Oct. 21, 1941. V. I. MONCRIEFF 2,259,905

VALVE TAPPET

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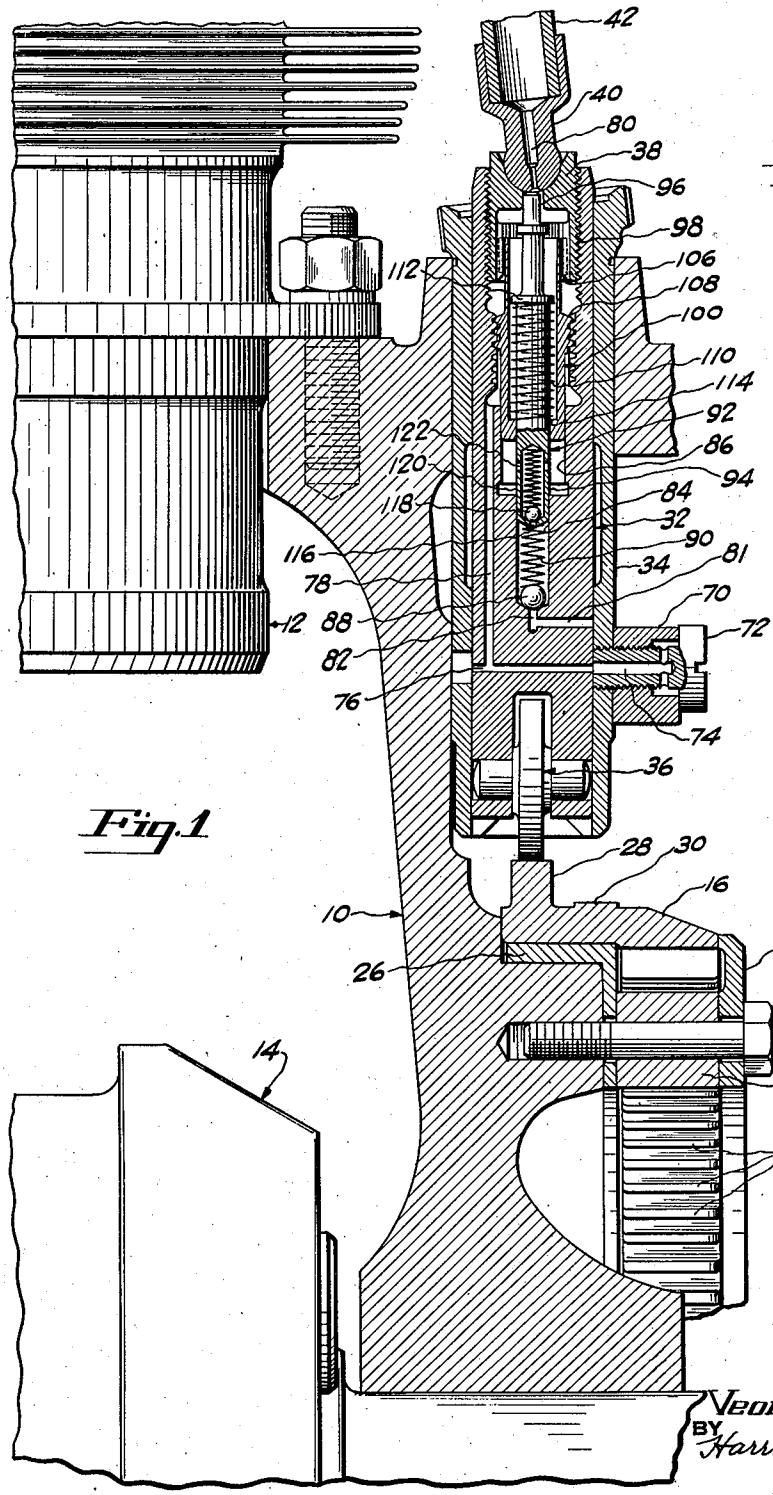
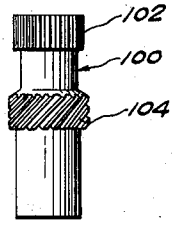


Fig. 1

Fig. 4.



