

Oct. 17, 1950

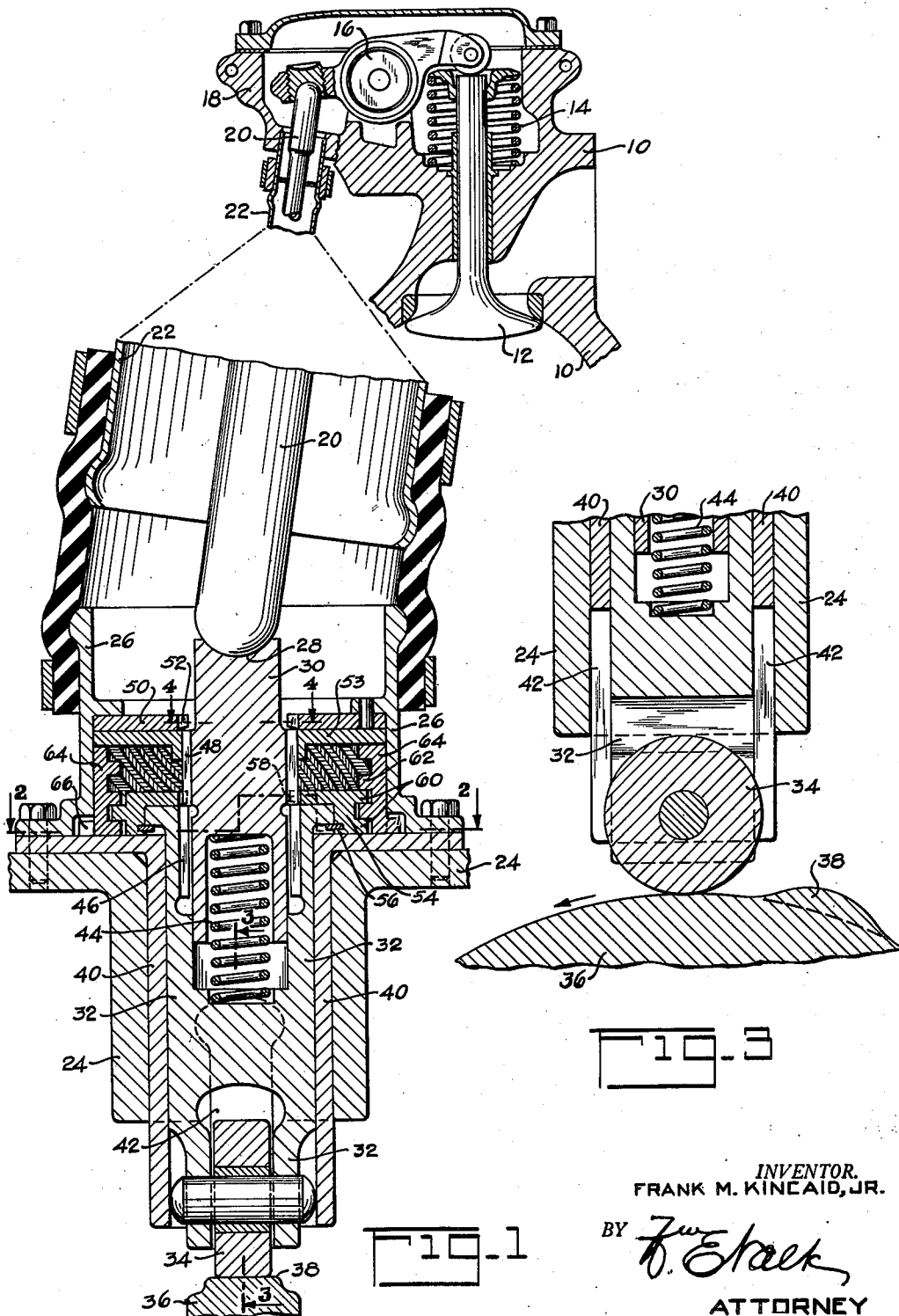
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INTERMITTENTLY OPERATED VALVE TAPPET

