Dec. 22, 1942. W. F. ISLEY 2,305,874

ENGINE

Filed Feb. 23, 1942 2 Sheets-Sheet 1

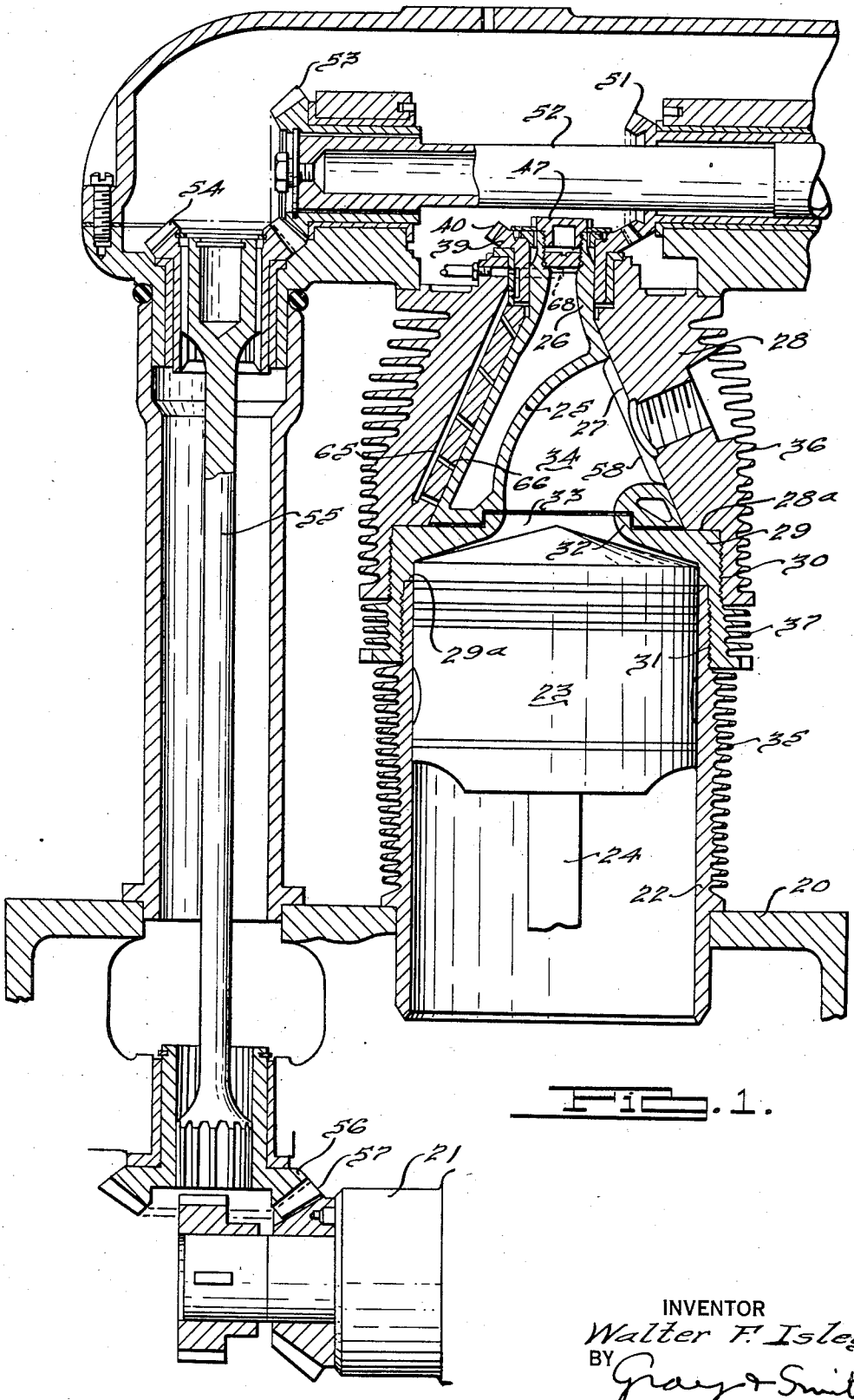



Fig. 1.

