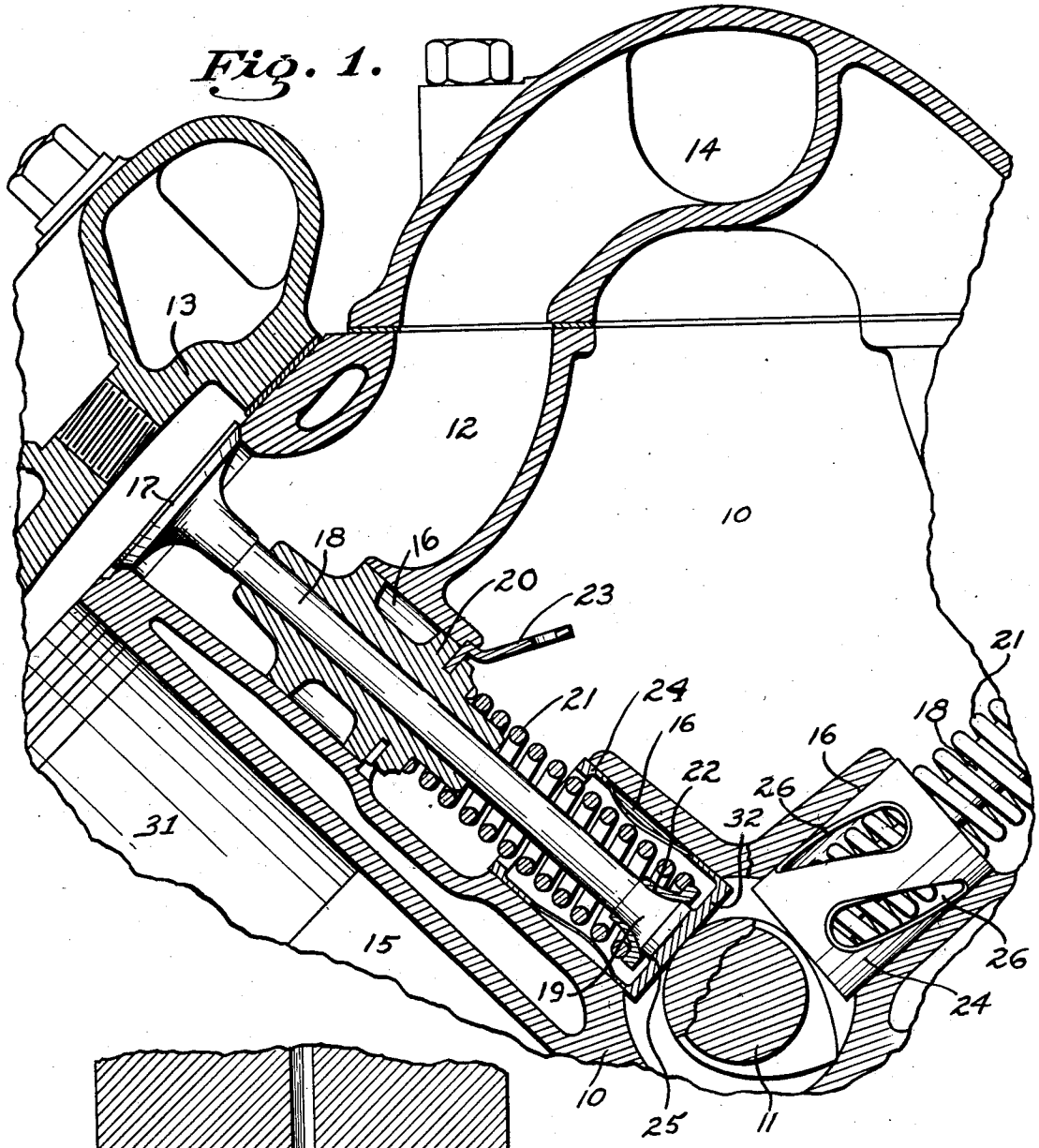
April 23, 1935. H. FORD 1,998,612

VALVE TAPPET

Filed March 3, 1933

Fig. 1.