Filed April 23, 1946

2 Sheets-Sheet 1



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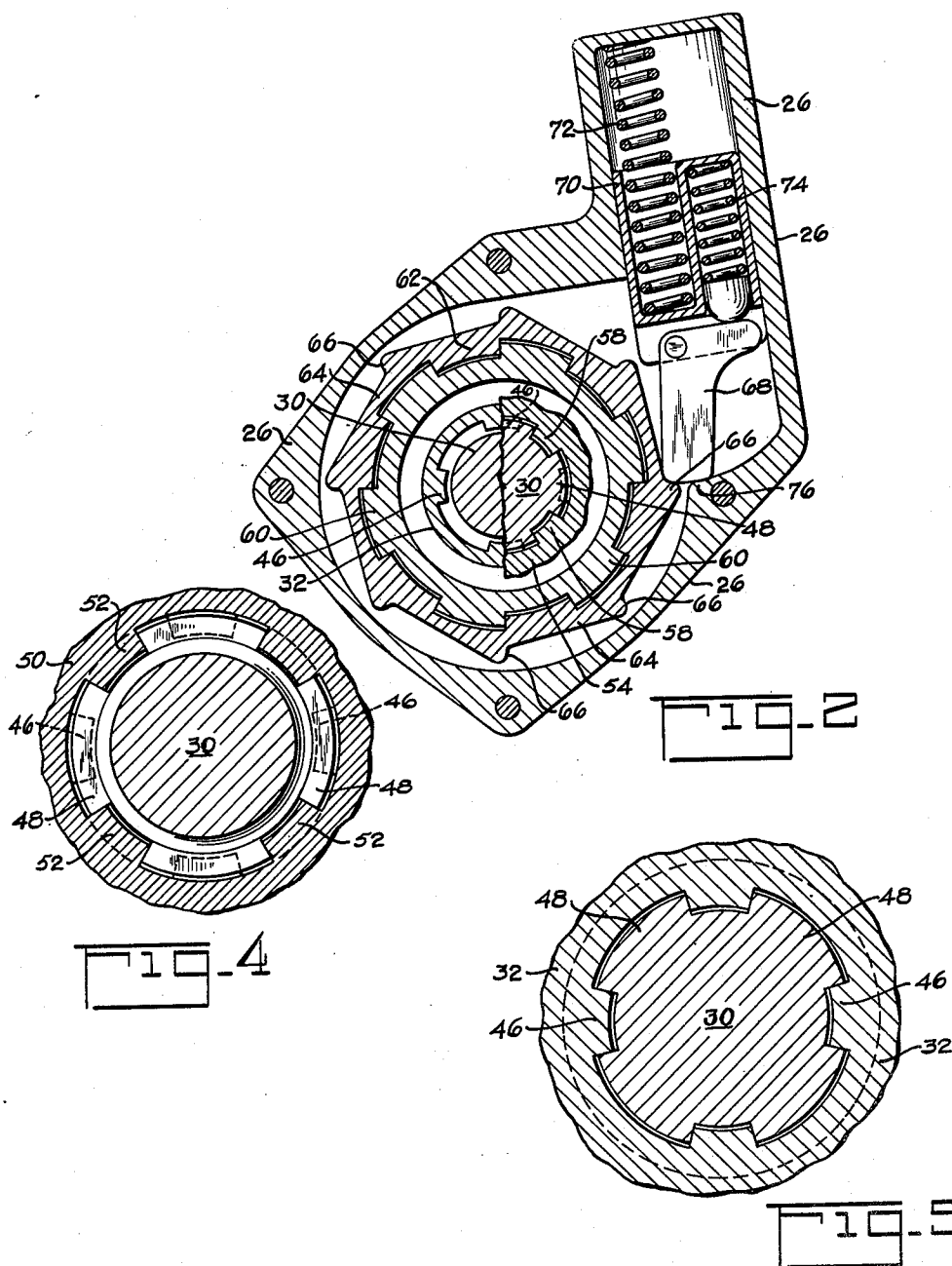
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INTERMITTENTLY OPERATED VALVE
TAPPET

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2 Claims. (Cl. 74-127)

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This invention relates to valve operating mechanisms and is particularly directed to such mechanisms for operating the valves of a four-stroke cycle internal combustion engine.

In a four-stroke cycle internal combustion engine, each engine intake and exhaust valve is operated once every two revolutions of the crankshaft. In the prior art constructions, the valves are operated by mechanism including cam means or other rotatable means driven by the engine at half the crankshaft speed. That is, in these prior art constructions, the valve operating cams or other rotatable means are driven at half engine speed in order to operate the valves once every two revolutions of the engine. It is an object of this invention to provide a novel and simple valve operating mechanism in which the valve operating cam or cams or other rotatable means are driven at engine speed and the valve operating mechanism is so arranged that the valves are only operated once every two crankshaft revolutions. With this construction, the special cam shafts and cam drives of the prior art, made necessary because of the difference between the engine and cam speeds, are eliminated. This feature is particularly important in aircraft engines because of the resulting saving in weight.

Other objects of this invention will become apparent upon reading the annexed detailed description in connection with the drawing in which:

Figure 1 is a sectional view through a portion of an internal combustion engine embodying the valve operating mechanism of the invention;

Figure 2 is a sectional view along line 2-2 of Figure 1;

Figure 3 is a sectional view along line 3-3 of Figure 1;

Figure 4 is an enlarged sectional view along line 4-4 of Figure 1; and

Figure 5 is an enlarged sectional view illustrating the valve tappet members with their splines in sliding engagement.