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Fig. 2

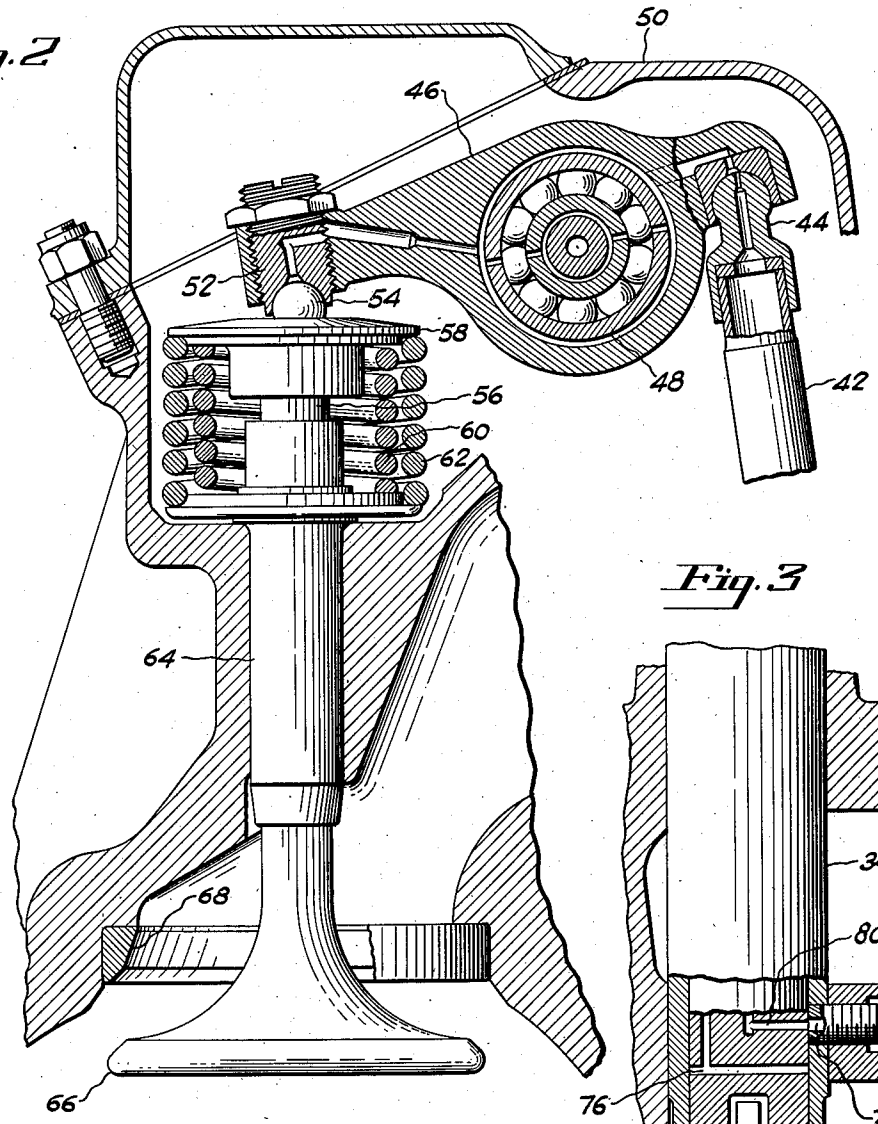


Fig. 3

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VALVE TAPPET

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9 Claims. (Cl. 123—90)

This invention relates to improvements in valve operating mechanisms and has particular reference to an improved valve tappet including hydraulic means for adjusting the operating mechanism to eliminate clearance between the different elements thereof.

An object of the invention resides in the provision of an improved hydraulic adjusting mechanism for a valve tappet in which the valve operating forces transmitted through the tappet are not carried by the hydraulic fluid used to adjust the tappet but instead, are transmitted through metal screw threads of relatively low pitch whereby the action of the tappet itself is positive and the hydraulic fluid serves only to adjust the tappet to take up clearance in the valve actuating mechanism.

A further object resides in the provision of an improved valve operating mechanism including an automatic tappet adjusting mechanism which functions to maintain the valve operating mechanism tight at all times during operation but which is not capable of itself of exerting a force which would open the valve or tend to maintain the valve open when the operating mechanism is in valve closing position.