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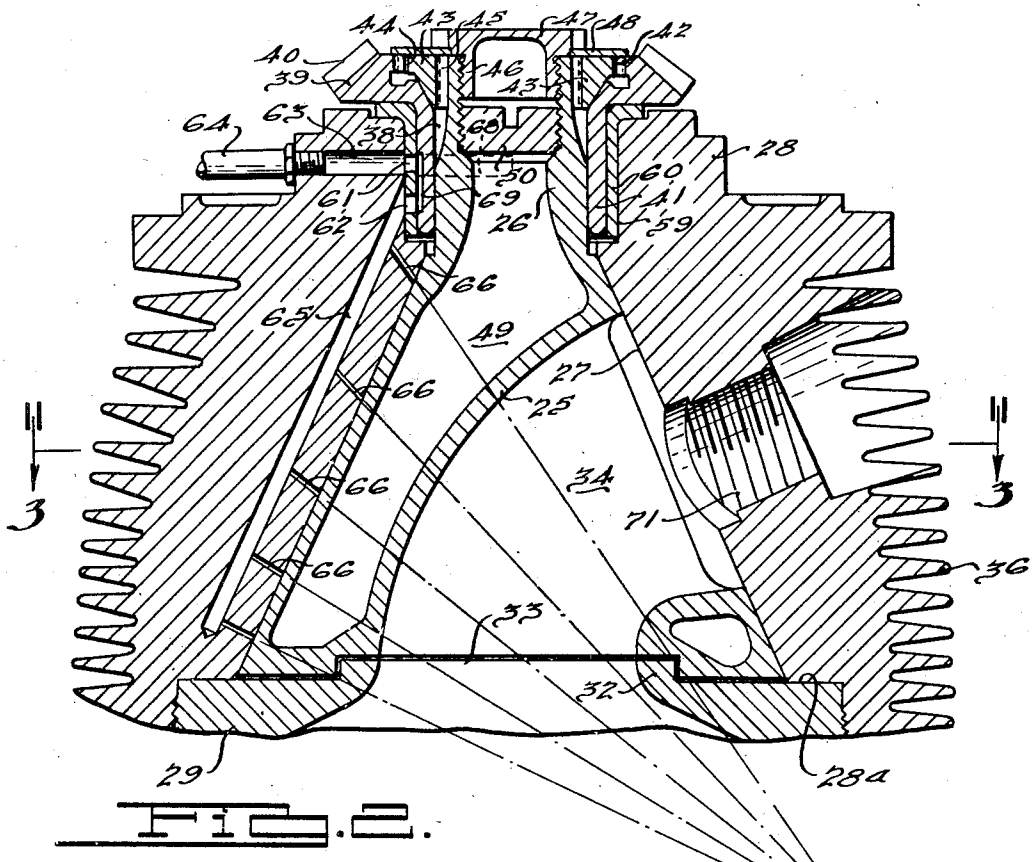



Fig. 2.

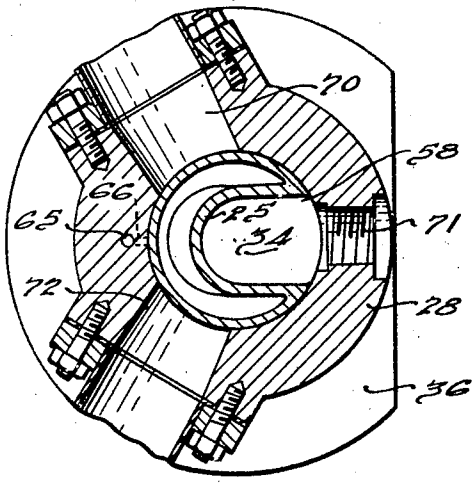



Fig. 3.

