 2 and the gaseous passages 11 thereof, being thus constructed to enclose said cylinders and said gaseous passages, said water jackets being adapted to contain water for cooling my invention in opposition to the heat resulting from the normal fuel combustion of same.

15 indicates one of the cylinder valves, adapted to open and close the gaseous passages 11 as desired by the cams 16 of the cam shaft 17, which are adapted to lift said valves to their open position, as shown in Fig. 1, thru the push rods 18 interposed lengthwise between said cams and said valves, the stems 19 of said valves and said push rods being arranged in an end to end relationship. The spring seats 20 encircle and are secured to the valve stems 19 by the washers 21 which also encircle said valve stems at the grooves 22 thereof. 23 is one of the expansion coil springs encircling the valve stem guides 12 and interposed in such manner as to exert longitudinal tension between the spring seats 20 and the flat portions 24 of the water jackets 14, said coil springs tending constantly to hold the valves 15 against their respective seats 10 in opposition to the cams 16,

but correspondingly yielding to the lifting of said valves by said cams.

The cam shaft 17 is revolvably mounted in the crank case 1 by the journals 25 formed in said crank case. Said cam shaft, carries at the gear end of my invention the cam shaft gear 26 which is secured thereto by the screws 27 and adapted to rotate as a unit with said cam shaft, such a gear being known to those familiar with the art, as a cam shaft gear.

The rotation of said cam shaft is effected by said cam shaft gear which is adapted to mesh with the crank shaft gear 28 keyed to one end of the crank shaft 4, by the key 29, and rotatable therewith. The cam shaft gear 26 having twice the number of teeth 30, as the crank shaft gear 28 has teeth 31, is geared down thereby and adapted to rotate one revolution to two revolutions of said crank shaft gear, in accordance with the usual construction of four cycle internal combustion engines.

The generator 32 mounted on the shelf 33 of crank case 1, is driven by the generator drive gear 34 which in turn is driven by the cam shaft gear 26 with which said generator drive gear is adapted to rotate in meshed relation, said generator drive gear being keyed to the generator shaft 35 by the key 36. The generator 32 is provided to supply the electrical ignition current for the spark plugs 37 threaded in the cylinder head 3, so as to slightly protrude one each into the cylinders 2, by which arrangement said spark plugs serve as the firing means for my invention.

The oil reservoir 38 is secured to the lower side of the crank case 1 forming a lubricating oil container and also serving as an inspection plate by the removal of which, certain manual adjustments and repairs may be made.

I have observed in many internal combustion engines, the embodiment of a force feed oil pump, comprising a somewhat auxiliary mechanism to the engine proper but propelled by a driving means interposed between such pump and some revolvable member of the engine, usually the crank shaft. In cases where such an arrangement is used, one pump is usually provided to each engine and adapted in such manner that during the normal rotation of the revolvable parts of such engine said pump will pump oil from an oil reservoir, such as 38 of my invention, thru tributaries to the various lubricated portions of such engine, as desired. I have also observed that in numerous instances that such pumps are what are known as gear pumps, hydraulic pressure being brought about by a pair of closely encased gears meshing with each other and revolvable in opposite directions. I have also noticed that the gears of such pumps have much the

same general form and relation as does the crank shaft gear 28 and the cam shaft gear 26 of my invention, which are in fact timing gears typical of four cycle engines and I have therefore in my invention so incased and adapted said crank shaft gear and said cam shaft gear that these identical gears serve as pumping gears operable in the same manner as the gears of a usual gear pump, as will be understood, and serve to pump oil to the various lubricated parts of my invention, while also serving as timing gears.

Referring to Fig. 2 and Fig. 3, the crank shaft gear 28 and the cam shaft gear 26 are enclosed in a close fitting gear casing 39 formed on the crank case 1 at the gear end of my invention and completed by the inspection plate 40, said gears having freedom of rotation within said gear casing. During the operation of my invention the crank shaft 4 and the crank shaft gear 28 revolve clockwise or in the direction indicated by the arrow 41. The cam shaft gear 26 being meshed with said crank shaft gear is rotated by said crank shaft gear in the direction of the arrow 43 being counter clockwise or opposite to the rotation of said crank shaft gear. During the continued operation of my invention, oil is carried from the space 44 of the gear casing 39 by the openings 45 between the teeth 31 of said crank shaft gear, around to the space 46 of the gear casing 39. At the meshing point 42, however, said openings engage the teeth 30 of the cam shaft gear 26 so that said teeth nearly fill the said openings and the oil contained therein is nearly all crowded out thereby and forced to accumulate in the space 46 of said casing 39, causing hydraulic pressure in the space 46, sufficient to force oil thus accumulated, out of said space by way of the outlet tube 47 which comprises a passage opening out of said casing.