A still further object resides in the provision of an improved hydraulic adjusting device for the operating gear of an engine valve so constructed and arranged that looseness or clearance in the valve gear is gradually compensated during the initial period of engine operation and the adjustment is thereafter continuously maintained during the operating period rather than making a new adjustment for each operation of the valve gear.

Other objects and advantages will be more particularly pointed out hereinafter or will become apparent as the description proceeds.

In the accompanying drawings, in which like reference numerals are used to designate similar parts throughout, there is illustrated a typical engine valve and valve actuating mechanism and an actuating mechanism adjusting device for substantially eliminating clearance between the various elements of the valve actuating mechanism during engine operation. The drawings, however, are for the purpose of illustration only and are not to be taken as limiting the invention since it will be apparent to those skilled in the art that various changes in the illustrated construction may be resorted to without in any way exceeding the scope of the invention.

In the accompanying drawings, Fig. 1 is a sectional view of a fragmentary portion of an engine and engine valve operating gear showing the valve gear adjusting mechanism of the invention applied thereto.

Fig. 2 is a sectional view of a different fragmentary portion of an engine showing an engine valve and the portion of the valve actuating mechanism directly associated therewith.

Fig. 3 is a view of the adjusting mechanism shown in Fig. 1 showing the mechanism in a different operative position from that illustrated in Fig. 1, and

Fig. 4 is an elevational view of one of the elements of the adjusting mechanism shown in Fig. 1.

Referring to the drawings in detail and particularly to Fig. 1, the numeral 10 generally indicates the engine crankcase which carries one or more cylinders 12 and a rotatable crankshaft 14 connected to pistons reciprocable in the cylinders by conventional connecting rods or link rods, not illustrated. A rotatable valve cam 16 is retained on the crankcase surrounding or adjacent to the crankshaft 14 by suitable means such as the bolt 18, ring 20 and spacer 22 and is driven from the crankshaft by suitable means including the gear teeth 24. In a radial type of internal combustion engine, such as that illustrated, the valve cam member 16 is in the form of a ring supported by a bearing 26 on a crankcase offset and is provided with two rows of valve operating cams, as indicated at 28 and 30. A tappet, generally indicated at 32, is slidably mounted in a tappet guide 34 secured in the crankcase 10 and is provided at its lower or inner end with a roller 36 which rolls on the cams of the row 28 and at its upper end with a socket member 38 which receives the ball end 40 of the push rod 42. The push rod 42 extends along the cylinder 12 and at its upper end is provided with a ball element 44, particularly illustrated in Fig. 2, which is received in a socket in one end of a valve rocker arm 46 rotatably mounted intermediate its length on the anti-friction bearing 48 secured in the rocker box 50 and carrying at its opposite end an adjustable socket 52 which receives a ball 54 bearing on the upper end of the valve stem 56. The valve stem 56 has secured upon the upper or outer end thereof a valve spring retainer 58 which cooperates with the valve springs 60 and 62 to move the valve stem through the guide 64 to bring the head 66 into closing relation with the valve seat 68. The rocker arm 46 under actuation of the push rod 42 acts to compress the springs 60 and 62 and move the head 66 away from the seat 68 to open the valve, in a manner

well known to the art. While only one valve and valve operating mechanism has been illustrated, it is well known that the conventional engine has a plurality of cylinders, two or more valves for each cylinder and an operating gear for each valve. In the engine illustrated one-half of the total number of valves may be actuated by the cams of the row 28 and the other half by the cams of the row 30, but any other arrangement may be used as may be convenient or desired.

From the above construction, it will be apparent that whenever the roller 36 rides up on one of the cams in the row 28, as is particularly illustrated in Fig. 1, the tappet 32 will be moved upwardly or outwardly in the guide 34 and will move the push rod 42 to rotate the rocker arm 46 about the bearing 48 and move the plug 52 and ball 54 in a direction to force the valve stem 56 downwardly or inwardly through the guide 60 to compress the springs 60 and 62 and open the valve, and when the roller rides down off of the cam the springs 60 and 62 will close the valve and force the push rod and valve tappet downwardly or inwardly to ride on the inter-cam track of the cam member 16, in the position particularly illustrated in Fig. 3.