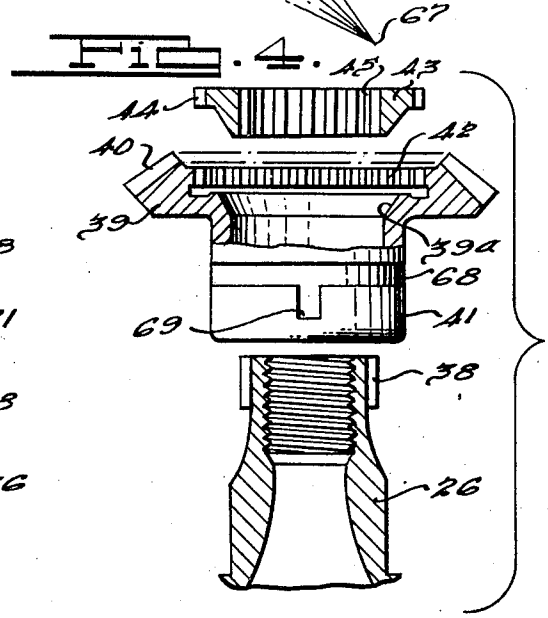



Fig. 4.

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# UNITED STATES PATENT OFFICE

2,305,874

## ENGINE

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Application February 23, 1942, Serial No. 431,948

22 Claims. (Cl. 123—80)

This invention relates to internal combustion engines and particularly to engines of the type having rotatable valves in the head thereof. The present invention has particular application to an internal combustion engine of the kind in which the rotatable valve in the head, preferably although not necessarily of the kind which rotates continuously in one direction, is formed with substantially all or at least the major portion of the combustion chamber and is generally conical or frusto-conical in shape. The combustion chamber within the rotor or rotary valve has an opening at one end leading to the cylinder and a second opening preferably at a side thereof adapted to communicate during operation with an outlet or inlet passage, or both, as the case may be, and the combustible charge within the combustion chamber is fired preferably by spark ignition.

Engines of the foregoing type present the possibility of considerable advantages, long recognized, as compared with conventional engines of the poppet valve type, such as simplification of construction, reduction in weight, and higher speed operation with consequent increase in power output. Many difficulties, however, are presented in the production of a satisfactory engine of this type, one of the most serious being in connection with the lubrication of the rotary valve and oil consumption. It is important that lubricating oil be supplied to the rotary valve and that an adequate oil film be maintained between juxtaposed rubbing surfaces of the valve and the cylinder head during operation.

Although the importance of valve lubrication in this type of engine has been recognized and considerable attention has been directed to this phase, yet in no instance am I aware of the solution of the problem of accurately controlling the valve lubrication so as to deliver to the valve predetermined quantities of oil at predetermined timed intervals.

One of the objects of the present invention is to provide a lubricating means for a rotatable valve of the above type of engine which will be more efficient and accurate thereby improving the operation of the engine and reducing oil consumption.

Another object of the invention is to provide a positive and dependable means for delivering to the rotary valve measured quantities of lubricating oil at predetermined timed intervals.

A further object of the invention is to provide a relatively simple and efficient means for metering the lubricating oil and intermittently delivering the oil to the rotary valve in metered or predetermined amounts whereby substantially exact control is maintained of the oil used to lubricate the valve and consequent elimination of excessive oil comsumption is achieved.

Still a further object of the invention is to provide improved lubricating means for the rotary valve of an engine of the above mentioned type in which the delivery of oil to the valve is controlled by a part of the valve drive mechanism and is timed so as to provide a film of oil at that portion of the valve surface subject to greatest impact pressure against the head during the operation cycle.

A further object of the invention is to ensure adequate lubrication of the rotary valve at the time of ignition and at such locality as not only to prevent scoring but also to assist in sealing the intake and exhaust ports against gas leakage and consequent loss of power.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a fragmentary sectional elevation illustrating a portion of a multi-cylinder engine embodying the present invention.

Fig. 2 is an enlarged sectional elevation illustrating particularly the cylinder head and rotary valve or combustion chamber structure shown in Fig. 1.

