(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 160 287**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **85105161.5**

(51) Int. Cl.⁴: **F 01 L 1/24**

(22) Date of filing: **26.04.85**

(30) Priority: **03.05.84 IT 5333184 U**

(43) Date of publication of application:
06.11.85 Bulletin 85/45

(84) Designated Contracting States:
DE FR GB SE

(71) Applicant: **RIV-SKF OFFICINE DI VILLAR PEROSA S.p.A**
Via Mazzini 53
I-10123 Torino(IT)

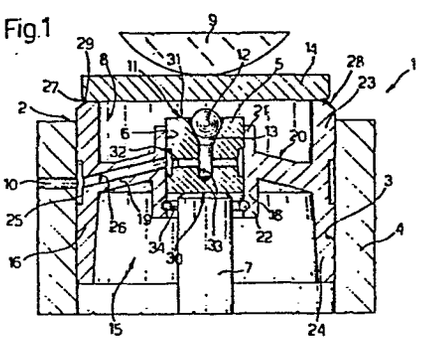
(72) Inventor: **Colanzi, Franco**
Piazza Rivoli, 6
I-10100 Torino(IT)

(74) Representative: **Prato, Roberto et al,**
c/o Ing. Carlo e Mario Torta Via Viotti 9
I-10121 Torino(IT)

(54) **Perfected hydraulic tappet with automatic slack take-up for internal combustion engines.**

(57) Tappet (1) having a pressure chamber (8) supplied by a pipe (10) having a cut-off valve (11) with a ball (12) floating in a respective truncated-cone seat (13), the said chamber (8) being defined by the upper part (23) of an outer coupling (16) forming part of a cup member (2) cooperating with a cam (9), by a lower annular wall (19) connecting the said outer coupling (16) to a corresponding integral inner coupling (18), by a plate (14) laser-welded for closing off the said upper part of the said outer coupling (16) and the said chamber (8), and by a piston (5) housed in sliding manner inside the said inner coupling (18).

Fig.1



EP 0 160 287 A2

PERFECTED HYDRAULIC TAPPET WITH AUTOMATIC SLACK TAKE-UP FOR INTERNAL COMBUSTION ENGINES

The present invention relates to a perfected hydraulic tappet with automatic slack take-up for internal combustion engines, in particular, one comprising a cup member, the latter housed in axially-sliding manner in a seat on the said engine and cooperating with a cam facing the said seat, and a piston housed in sliding manner inside the said cup member and defining with the latter a chamber filled with fluid under pressure, e.g. oil, supplied by a pipe fitted with a cut-off member.

In addition to being relatively complex in design, and therefore expensive to make, hydraulic tappets of the aforementioned type usually present a relatively small pressure chamber, the diameter of the latter being essentially equal to or only slightly larger than the diameter of the piston. Furthermore, mechanical wear due to mutual sliding of the control cam and cup member re-

sults in severe wear on the latter. Finally, on the aforementioned known types of tappets, the cut-off member, usually consisting of a ball moving in a respective sealing seat, must be provided with retaining means for securing it in the correct position and which, in addition to complicating overall design of the tappet and, consequently, increasing production cost, also occupy part of the pressure chamber, thus reducing its volume even further. In view of the aforementioned drawbacks, such known types of tappets usually provide for relatively poor operating efficiency.

The aim of the present invention is to provide a hydraulic tappet of the aforementioned type that is relatively straightforward and cheap to produce, of simple design and assembly, relatively unaffected by mechanical wear due to mutual sliding of the cam and cup member, and which provides for a high degree of efficiency and operating precision.