As the engine operating temperature is considerably above the temperature of the atmosphere and as the metal elements of the valve operating gear have a natural coefficient of heat expansion and the length of the cylinders also changes because of the heat expansion coefficient of the cylinder material and the change of temperature from inoperative to engine operating conditions, and as it is not always possible to maintain the valve operating mechanism in exact adjustment, there is nearly always a certain amount of clearance or looseness in the valve operating mechanism which will permit a certain amount of movement of the tappet 32 before the valve begins to open. This clearance may increase or decrease as the engine warms up, the tendency in the type of engine illustrated being for the clearance to increase with temperature until it becomes relatively large, in some cases of the order of 0.060 of an inch. This large clearance occasions an objectionable amount of noise and considerable unnecessary wear of the valve parts and leakage of lubricating fluid when the valve actuating mechanism is supplied with pressure lubrication from the engine. A large number of devices have been suggested for automatically eliminating this clearance during engine operation but so far as applicant is aware these various prior art devices are subject to certain serious defects and no one of them has, up to the present, been put to any important commercial use.

It is to be understood that, while the improved automatic adjusting mechanism for the valve operating gear of an engine has been shown as applied to a radial type of engine such as is ordinarily used for the propulsion of aircraft, this arrangement is for convenience in illustration only and is merely one typical example of the application of applicant's improved mechanism and the mechanism may be applied to the valve actuating gear of any type of engine using valves actuated by slidable cam operated tappets.

In the improved construction, oil under pressure from the engine lubricating system is led through the manifold 70 to the interiors of the various tappet guides 34 by means of drilled screw plugs 72 which provide ports 74 leading from the interior of the manifold through the wall of the tappet guide. The tappet is provided with a transverse channel 76 which connects with a longitudinal channel 78 which leads the oil past the tappet adjusting mechanism to a channel 80 provided in the inner ball end 40 from which the oil flows through the hollow push rod and through channels in the upper or outer ball end 44 and in the rocker arm 46 to lubricate the valve operating mechanism all as particularly set forth in United States Patent Number 2,123,681, issued July 12, 1938, to Andrew V. D. Willgoos for Internal combustion engine-rocker arm lubrication. As is particularly shown in Fig. 1 and as is particularly set forth in the patent above referred to, the ports 74 and 76 register only when the roller 36 is moved outwardly by one of the cams 28 so that the valve actuating mechanism receives a supply of lubricant for a short period each time the mechanism is placed under load by a cam. A second transverse channel 81 in the lower portion of the tappet 32 registers with the port 74 when the tappet is in the position corresponding to that in which the roller 36 is between cams, as is particularly shown in Fig. 3. In the position of the tappets shown in Fig. 3 the channel 76 is out of registry with the port 74 and its ends are sealed by the walls of the tappet guide 34 and oil under pressure is supplied from the port 74 through the channel 81 and connecting channel 82 to a longitudinal well or bore 84 provided in the tappet at the bottom of the larger bore 86 which extends to the upper end of the tappet. A check ball 88 is urged by a compression spring 90 to seat in the inner end of the bore 84 to close the channel 82 and prevent oil from flowing out of the bore through the channel. A reciprocable plunger 92 has a hollow lower end portion 94 reciprocable in the bore 84 and a reduced upper end portion 96 passing through an aperture provided in the socket 38 and into contact with the ball end 40. The socket 38 is screw threaded into the open end of the bore 86, as indicated at 98, in such a manner that rotation of the socket relative to the tappet screw thread will adjust the distance between the cam track contacting surface of the roller 36 and the surface of the socket 38 contacting the ball end 40 to thereby close up any spaces between the socket and the push rod 42, the push rod and the rocker arm 46, or the rocker arm and the end of the valve stem 56. Surrounding the upper portion of the plunger 92 there is a tubular member 100, particularly illustrated in Fig. 4, having two sets of external splines as indicated at 102 and 104. The end splines 102 are arranged parallel to the axis of the tubular member and cooperate with internal splines 106 provided in the hollow inner portion of the socket 38. The splines 104 are spiral in form that is, arranged at an angle to the axis of the tubular member, and cooperate with corresponding spiral splines 108 provided in the interior of the tappet 32 intermediate the length of the bore 86. The lower portion of the member 100 has a substantially fluid tight fit with the lower end of the bore 86. The screw threads 98 and the splines 102 and 104 are so designed that an upward movement of the member 100 in the bore 108 toward the socket 38 will rotate the socket in a direction to screw it outwardly relative to the tappet on the threads 98, and a movement of the member 100 toward the bottom of the bore 86 will move the socket 38 inwardly relative to the tappet. While the socket may be moved inwardly and outwardly relative to the tappet it is to be noted