Fig. 3 is a reduced section taken substantially through lines 3—3 of Fig. 2 looking in the direction of the arrows.

Fig. 4 is an enlarged exploded sectional view illustrating a portion of the means for driving the valve or combustion chamber rotor.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is illustrated, by way of example, one embodiment of the invention as applied to an internal combustion engine of the spark ignition type designed particularly for the power plant of an aircraft. The invention

may obviously be embodied in engines for other purposes, such as automotive, marine and industrial engines. For most uses the engine is of the multi-cylinder type, although any number of cylinder units may be employed in any given engine. In the present embodiment, for the purposes of simplicity, a single cylinder unit of the engine is illustrated, it being understood that the remaining cylinders of the engine are identical to the structure herein shown and described.

Referring to Fig. 1, the present engine comprises a suitable crankcase 20 within which is mounted a crankshaft 21 supported in bearings according to conventional practice. A cylinder 22 is secured rigidly to the crankcase and has its lower or inner end projecting thereinto. Mounted to reciprocate within the cylinder is a piston 23 adapted to be connected in the usual manner by a connecting rod 24 to the crankshaft 21.

In the present engine the combustion chamber of the cylinder is formed principally within a rotor or rotary member 25, this member comprising a frusto-conical body arranged immediately above the piston when at the top of its stroke and also having a cylindrical stem 26 projecting from the outer end of the rotor body. The rotor 25 fits within a correspondingly shaped substantially frusto-conical cavity 27 in an upper cylinder head member 28. The cylinder head of the engine may be said to comprise two portions or members secured together and to the upper end of the cylinder 22. In addition to the outer member 28 the cylinder head comprises an intermediate member 29 which may herein be termed the rotor mask or shield and forming the pressure control member for the rotor and head and also the throat opening from the cylinder into the combustion chamber.

The upper or outer end of the cylinder is formed with external threads which are engaged by internal threads on the cylindrical skirt portion of the head member 29 as indicated at 31. The member 29 in turn is provided with external threads which are engaged by internal threads on the cylindrical skirt portion of the outer cylinder head member 28, as indicated at 30. From this construction it will be seen that the cylinder head or mask member 29 may be screwed down tightly over the outer end of the cylinder 22 until the annular shoulder 29a of the member 29 substantially abuts against or engages the upper or outer edge of the cylinder, as shown in Fig. 1. Also it will be seen that the outer cylinder head member 28 is screwed down tightly over the member 29 until the bottom shoulder 28a of the head 28 substantially engages or abuts against the upper flat ledge or face of the member 29.

The rotor mask or shield member 29 terminates centrally in a projecting annular flange 32 which forms the throat opening 33 into the combustion chamber 34 of the rotor member or rotary valve 25. The piston 23 is preferably formed at its outer end with a tapered portion, as illustrated in Fig. 1, which projects into the throat opening 33, thereby reducing the size of the combustion space and preferably confining the combustion chamber substantially to the space within the rotary valve 25. The piston at the top of its stroke, as shown in Fig. 1, preferably has only a minimum operating clearance with the bottom correspondingly tapered wall of the mask plate 29.

The present engine is illustrated as being air cooled and, accordingly, the cylinder 22 is provided with projecting fins 35. Cooling fins 36 and 37 are also provided on the cylinder head members 28 and 29, respectively. It will be understood that the present invention is not limited to an air cooled engine as it will be apparent that any effective cooling system may be utilized. Furthermore, the invention is not limited to the particular design and construction of rotary valve, combustion chamber, cylinder and cylinder head construction herein illustrated for the purpose of exemplifying one embodiment of the present invention.