With this aim in view, the present invention relates to a hydraulic tappet with automatic slack take-up for internal combustion engines, the said tappet comprising a cup member housed in axially-sliding manner in a seat on the said engine and cooperating with a cam facing the said seat; a piston housed in sliding manner inside the said cup member and cooperating at the bottom with a rod having one end sliding axially inside the said seat, the said piston defining, with and inside the said cup member, a chamber designed to be filled with fluid under pressure; a supply pipe for the said fluid formed at least partly through the said cup member; and

a cut-off valve consisting of a ball housed in floating manner at least partly inside a truncated-cone seat which opens out at the top inside the said chamber and in which terminates the said pipe; characterised by the fact that the said cup member comprises : a first member, in turn, comprising an outer coupling and inner coupling, both cylindrical and formed coaxially in one piece, one inside the other, and an annular wall connecting and integral with the said couplings and arranged essentially perpendicular to the same; and a second member consisting of a cylindrical plate, the latter being made of harder material than the said first member and secured integral with the latter and facing the said annular wall for closing off the top end of the said outer coupling, and defining with the said annular wall and the said plate, the said chamber; the said piston being housed in sliding manner inside the said inner coupling with an active surface facing the said chamber for defining the latter on the said inner coupling.

Two non-limiting arrangements of the present invention will now be described with reference to the attached drawings in which :

- Fig.1 shows an elevated section of a hydraulic tappet according to the present invention;
- Fig.2 shows a similar section of a possible variation of the Fig.1 tappet.

Number 1 in Fig.1 indicates a hydraulic tappet with automatic slack take-up for any known type of internal combustion engine (not shown), the said tappet comprising a cup member 2 housed in axially-sliding manner inside

an essentially-cylindrical seat 3 formed in the block 4 on the said known type of engine (not shown); a piston 5 housed in sliding manner inside a seat 6 in cup member 2 and cooperating at the bottom with a rod 7 having a top end sliding axially in seat 3; a pressure chamber 8 defined by piston 5 and member 2, formed inside the latter and designed to be filled with pressure fluid, usually lubricating oil, for enabling mutual sliding of member 2 and piston 5 for taking up any slack between rod 7 and cam 9 facing seat 3 and cooperating with member 2; a supply pipe 10 for the said pressure fluid; and a cut-off valve 11 on pipe 10 for enabling exclusive one-way supply of the said pressure fluid along pipe 10 into chamber 8. In more detail, valve 11 comprises a ball 12 of appropriate diameter and housed floating at least partly inside a truncated-cone seat 13, the latter being arranged directly facing and communicating with chamber 8 into which it opens at the top, and being connected at the bottom to pipe 10 terminating inside it. According to the present invention, cup member 2 comprises two separate members, 14 and 15, secured integral with each other; the first defined by an essentially-flat, cylindrical plate of appropriate thickness and made from relatively hard material, e.g. by sintering hard metals; and the second defined by a load-bearing structure preferably made of steel or any other material of lower cost and hardness than the material of plate 14. In more detail, according to the present invention, member 15 comprises an essentially-cylindrical outer coupling 16 essentially equal in diameter to seat 3 inside which

coupling 16 is designed to slide; an inner coupling 18, also essentially cylindrical, fitted coaxially and concentrically inside coupling 16 and being smaller in diameter and length as compared with the same; and an annular wall 19 connecting couplings 16 and 18, formed integral with both and arranged essentially perpendicular to the axis of the same, in such a manner as to extend essentially radially and divide coupling 16 internally into two cavities, the upper cavity defining chamber 8 and the lower cavity open towards seat 3 for accommodating rod 7. In more detail, coupling 18, which is thus formed integral in one piece with wall 19 and outer coupling 16, is provided internally with seat 6 and presents essentially the same diameter and length as cylindrical piston 5 housed in sliding manner inside it. According to the arrangement shown in Fig.1, wall 19, instead of being flat, is essentially slanted so as to define an essentially conical surface 20 defining, at the bottom, the bottom of chamber 8 and joining up with coupling 18 essentially on the centre line of the latter. The opposite ends, 21 and 22, of coupling 18 thus project from wall 19 respectively into chamber 8 and into the said lower cavity defined inside coupling 16 by wall 19. The latter also separates coupling 16 into two opposite, cylindrical, annular ends,respectively top end 23 and bottom end 24, the latter defining laterally chamber 8 and the said lower cavity in coupling 16 respectively. The said wall 19 is also fitted internally with pipe 10, the latter comprising an annular groove 25, formed externally on coupling 16 for a length essentially equal to the dis-

tance travelled by cup member 2 inside respective seat 3, and a slanting radial hole 26 formed through wall 19 and inner coupling 18 and coming out inside seat 6 defined by the said inner coupling 18. On end 23 at the top, coupling 16 is closed off by plate 14 arranged facing wall 19 and thus defining the top of chamber 8. According to the present invention, the diameter of plate 14 is larger than the inside diameter of coupling 16 and smaller than the outside diameter of the same, i.e. the diameter of seat 3. Towards end 23, the said plate 14 presents a bevel 27 facing a respective bevel 28 formed on end 23 itself. According to the present invention, plate 14 and end 23 on coupling 16 are laser-welded together so that, at bevels 27 and 28, plate 14 is secured to end 23 by weld bead 29.