that the force between the socket and the tappet for opening the valve is carried by the screw thread 98 and not by the lubricating oil supplied through the channel 80. A compression spring 110 disposed between an annular shoulder 112 on the plunger 92 and an internal flange 114 at the inner end of the member 100 resiliently urges the plunger 92 outwardly with respect to the member 100 and the tappet and maintains the upper end of the plunger in contact with the adjacent surface of the ball end 40. The hollow inner end 94 of the plunger 92 is provided with a valve seat surrounding an aperture 116 closed from the inside by a check ball 118 urged into seating relation over the aperture by a coil spring 120. Ports 122 lead from the interior of the hollow end 94 into the space in the bottom of the bore 86 below the end of the tubular member 100.

The operation of the device is substantially as follows:

Assuming that there is an undesirable amount of clearance in the valve actuating mechanism when the valve is closed and the valve is closed and the roller 36 is between cams, as illustrated in Fig. 3, the plunger 92 will be forced upwardly by the spring 110 lifting the ball end 40 out of contact with the socket 38, it being assumed that the member 100 is in a predetermined limiting inward position. If the engine is operating or begins to operate, as the roller 36 rides up on a cam 28 the tappet 32 will be forced upwardly. As the strength of the spring 110 is not sufficient to compress the valve springs 60 and 62, the plunger 92 will be forced inwardly until the ball end 40 comes in contact with the surface of the socket 38. As the plunger is forced inwardly oil from the space in the wall 84 below the plunger will be forced through the aperture 116 and into the interior of the hollow end 94 forcing some oil contained in this hollow end out through the ports 122 into the space below the member 100. This oil forced into the space below the member 100 will raise the member 100 a slight amount and cause it to rotate the socket 38 outwardly on the screw threads 98. The plunger 92 will continue to operate in this manner as long as there is clearance in the valve actuating mechanism, gradually pumping oil from the bore 84 into the space below the member 100 until the socket 38 has been rotated outwardly on the screw thread 98 a sufficient amount to take up the clearance and discontinue the pumping action of the plunger. The oil pumped from the well 84 by the plunger 92 is replenished each time the channel 80 comes into registry with the port 74 in the relative position of the parts illustrated in Fig. 3. As long as the engine is operating there will be a constant supply of fluid available to maintain the member 100 in the proper position to eliminate clearance in the valve actuating mechanism but as soon as the engine stops this fluid will tend to gradually leak from the mechanism and the spring 110 will then force the member 100 inwardly of the bore 86 to its limiting inward position from which position it will automatically start to move to eliminate clearance in valve actuating mechanism when the engine is again put into operation.

The oil for lubricating the valve mechanism flows from the channel 78 into the interior of the bore 86 beyond the portion which provides the fluid tight seal with the member 100 and then flows through the spline connections 104 and 102 to fill the member 100 and the hollow interior of the inner portion of the socket 38, from where it flows through a clearance provided between the plunger end 96 and the aperture in the socket 38 to the end of the channel 80 in the ball end 40.

While a suitable mechanical embodiment for the purpose of disclosing the invention has been hereinabove described and illustrated in the accompanying drawings, it is to be understood that the invention is not limited to the particular construction so illustrated and described but that such changes in the size, shape and arrangements of the various parts may be resorted to as come within the scope of the subjoined claims.