The rotor 25 is driven through the medium of the stem 26 which is positively connected to a driving gear in such manner as to permit slight relative axial and radial movement between the driving gear and the rotor. The stem 26 of the rotor is provided with external longitudinal splines 38 and is also provided with internal threads within the cylindrical bore thereof. The rotor is driven by a gear 39 having suitable gear teeth 40, this gear being formed with a depending cylindrical hub or sleeve 41 having a sliding fit over the stem 26. The gear 41 also has internal tooth-like splines 42. A coupling member 43 fits within the annular space formed between the teeth 42 of the driving gear 39, this coupling member having exterior teeth or splines 44 fitting into the spaces between the splines 42 of the driving gear and also having internal splines 45 fitting within the spaces formed by the splines 38 of the stem 26. The coupling member 43 has an annular tapered surface engageable with a correspondingly shaped tapered surface 39a of the gear 39. 46 is a clamping nut having external threads engageable with the threads of the valve stem 26 and having an outwardly projecting circular flange 47. Interposed between this flange and the end of the stem 26 is a spring washer 48 having a central aperture through which the clamping nut projects, the washer being of a sufficient diameter to engage the upper face of the gear 39, as shown in Fig. 2.

The rotor body 25 is cored entirely around the combustion chamber 34 to provide a cavity 49 which is closed at the upper end of the valve by means of a screw plug 50 screwed tightly into the threaded portion of the valve stem 26 below the clamping nut 46. Any suitable heat transfer or conducting medium, such as metallic sodium, is introduced into the cavity 49 through the hollow stem 26, and sealed therein by the screw plug 50.

Referring to Fig. 1, the gear 39, which is attached to the projecting stem of the rotor 25, is driven through the medium of a gear 51 attached to a top horizontal shaft 52. This shaft is of the desired length to permit simultaneous driving of the rotors of a plurality of cylinders arranged in line. Attached to the end of the shaft 52 is a gear 53 which is driven by a gear 54 secured to the upper end of a tower shaft 55. This shaft is suitably housed and has secured to the lower end thereof a gear 56 driven by a gear 57 attached to the crank shaft 21. It will be understood that in the particular embodiment herein illustrated in which the valve 34 has a single port 58 in its side adapted to register in succession with an intake port 70, a spark plug at location 71 and an exhaust port 72, the rotary valve is driven at one-half engine speed. The driving mechanism, above described and shown in the drawings, is illustrative of a suitable mecha-

nism by which one or a plurality of rotary valves may be driven from the crank shaft.

The frusto-conical cavity 27 in the cylinder head 28 terminates at its upper end in a cylindrical counter-bore 59. Fixed within this counter-bore is a sleeve or bushing 60 which preferably has a press fit therein so as to be non-revoluble. The sleeve or hub portion 41 of gear 39, therefore, rotates within the sleeve or bushing 60. The sleeve 60 at one side thereof is provided with vertically spaced radially extending holes or ports 61 and 62. The upper hole or port 61 registers with and is constantly in communication with a transverse drilled hole 63 in the upper end of the cylinder head 28. The hole or passage 63 is in communication with a pipe or tube 64 into which lubricating oil is constantly forced under pressure through the medium of any suitable oil pump system. The lower hole or port 62 registers with and is constantly in communication with the upper end of a drilled hole 65, this hole or passage extending parallel to the tapered wall of the valve cavity 27 and substantially the full length thereof. Leading from the passage 65 to the tapered wall of the cavity 27 and, hence, to the space between the adjacent walls of the valve 25 and the cavity 27 are relatively narrow or small ducts or passages 66. These passages are in the form of holes drilled through the wall of the cavity 27 into the hole or passage 65, and preferably all of the passages 66 (five being shown in the present embodiment by way of example) are drilled from a common center 67, as indicated by the dot and dash lines in Fig. 2.