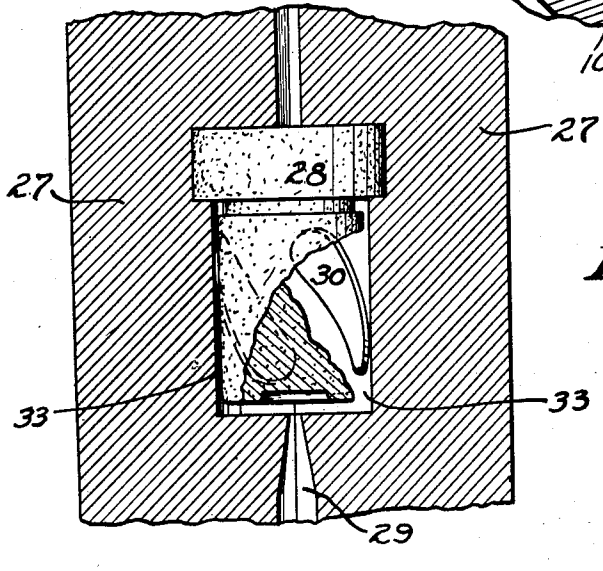


Fig. 2.

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VALVE TAPPET

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1 Claim. (Cl. 123—90)

The object of my invention is to provide an engine having a valve tappet of simple, durable and inexpensive construction.

Still a further object of my invention is to provide a valve tappet which will be exceptionally light in weight so as to minimize the reciprocating weight of the valve assembly and thus either permit higher operating speeds or permit a reduction in the size of the valve spring required.

More particularly, my invention comprises a cylindrical tappet which is reciprocally mounted in an engine cylinder block adjacent to the engine cam shaft and which absorbs the side thrust incidental to the action of the individual cam upon the valve tappet. The valve is directly operated by this tappet to thus eliminate all side thrust from the valve stem. Further, my improved valve is formed as a chilled casting and is provided with a plurality of cored openings therethrough, which openings are elongated and extend spirally around the tappets. The purpose of providing such spiral openings is so that the circumference of the tappet may be finished on a centerless grinder, whereas if openings of another shape were provided the tappet could not be centerless ground.

A further result attributable to such spiral openings is that the valve tappet wears uniformly around its periphery and further wears the bearing opening in the cylinder block uniformly to thus insure that the tappet may freely rotate at all times.

Further, such spiral openings distribute lubricating oil around the full periphery of the tappet to thus insure long life for the engine under most unfavorable operating conditions.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claim, and illustrated in the accompanying drawing, in which:

Figure 1 shows a transverse sectional view through the valve chamber of a V-type engine having my improved valve tappets incorporated therein, and

Figure 2 shows a transverse sectional view through a mold used to form my improved valve tappet.

Referring to the accompanying drawing, I have used the reference numeral 10 to indicate generally the cylinder block of a V-type internal combustion engine. A cam shaft 11 is rotatably mounted lengthwise through the cylinder block in the conventional manner, this shaft being located in the angle between the two rows of cylinders.

A plurality of intake and exhaust ports 12 are cast in the cylinder block, these ports communicating with ducts formed in a manifold 14. These ports also communicate with combustion chambers which are formed by means of cylinder heads 13. The combined manifold and cover plate 14 forms a closure for the space between the cylinder blocks of the engine and also forms the intake manifold for the engine. A plurality of cylindrical bores 15 are provided in the cylinder block 10 in which pistons 31 are mounted in this conventional manner. A plurality of valve bores 16 are disposed parallel to the cylinder bores 15, the axes of the valve bores 16 intersecting the axis of the cam shaft 11. My improved valve tappets are adapted to be reciprocally mounted in the bores 16 adjacent to the respective cams on the cam shaft so as to be reciprocated thereby.