Referring to the drawing, an engine cylinder of a four-stroke cycle internal combustion engine, illustrated in part at 10, is provided with a valve 12 to be operated once every two revolutions of the engine crankshaft. The valve 12 is provided with a valve spring 14 for urging the valve in a closing direction. A rocker member 16, pivotally mounted in a cylinder head rocker box 18, has one arm engaging the stem of the valve 12 and has its other arm operatively engaging a push rod 20. A cylindrical housing 22 is disposed about the push rod 20 between the rocker box 18 and the

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engine crankcase 24. The engine crankcase is provided with a hollow member 26 to which the housing 22 is secured in the usual manner.

The lower end of the push rod 20 is received in a spherical seat 28 of a valve tappet comprising telescopic members 30 and 32. For convenience, the tappet members 30 and 32 are referred to as the upper and lower tappet members respectively. The lower tappet member 32 is provided with a cam follower roller 34 disposed in engagement with a rotatable cam member 36 driven by the engine in the direction indicated in Figure 3. The cam member 36 is provided with a cam lobe for actuating the valve tappet once each crankshaft revolution. The valve tappet is slidably mounted in a guide 40 secured to the engine crankcase 24. The guide 40 extends downwardly about the roller 34 and is provided with slots 42 through which the roller projects thereby preventing rotation of the valve tappet member 32 relative to the guide 40 and engine crankcase. The valve tappet members 30 and 32 are urged apart by a spring 44 to take up the clearance in the valve operating mechanism and to maintain the cam follower roller 34 in contact with its cam.

The valve tappet member 32 is provided with internal axial splines 46 adapted to slide between external axial splines 48 on the valve tappet member 30 when the splines 46 are alined with the spaces between splines 48 as illustrated in Figure 5. In addition, a member 50, rigidly carried by the member 26 and engine crankcase 24, is provided with axial splines 52 between which the axial splines 48 are arranged to slide as soon as the upper tappet member 30 moves upwardly from its downward or valve closed position illustrated in Figure 1. In this way, as soon as the tappet member 30 is raised from its retracted position, rotation of the tappet member 30 is prevented by meshing engagement of the axial splines 48 and 52. Also provided is a member 53 to act as a guide or pilot for the upper tappet member 30.

The lower tappet member 32 is provided with an annular member 54 secured thereto against axial movement by a snap ring 56. The member 54 is free to rotate relative to the tappet member 32 and is provided with axial splines 58 disposed in meshing engagement with the splines 48 of the upper tappet member 30 thereby preventing relative rotation between the annular member 54 and the tappet member 30. The annular member 54 is also provided with external helical splines 60 engaged with internal helical splines 62 on a ratchet wheel 64. The ratchet wheel

64 is provided with ratchet teeth 66, the number of the teeth 66 being equal to twice the number of the splines 48.

A pawl 68 is engageable with the ratchet teeth 66 to inhibit counterclockwise rotation of the ratchet wheel 64 as viewed in Figure 2. The pawl 68 is pivotally mounted on a member 70 slidably carried within a recess in the member 26 and urged outwardly by a spring 72. In addition, a spring 74 acts on the pawl 68 for rotating the pawl 68 into engagement with the ratchet wheel 64. The orientation of the helical splines 62 is such that axial upward motion of the annular member 54 effects clockwise rotation of the ratchet wheel 64 as viewed in Figure 2 and downward axial movement of the member effects counterclockwise rotation of the ratchet wheel 64.

With the aforescribed construction, and with the tappet members having the relative rotative positions illustrated in Figure 2, when the cam lobe 38 actuates or raises the tappet member 32, the upper ends of the splines 46 abut against the lower ends of the splines 48 whereby the upper tappet member 30 is raised and the valve 12 is opened. As soon as the tappet member 30 is raised slightly, the splines 48 engage between the splines 52 to prevent rotation of the tappet member 30 and annular member 54. The resulting upward axial motion of the annular member 54 effects clockwise rotation of the ratchet wheel 64.

The lead of the helical splines 62 is so chosen that, when the tappet is raised to its maximum extent by a cam lobe 38, the ratchet wheel 64 has been rotated one tooth whereby the pawl 68 rides over and engages the next tooth 66. Then, when the cam lobe 38 moves beyond the cam follower roller 34, the tappet returns to its lowered or retracted position. During this return movement, the downward axial movement of the annular member 54 now forces the ratchet wheel 64 to rotate counterclockwise thereby compressing and storing energy in the spring 72 at the same time the spring 74 maintains the pawl 68 in engagement with the particular tooth 66 engaged during this return movement of the tappet.