Having now described the invention so that others skilled in the art may clearly understand the same, what it is desired to secure by Letters Patent is as follows:

1. An adjustable valve tappet comprising, a cam actuated reciprocable portion, an adjustable abutment screw threaded into one end of said reciprocable portion on low pitch irreversible screw threads, fluid pressure actuated means for rotating said abutment relative to said reciprocable portion to adjust the length of said tappet, and means operative only when the length of said tappet is insufficient for applying fluid pressure to said pressure actuated means.

2. An adjustable valve tappet comprising, a hollow reciprocable member, an adjustable abutment screw threaded into one end of said reciprocable member, a fluid pressure actuated element for adjusting said abutment relative to said reciprocable member, and a pump carried by said reciprocable member and having an actuating portion extending through said abutment for applying fluid pressure to said pressure actuated element.

3. In an engine valve actuating mechanism including a cam, and a tappet movable by said cam, means for automatically eliminating clearance between said tappet and the valve comprising, an abutment adjustably threaded into said tappet, a fluid pressure device carried by said tappet for rotating said abutment to adjust the same relative to said tappet, and a pump also carried by said tappet operated by relative movement between said tappet and said valve when clearance exists between said tappet and said valve to apply fluid pressure to said abutment adjusting member.

4. In an engine valve actuating mechanism including a cam, a tappet movable by said cam, and a push rod movable by said tappet, means for automatically eliminating clearance between said tappet and said valve comprising, an abutment adjustably threaded into said tappet, a fluid pressure actuated member for rotating said abutment to adjust the same relative to said tappet, and a pump operative by relative movement of said tappet and said push rod when clearance exists between said tappet and said valve to apply fluid pressure to said abutment adjusting member.

5. In a valve actuating mechanism including a cam, a tappet actuated by said cam, and means for transferring the movements of said tappet to said valve adjustable relative to said tappet to change the effective length of said tappet, means for adjusting the length of said tappet between said cam and said movement transferring means comprising, fluid pressure actuated means operatively connected with said movement transferring means for changing the effective length of said tappet, and a pump operative only when the length of said tappet is insufficient for ap-

plying fluid pressure to said pressure actuated means.

6. In a valve actuating mechanism including a cam, a tappet actuated by said cam, means for transferring the movements of said tappet to said valve, and means for supplying lubricating oil to said tappet, fluid pressure actuated means for adjusting the effective length of said tappet, and a pump connected with said lubricating oil supply only at predetermined positions of said tappet operative only when the effective length of said tappet is insufficient to apply fluid pressure to said pressure actuated means.

7. In a valve actuating mechanism including a cam, a tappet actuated by said cam, means for transferring the movements of said tappet to said valve, and means for supplying lubricating oil to said tappet, fluid pressure actuated means for adjusting the effective length of said tappet, and a pump connected with said lubricating oil supply only at predetermined positions of said tappet operative only when the effective length of said tappet is insufficient, to apply fluid pressure to said pressure actuated means, and a channel in said tappet connected with said lubricating oil supply only at predetermined positions of said tappet other than said above mentioned predetermined positions for supplying lubricating oil to said movement transferring means.

8. In combination with an engine valve gear including a valve, a valve spring, a push rod operatively connected with said valve, a tappet, and a cam for moving said tappet, means for automatically adjusting the effective length of said tappet to eliminate clearance in said valve gear comprising, an abutment for said push rod screw threaded into the outer end of said tappet, a fluid pressure actuated element for turning said abutment on said screw threads to eliminate clearance in said valve gear, and a fluid pump for applying fluid pressure to said pressure actuated element said pump having an actuating plunger extending through said abutment into contact with said push rod and a spring acting on said stem to urge said push rod away from said tappet said spring having less strength than said valve spring whereby said pump will be operated during operation of said valve gear with clearance between the parts thereof.

9. In a valve actuating mechanism including a cam, a tappet actuated by said cam, and means including a push rod for transferring the movements of said tappet to said valve, means for adjusting the length of said tappet between said cam and said push rod comprising, fluid pressure actuated means for changing the effective length of said tappet, resilient means for separating said tappet and push rod when not under load, and a pump operated by relative movement between said tappet and said push rod for applying fluid pressure to said pressure actuated means.

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