The cam shaft gear 26 meshes with the generator drive gear 34 at the point 48, by which said generator drive gear may be propelled in the direction of the arrow 49 being clockwise, and opposite to the direction of rotation of said cam shaft gear, so that oil may be carried by the openings 50 between the teeth 51 of said generator drive gear from the space 52 to the space 53 of the casing 39. The openings 50 are nearly filled, when passing the meshing point 48, however, by the teeth 30 of the cam shaft gear 26, and the oil contained in said openings is thus nearly all crowded out and forced to accumulate in the space 53 of the casing 39 and the oil which accumulates in said space is forced out thru the tubular passage 54 (shown partly by dotted lines in Fig. 2 and Fig. 3), which serves as a connecting port passage between the space 53 and the space 46 of the casing 39 by which the accumulation of oil from both of said spaces is

united, the oil from the space 53 being thus discharged thru the outlet tube 47 together with the oil deposited at the space 46 by the crank shaft gear 28.

5 The openings 55 between the teeth 30 of the cam shaft gear 26 serve to carry oil from the space 44 to the space 53 of the case 39 which oil is crowded from said openings by the teeth 51 of the generator gear 34 which engage with said openings at the gear meshing point 48. By this arrangement oil carried by said cam shaft gear to the space 53 unites with the oil carried to said space by the generator gear 34 as explained above, and is forced out of said space thru the tubular passage 54 into the space 46 and thence into the outlet tube 47. Upon continued revolving of said cam shaft gear the openings 55 thereof again fill with oil from the space 52 which oil is carried to the space 46, said oil being crowded from said openings by the teeth 31 of the crank shaft gear 28 at the meshing point 42, said oil being thus united with the oil otherwise deposited at the space 46 by the previously explained means, and the oil thus united is forced out thru the outlet tube 47.

The space 52 is connected to the space 44 by a continuous passage (shown partly by dash lines in Fig. 2) comprised of the tube 56, the T coupling 57 and the tube 58, being arranged in order as stated.

The central branch 59 of the T coupling 57 engages the upper end of the tube 60 (shown partly in treble dot and dash lines in Fig. 2) making the tubes 56 and 58 tributary to the tube 60. The other end of the tube 60 is disposed within the oil reservoir 38 and supports at said end the screen 61 which is partly submerged in the oil 62 from which the pump formed by the gears 26, 28 and 34, sucks up oil thru the tube 60 and the T coupling 57 a part of said oil being thence sucked thru the tube 58 by the crank shaft gear 28 and the cam shaft gear 26 and the remainder being sucked thru the tube 56 by the cam shaft gear 26 and the generator drive gear 34.

The oil discharged into the outlet tube 47 as explained above, passes from said outlet tube into the main lubricating supply line 63, by way of the T coupling 64. Said main lubricating supply line 63 is comprised of tubular sections 65 joined together by the T couplings 66 and 67. The T couplings 66 form junctions which join said main lubricating supply line to the cylinder lubricating tributaries 68, one going to each of the cylinders 2 by which arrangement the inner cylindrical surfaces of said cylinders and the pistons 7 are lubricated. The T couplings 67 and 64 serve as junctions joining said main lubricating line with the bearing tributaries 69 (shown partly in dash and double dot lines in Fig. 2) said bearing

tributaries protruding into the crank case 1 and comprising a lubricating passage to the cam shaft journals 25 with the horizontal tubes 70 which are joined to the bearing tributaries 69 by the T couplings 71 which serve to also join the bearing tributaries 69 with the vertical tubes 72 which are thus adapted to carry oil from the bearing tributaries 69 to the crank shaft journals 5 which are adapted to be lubricated thereby.