The sleeve portion 41 of the gear 39 is provided with an annular groove or channel 68 which is adapted to register with and be in communication with the port 61 and hence with the communicating oil inlet passage 63. In the present embodiment of the invention the groove 68 extends only part way around the sleeve 41, approximately half way as herein shown. It will be understood that the circumferential length of the groove may vary and, in fact, it may extend entirely around the sleeve so as to be in constant communication with port 61. At a given point in the annular groove or channel 68 there is provided a short communicating groove or passage 69 which extends downwardly from the channel 68 and in a direction parallel to the axis of rotation of the gear 39. This short notch or groove 69 is adapted to register at each revolution of the gear 39 and hence at each revolution of the rotor 25, with the port 62 leading into the communicating oil passage 65. Thus, it will be seen that at each revolution of the driving gear 39 and of the rotor 25 the oil inlet passage 63 will be placed in direct communication with the oil distributing passage 65 through the medium of oil ports 61 and 62 and oil passage 69 which bridges the space between these ports. At longer intervals, however, during the revolution of the driving gear and valve the oil inlet passage 63 will be in communication through port 61 with oil distributing channel 68 which in turn provides lubrication for the hub of the gear 39 rotating within the bushing 60.

From the foregoing it will be seen that I have provided an improved and efficient means for lubricating the valve 25 in which substantially metered or measured amounts of oil are delivered to the valve at predetermined timed intervals. In the present instance oil is delivered under pressure through the passages 66 once during every revolution of the valve. The amount of this oil so supplied to the valve is predetermined and can be varied by varying the width of the bridging passage 69. Since conduit 63 is constantly under oil pressure it will be apparent that the amount of oil forced through passages 66 to the valve will be governed by the time interval that the ports 61 and 62 are bridged or connected by the passage 69. Hence, the speed of rotation of the gear 39 and the width of passage 69 are the controlling factors.

It will be noted also that distributing passage 65 and ducts 66 are located in the head 28 opposite the spark plug location 71. At the time of firing the charge in the combustion chamber 34 the explosion pressure tends to shift the valve laterally toward the opposite wall of the cavity 27 and also outwardly. Due to this shifting of the valve under the force of the explosion it is desirable that an adequate oil film be provided at the locality of greatest pressure of the valve against the wall of the cylinder head. In the present engine it is preferred that the passage 69 connect the ports 61 and 62 at or just prior to ignition so that the shift of the valve under the explosion pressure will be against a body of oil already forced and being forced between the juxtaposed surfaces of the valve and head, which oil will be squeezed out between the surfaces to produce and maintain an unbroken oil film which not only prevents scoring but also assists in sealing the ports 70 and 72 against gas leakage and consequent loss of power.

I claim:

1. In an internal combustion engine having a cylinder, a cylinder head and a reciprocable piston in said cylinder, a rotor supported in said head for rotation and having a combustion chamber in said rotor provided with a port opening into the cylinder, an oil passage in the head for delivering oil to the juxtaposed surfaces of the rotor and head, an oil inlet conduit for supplying oil under pressure to said passage, and means controlled in timed relation to the rotation of said rotor for intermittently connecting said conduit and passage.

2. In an internal combustion engine having a cylinder, a cylinder head and a reciprocable piston in said cylinder, a rotor supported in said head for rotation and having a combustion chamber in said rotor provided with a port opening into the cylinder, an oil passage in the head for delivering oil to the juxtaposed surfaces of the rotor and head, an oil inlet conduit for supplying oil under pressure to said passage, and rotatable means for connecting and disconnecting said conduit and passage.

3. In an internal combustion engine having a cylinder, a cylinder head and a reciprocable piston in said cylinder, a rotor supported in said head for rotation and having a combustion chamber in said rotor provided with a port opening into the cylinder, an oil passage in the head for delivering oil to the juxtaposed surfaces of the rotor and head, an oil inlet conduit for supplying oil under pressure to said passage, and driving means for said rotor having means for making and breaking communication between said conduit and passage.

4. In an internal combustion engine having a cylinder, a cylinder head and a reciprocable piston in said cylinder, a rotor supported in said head for rotation and having a combustion chamber in said rotor provided with a port opening into the cylinder, an oil passage in the head for

delivering oil to the juxtaposed surfaces of the rotor and head, an oil inlet conduit for supplying oil under pressure to said passage, a driving gear for rotating said rotor continuously in one direction, and means controlled by said gear for intermittently making and breaking communication between said conduit and passage.

5. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet conduit, and rotatable means for making communication between said conduit and passage.

6. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet conduit, a gear for driving said valve, and means controlled by said gear for intermittently making and breaking communication between said conduit and passage.

7. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet conduit, and means controlled in timed relation to the rotation of said rotor for intermittently connecting said conduit and passage.

8. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet conduit, said conduit and passage having their ends adjacently arranged, and a member rotatable with the valve and having a passage adapted to connect said ends at predetermined times.

9. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet conduit, and rotatable means for connecting and disconnecting said conduit and passage.

10. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet passage, a rotary member having a portion intermittently in communication with both passages and a portion in communication during a longer period of time with one of said passages.

11. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet passage, and a rotary member having an annular channel in periodic communication with one of said passages and also having a channel transverse to said annular channel adapted to communicate intermittently with both passages.

12. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil to the bearing surface of said valve, an oil inlet passage, and a rotary gear member having an annular channel adapted to communicate with one of said passages and also having a channel transverse to said annular channel adapted to connect said passages once during each revolution of the gear member.

13. In an internal combustion engine having a cylinder head and a rotatable cone type valve therein, a gear connected to the outer end of the valve, an oil conduit in said head for directing lubricating oil to the tapered bearing surface of the valve, said conduit being normally interrupted at one locality in its length, and means controlled by said gear for intermittently making communication between the interrupted portions of said conduit.

14. In an internal combustion engine having a cylinder head and a rotatable cone type valve therein, a gear connected to the outer end of the valve, an oil conduit in said head for directing lubricating oil to the tapered bearing surface of the valve, said conduit being normally interrupted at one locality in its length, and a sleeve fixed to said gear and having a conduit portion for intermittently making communication between the interrupted portions of said conduit.

15. In an internal combustion engine having a cylinder head and a rotatable cone type valve therein, a gear connected to the outer end of the valve, said gear having a sleeve portion embracing an extended portion of the valve, a fixed bushing within which said sleeve portion rotates, an oil inlet conduit leading to a port in said bushing, and an oil passage leading to a second port in said bushing, said sleeve portion having a channel adapted to effect communication between said ports.

16. In an internal combustion engine having a cylinder head and a rotatable cone type valve therein, a gear connected to the outer end of the valve, an oil conduit in said head for directing lubricating oil to the tapered bearing surface of the valve, said conduit being normally interrupted at one locality in its length, and means controlled by said gear for intermittently making communication between the interrupted portions of said conduit, said valve having a combustion chamber and port in the side of the valve leading to said chamber and located opposite said conduit.

17. An internal combustion engine comprising a cylinder having a reciprocable piston therein, a rotatable frusto-conical valve associated with the cylinder and including therein a portion of the combustion space, a fixed body within which said valve rotates and having a passage for directing oil at separated points to the bearing surface of said valve, an oil inlet conduit, and rotatable means for making communication between said conduit and passage, said valve having a port leading from the combustion space at that side of the valve substantially diametrically opposite said separated points.

18. In an internal combustion engine, a rotatable valve, a body within which said valve rotates and having conduit means for directing oil to the bearing surface of said valve, an oil inlet conduit, and rotatable means for making communication between said inlet conduit and conduit means.

19. In an internal combustion engine, a rotatable valve, a body within which said valve rotates and having conduit means for directing oil to the bearing surface of said valve, an oil inlet conduit, and rotatable means for making and breaking communication between said inlet conduit and conduit means.

20. In an internal combustion engine, a rotatable valve, a body within which said valve rotates and having a conduit for directing oil to the bearing surface of said valve, and rotatable means for making and breaking communication between said conduit and bearing surface.

21. In an internal combustion engine, a rotatable valve, a body within which said valve rotates and having a conduit for directing oil to the bearing surface of said valve, and driving means for the valve including means for metering the oil flowing through said conduit to said bearing surface.

22. In an internal combustion engine, a rotatable valve, a body within which said valve rotates and having a conduit for directing oil to the bearing surface of said valve, and rotatable means for metering the oil flowing through said conduit to said bearing surface.

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