According to the present invention, the height of chamber 8 is such that the distance between truncated-cone seat 13 and plate 14 is less than the diameter of ball 12, plate 14 thus acting as a retainer for the said ball 12 which, even if housed freely inside seat 13, is thus prevented from being withdrawn from the same. According to the preferred arrangement shown in Fig.1, valve 11 is fitted directly on to piston 5, the latter consisting of a solid cylindrical body the bottom face 30 of which rests on rod 7 and the top face 31 of which is arranged facing chamber 8, in such a manner as to define the latter at coupling 18 by essentially defining a sliding wall by which the said chamber 8 is closed off. Truncated-cone seat 13 is formed on face 31, inside piston 5, and is connected to radial hole 26 by a further pair of holes,

one radial 32 and one axial 33, formed through piston 5. Coupling 18 is provided on bottom end 22 with a check ring 34 designed to act as a limit stop for piston 5. Face 31 on piston 5 defines an active surface designed to detect the pressure inside chamber 8 and so cause piston 5 to slide inside seat 6 and consequent displacement of member 2 and piston 5, which are maintained contacting cam 9 and rod 7 respectively by the pressure inside chamber 8, thus enabling recovery of any slack between cam 9 and rod 7 due to wear on tappet 1 and/or machining tolerances.

Tapper 1 operates in known manner and will be clear from the foregoing description. When the engine is started up, lubricating oil under pressure is fed along pipe 10 into seat 13 where it lifts ball 12 so as to flow into chamber 8 until the latter is full. As the said chamber 8 is being filled, the pressure exerted on the inner face of plate 14 and on the active face 31 of piston 5, as already described, causes member 2 and piston 5 to separate, thus enabling any slack to be taken up. During operation of tappet 1, chamber 8 remains full of oil, in that the latter is prevented from flowing out through seat 13 by ball 12 which is forced against seat 13 in fluidtight manner by the pressure in chamber 8, just like any other type of non-return valve. From the foregoing description and the illustration in Fig.1, chamber 8 clearly presents a considerable volume in relation to the size of piston 5. Furthermore, ball 12, being provided with no mechanical retaining means mounted inside chamber 8, reacts readily to any change in oil pressure

inside chamber 8 or pipe 10. Tappet 1 according to the present invention thus clearly provides for a high degree of reliability, fast operation and far greater efficiency as compared with known tappets. Furthermore, constructing cup member 2 in two separate parts having different mechanical characteristics and laser-welded together provides for simplifying manufacture of tappet 1, reducing cost and increasing working life by reducing wear on member 2, the said reduction in wear being provided for by cam 9 cooperating directly with plate 14 having superior mechanical characteristics as compared with the rest of member 2.

Fig.2 shows a hydraulic tappet 1a consisting of a possible variation of tappet 1 as already described. For the sake of simplicity, any details similar or identical to those already described are referred to using the same numbers. Tappet 1a differs from tappet 1 solely as to the shape of annular wall 19 defining chamber 8 at the bottom and to the position of valve 11. The latter, in fact, is fitted on to cup member 2, in that seat 13 is formed on surface 20 of wall 19, the said surface 20 being essentially flat instead of conical as on tappet 1 in Fig.1. According to the Fig.2 arrangement, therefore, pipe 10 comprises only radial hole 26 and seat 13 is formed next to outer coupling 16. End 23 on the latter is relatively short and essentially equal in length to the height of chamber 8, so that the distance between seat 13 and plate 14 is less than the diameter of ball 12, as in the case of tappet 1, thus resulting in plate 14 acting as a retaining member for the said ball 12.