The valve used with this construction consists of a valve head member 17 which is formed integrally with one end of a valve stem 18, which stem has a somewhat enlarged foot 19 formed on the other end thereof. An axially split bushing 20 is slidably clamped around the valve stem 18, this bushing being readily insertable into the bore 16 so as to reciprocally mount the valve stem in its proper position. A valve spring 21 extends between the lower end of the bushing 20 and a U shaped washer 22 which is secured on the foot 19, and the bushing 20 is prevented from axial movement in the bore 16 by means of the U shaped clip 23.

To insert this valve assembly in the engine, the bushing 20 is first clamped around the valve stem and then the spring 21 and U shaped washer 22 are installed in position. The whole assembly is then pushed downwardly into its particular bore 16 in the block 10 and a suitable tool is provided for forcing the bushing downwardly against the pressure of the spring 21 so that the clip 23 may be inserted in place. The spring pressure then maintains this bushing in position to retain the assembly in position.

My improved valve tappet is adapted to be reciprocally mounted in the bore 16 adjacent to the cam shaft to thus reciprocate the valve stem foot. The tappet comprises a cylindrical member 24 of substantially the same diameter as the bore 16, which cylindrical member is cast with relatively light side walls and with a somewhat heavier head 32 cast integrally with the end adjacent to the cam shaft. The valve stem, spring

and foot extend down into the cylinder **24** and abut the head **32**. It will be noted that a boss **25** is cast upon the inside of the head **32**, which boss is machined in relation to the exterior face of the head to a predetermined dimension to thus maintain a fixed predetermined length for the valve stem.

Referring to Figure 1 of the drawing, it will be seen that the cylindrical portion **24** of each tappet is provided with a plurality of spirally extending elongated openings **26** therein, the angular lead of each opening being such that an axial line drawn from end to end at any place around the periphery will pass through one of the spiral openings. Consequently, the bearing lengths from all points at one end of the tappet to corresponding points at the other end will be the same. This result is very important both in the manufacture and in the operation of the tappet.

A feature of great importance in connection with this device is the means whereby an extremely light weight construction for this tappet is possible, while at the same time providing a device which may be commercially manufactured and which will give satisfactory service. It is well known that in internal combustion engine construction the valve reciprocating parts should be as light in weight as possible. As the speed of the engine is increased the work to be done by the valve springs in returning the valves and tappets so as to follow the operating cam proportionally increases.

In fact, the top speed for most engines is governed by the valve springs and is that speed at which the valves no longer follow the cam lobes upon their downward stroke. If the exhaust valve remains open after the exhaust stroke has been completed then the succeeding, or intake stroke, draws in exhaust gas in varying proportions to reduce the mean effective pressure of the engine. Heavier valve springs may be provided but such springs require increasing power to operate same and thus reduce the output of the engine. At ordinary engine speed only a very small percentage of the effort required to compress the valve springs is returned to the cam shaft, due to the inertia of the valves and tappets.

An example of the importance of reducing the weight of the valve reciprocating parts is brought out by the fact that Figure 1 of the drawing is a full-sized sectional view through an eight cylinder automobile engine which develops 75 H. P. at 3200 R. P. M. The tappets **24** shown herein are apertured at **26**, as described for the primary purpose of lightening the weight of the tappets. Even though the side wall thickness of the tappet is exceptionally thin still sufficient metal is removed by reason of these spirally formed openings that the pressure of the springs may be reduced six pounds without decreasing the engine top speed from that which would be required if the openings were not provided in the tappet. This reduction of six pounds pressure directly results in an increase of 2.3 horsepower in the output of this engine, slightly over one and one-half horsepower being a result of the reduced power required to operate the valve springs and the remaining increase resulting from the reduced friction upon the cam shaft bearings and cams. Longer life for the reciprocating parts further results.