At the end of the return movement of the tappet, the splines 48 and 52 disengage, thereby freeing the upper tappet member 30 for rotation whereupon the spring 72 through the pawl 68 rotates the ratchet wheel 64, annular member 54 and upper tappet member 30 through an arc corresponding to one ratchet tooth—that is, through an angle equal to 360° divided by the number of ratchet teeth 66. A shoulder 76 limits the extent to which the pawl 68 and spring 72 can rotate the ratchet wheel. Since the number of splines 48 is only equal to one-half the number of ratchet teeth 66, this rotation of the upper tappet member 30 relative to the lower tappet member 32 brings the splines 48 into alinement with the spaces between the splines 46. Accordingly, the next time the cam lobe 38 raises or actuates the cam follower roller 34, the tappet member 32 is raised, but its splines 46 now slide between the splines 48 so that the upper tappet member 30 is not raised and the valve 12 remains closed.

During this second tappet actuation, the meshing engagement of the splines 46 and 48 locks the tappet member 30 and annular member 54 against rotation. Also, the annular member 54 is forced axially upward by the now abutting engagement of the splines 46 and 52. Therefore, as before, the ratchet wheel 64 is forced to ro-

tate clockwise through an angle corresponding to one ratchet tooth whereupon the pawl 68 rides over and engages the next ratchet tooth 66. Then, upon the return or downward stroke of the tappet member 32, the ratchet wheel 64 rotates counterclockwise thereby compressing the spring 72. Upon completion of this return stroke, the splines 46 and 48 move out of meshing engagement whereupon the spring 72 again rotates the tappet member 30, annular member 54 and ratchet wheel 64 through an angle corresponding to one ratchet tooth whereby the splines 46 and 48 are again alined. Upon the next tappet actuation, the splines 46 abut the splines 48 whereupon the valve 12 is again opened.

The aforescribed structure provides a relatively simple and novel tappet construction in which its associated valve is only operated every other time that the valve tappet is actuated. With this arrangement, it is possible to drive the valve cams at engine speed and have the engine valves operate only once every two revolutions of the engine. Also, it may be desirable in other applications to make the number of ratchet teeth 66 equal to, for example, three or four times the number of splines 46 whereby the tappet must be actuated three or four times respectively for each operation of the valve or other member to be reciprocated. In this way, the tappet can be arranged so that n operations of the tappet take place for each forward and return movement of the member to be operated, where n is any whole number equal to the number of ratchet teeth 66 divided by the number of splines 46. As a further modification, instead of actuating the tappet member 32 by the rotatable cam member 38, it is also within the scope of this invention to actuate the tappet member 32 by other means—for example, in an engine valve application, by a conventional eccentric driven at engine speed.

While I have described my invention in detail in its present preferred embodiment, it will be obvious to those skilled in the art, after understanding my invention, that various changes and modifications may be made therein without departing from the spirit or scope thereof. I aim in the appended claims to cover all such modifications.

I claim as my invention:

1. Mechanism for operating a first member, said mechanism comprising second and third members, means for extending and retracting said second member, said second and third members having means so arranged that in one rotative position of said third member said means abut each other so that extension and retraction of said second member results in extension and retraction of said third member for operating said first member, and in another rotative position of said third member said means are arranged to pass each other whereupon extension and retraction of said second member is inoperative to effect a corresponding operation of said third member for operating said first member, and means operative to effect rotation of said third member upon each extension and retraction of said second member, said last-mentioned means comprising means for preventing rotation of said third member except in its retracted position, an annular member axially movable with and rotatable relative to said second member and rotatable with and axially movable relative to said third member, and a ratchet wheel, said

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annular member and ratchet wheel having means including engaging helical splines arranged to effect a predetermined rotation of said third member after each extension and retraction of said second member.

2. Mechanism for extending and retracting a first member; said mechanism comprising a second member; means for extending and retracting said second member; said members being relatively rotatable so that in one relative position of said members extension and retraction of said second member is operative to effect a corresponding movement of said first member and in another relative position of said members extension and retraction of said second member is inoperative to effect a corresponding movement of said first member; means operative to prevent relative rotation of said members during extension and retraction of said second members and to permit said relative rotation upon complete retraction of said second member; and means for relatively rotating said members from one of said relative positions to the others; said last named means comprising a ratchet member having helical splines, a spring, a pawl intercon-

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necting said spring and ratchet member, and means carried by said second member and engaging said helical splines for rotating said ratchet member during extension and retraction of said second member such that during extension of said second member said ratchet member moves relative to said pawl and during retraction of said second member said ratchet member moves said pawl against said spring and upon completion of said retraction said spring effects relative movement of said members from one of said positions to the other.

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