It is obvious that before my invention has been operated, or is at rest oil will not be distributed in the gear casing 39 or the various passages constructed in conjunction therewith, as the force of gravity would of course cause such oil to drain and settle into the bottom portion of the oil reservoir 38. In starting operation, however the combined pumping action of the crank shaft gear 28, the cam shaft gear 26, and the generator drive gear 34 tend to cause a vacuum condition at the spaces 44 and 52 in said gear casing, which vacuum tendency extends thruout the tubes 56 and 58, the T coupling 57 and the tube 60. Said vacuum tendency causes oil to be sucked thru the screen 61 into the tube 60 which oil divides in the T coupling 57, part of which is sucked up thru the tube 58 to the space 44 and the remainder being sucked up thru the tube 56 to the space 52, said oil passing thru the pumping process explained above, and thence thru the outlet tube 47 and the T coupling 64 into the main lubricating supply passage 63 and thence to the tributaries 68 and 69 in the manner heretofore set forth.

The plug 73 being threaded thru the floor 74 of the oil reservoir 38 is thus adapted to be removed by unscrewing same, by which said reservoir may be drained of oil and manual access may be had to the screen 61. The purpose of said screen is to prevent coarse settlings deposited in the reservoir 38 from being sucked up thru the tube 60.

It is understood that my invention serves, by hydraulic force to keep a film of oil between the points of contact of the aforementioned gear teeth.

While I have illustrated in a general way, certain instrumentalities which may be employed in carrying my invention into effect, it is evident that modifications may be made in the various details and the number of cylinders may vary in accordance with the number of parts sundry thereto, without departing from the scope of the appending claims, it being understood that my invention is not restricted to the particular form of internal combustion engine herein described.

I claim as my invention:

1. An explosive engine comprising a toothed gear axially carried with the crank shaft thereof, a toothed gear axially fixed to the cam shaft thereof, and meshing with

said crank shaft carried gear, a generator adapted to supply the electrical current for the firing mechanisms of said engine, a toothed gear axially fixed to said generator shaft in meshed relation with said cam shaft fixed gear, a gear casing adapted to enclose together said crank shaft carried gear, said cam shaft fixed gear and said generator gear, thereby comprising a gear pump with  
 10 said gears, passages constructed to, from and between said gears, by which the cam shaft fixed gear is adapted to serve simultaneously as the mate pumping gear for both the crank shaft carried gear and the  
 15 generator gear, for pumping lubricating fluid to the various frictional surfaces of said engine.

2. In an internal combustion engine the combination of a toothed crank gear, a  
 20 toothed cam shaft gear in meshing engagement with said crank gear, a generator adapted to supply the electrical current for the ignition of said engine, a toothed generator gear axially related to said generator  
 25 and meshing with said cam shaft gear and adapted to be rotated thereby, a gear pump housing adapted to enclose together all three of said gears, thereby comprising a hydraulic self-lubricating gear pump, an oil con-  
 30 tainer for retaining a surplus of oil for said engine, conduit means leading from said oil container to said gear pump housing, a conduit means leading from the approaching

crotch of said cam shaft gear and said generator gear to the approaching crotch of  
 35 said cam shaft gear and said crank gear, a main lubricating outlet conduit means leading from said gear pump housing and adapted to convey lubricating oil from said  
 40 gear pump, tributary conduits branching out from said outlet comprising a conduit means to the crank shaft journals, to the cam shaft journals, and to the cylinders of said engine, for lubricating same.

3. In an internal combustion engine hav-  
 45 ing a crank shaft, a cam shaft and an electrical generator shaft; a gear axially secured to said crank shaft; another gear axially secured to said generator shaft; an intermediate gear axially secured to said cam  
 50 shaft in meshed relation with both the crank shaft and the generator gear; a housing adapted to enclose said gears; a conduit means serving to communicate the approaching  
 55 interceptions of said gears; a conduit means serving to communicate the departing interceptions of said gears with the oil supply of said engine for sucking oil therefrom; and another conduit means communicating  
 60 the approaching interceptions of said gears with the bearings of said engine for lubricating same.

In testimony whereof, I have hereunto set my hand on this the 7 day of October, 1922,  
 A. D.

FRANK J. OAKES.