Although openings of any shape will reduce the weight of the valve still spiral openings, as described, are required for the following reasons. It is required that the valve tappets be allowed to freely rotate in order that a groove may not be worn in the head of the tappet due to the action of the cam thereon. If the tappet is prevented from rotating its cam follower surface will soon be scored and thus prevent the noiseless seating of the valve. When the valve tappet is allowed to rotate freely, the whole surface of the tappet head contacts with the cam and maintains a polished surface for the cam to bear against.

In order that the valve tappets be permitted to freely rotate it is essential that the wear produced by the side thrust of the tappets be uniform over the full circumference of the tappet bearing and to produce such uniform wear the openings must extend uniformly around the periphery of the tappet.

In the applicant's device the openings **26** are so arranged that the top end of each spiral opening slightly overlaps the bottom end of the adjacent opening and consequently the wear on the full periphery of the tappet is substantially uniform to insure that the tappet bearing is maintained in a truly cylindrical shape to thus allow the tappets to freely rotate at all times.

A further advantage results from these spiral openings inasmuch as oil is sprayed from the valve chamber into the inside of the tappet and collects on the spiral edges of the openings to thereby be distributed around the full circumference of the bearing, whereas if circular openings were provided, the tappet bearing would not be directly supplied with oil around its full circumference.

Still a further advantage arises from the use of such spiral openings in that the tappet may be ground in a centerless grinding machine. The use of centerless grinding machines for finishing the cylindrical surfaces materially reduces the manufacturing cost of such objects. To use such machines, however, the object to be ground must either be cylindrical in shape or of such shape that a uniform amount of metal will be required to be removed from all points around its periphery. For example, a cylindrical body with a large opening in one side thereof could not be centerless ground to a true cylinder even though the grinding wheel was sufficiently wide to overlap the ends of the body, the reason being that more metal would be removed by the wheel adjacent to the opening than at other points around the body. The applicant's tappet is so designed that a uniform amount of metal is required to be removed from all points around its periphery to be thereby well adapted for finishing by the centerless grinding method.

A feature of great importance in connection with this tappet is that both its cam face and cylindrical periphery are extremely hard, being formed as chill mold castings, so that exceptionally long life results. Referring to Figure 2, I have illustrated the mold wherewith my improved tappet is formed. A pair of cast-iron mold blocks **27** are provided, these blocks being formed with half cylindrical shaped openings **33** therein, corresponding to the cylindrical diameter of the tappets. A sand core **28** is fixed in position between the blocks and molten iron is fed in from a suitable gate **29** in the bottom to form the chill-casting. Spiral lugs **30** are formed in the mold so that the tappets are cast with the spiral openings formed therein. The lugs **30** also bear against the periphery of the sand core **28** to thereby accurately center the core in the mold and thus insure uniform wall thickness for the

tappet. In actual practice a dozen or more tappets are cast at one time from a single pair of molds, these molds having the desired number of openings 33 therein.

Some changes may be made in the arrangement, construction, and combination of the several parts used with my improved tappet without departing from the spirit of my invention, and it is my intention to cover by my claim such changes as may reasonably be included within the scope thereof.

I claim as my invention:

A valve tappet comprising, a relatively thin walled hollow cylindrical member having an integral angular reinforcing ring formed around one end thereof and having an integral head formed over the other end thereof, said head being materially thicker than the cylinder wall, said cylindrical portion forming a reciprocating bearing surface for the tappet with the outer face of said head forming a cam follower surface therefor, the interior face of said head having an inwardly extending boss formed integrally therewith of substantially the diameter of the valve foot with which the tappet coacts, and said cylindrical portion being characterized by having four of elongated spirally extending openings therein, said openings being of such width that at least half the circumference of said cylindrical portion is occupied by the said openings and said openings having a total angular lead of substantially 360°, whereby said tappet will be materially reduced in weight and still the cylindrical bearing surface will be adapted for finishing in a centerless grinding machine, said openings extending axially substantially from said ring to said head.

HENRY FORD.