For achieving a relatively large volume inside chamber 8 despite its limited height, according to the present invention, piston 5, obviously having no holes 32 or 33 as on the similar piston on tappet 1, is provided towards chamber 8 with a cavity 35 occupying most of the volume on piston 5 and defined by a surface 36, the latter being truncated-cone in shape in the non-limiting example shown and defining the active surface on piston 5 for detecting the pressure inside chamber 8. All the remaining details on tappet 1a, as well as its operation, are identical to those described in connection with tappet 1. As compared with the latter, tappet 1a is even more straightforward in design, owing to the relatively short length of pipe 10, thus resulting in even lower production cost. Tappet 1, on the other hand, has the advantage of being provided with a sealing seat on the piston, thus enabling lower production cost, should tappets for different engine types, i.e. having seats 3 of different sizes, need to be produced. If such is the case, the size of cup member 2, which is relatively cheap, is simply adapted and the same size piston 5 used on all the tappets, thus enabling obvious scale economy.

(Dr. Ing. PRATO Roberto)

CLAIMS

1) - Hydraulic tappet (1, 1a) with automatic slack take-up for internal combustion engines, the said tappet comprising a cup member (2) housed in axially-sliding manner in a seat (3) on the said engine and cooperating with a cam (9) facing the said seat; a piston (5) housed in sliding manner inside the said cup member (2) and cooperating at the bottom with a rod (7) having one end sliding axially inside the said seat (3), the said piston (5) defining, with and inside the said cup member (2), a chamber (8) designed to be filled with fluid under pressure; a supply pipe (10) for the said fluid formed at least partly through the said cup member (2); and a cut-off valve (11) consisting of a ball (12) housed in floating manner at least partly inside a truncated-cone seat (13) which opens out at the top inside the said chamber (8) and in which terminates the said pipe (10); characterised by the fact that the said cup member (2) comprises : a first member (15), in turn, comprising an outer coupling (16) and inner coupling (18), both cylindrical and formed coaxially in one piece, one inside the other, and an annular wall (19) connecting and integral with the said couplings (16, 18) and arranged essentially perpendicular to the same (16, 18); and a second member consisting of a cylindrical plate (14), the latter being made of harder material than the said first member (15) and secured integral with the latter and facing the said annular wall (19) for closing off the top end (23) of the said outer coupling (16), and defining, with the said an-

nular wall (19) and the said plate (14), the said chamber (8); the said piston (5) being housed in sliding manner inside the said inner coupling (18) with an active surface (31, 36) facing the said chamber (8) for defining the latter on the said inner coupling (18).

2) - Hydraulic tappet (1, 1a) according to Claim 1, characterised by the fact that the said plate (14) is secured to the said top end (23) of the said outer coupling (16) by means of a laser welding bead (29).

3) - Hydraulic tappet (1, 1a) according to Claim 2, characterised by the fact that the outside diameter of the said plate (14) is smaller than the outside diameter and larger than the inside diameter of the said coupling (16), and that the said outer coupling (16) and plate (14) are provided, at the joining point, with appropriate facing bevels (28, 27).

4) - Hydraulic tappet (1, 1a) according to one of the foregoing Claims, characterised by the fact that the height of the said chamber (8) is such that the distance between the said truncated-cone seat (13) and the said plate (14) is less than the diameter of the said ball (12), the said plate (14) thus acting as a retaining member for the said ball (12).

5) - Hydraulic tappet (1, 1a) according to one of the foregoing Claims, characterised by the fact that the said pipe (10) comprises an annular groove (25), formed externally on the said outer coupling (16) and of a length essentially equal to the distance travelled by the said cup member (2), and a slanting radial hole (26) formed through the said annular wall (19).

6) - Hydraulic tappet (1a) according to one of the foregoing Claims, characterised by the fact that the said truncated-cone seat (13) is formed in the said annular wall (19) defining the bottom of the said chamber (8) inside the said cup member (2), in such a manner that the said valve (11) is carried by the said cup member (2).

7) - Hydraulic tappet (1a) according to Claim 6, characterised by the fact that the said piston (5) is provided, towards the said chamber (8), with a cavity (35) defined by the said active surface (36).

8) - Hydraulic tappet (1) according to one of Claims 1 to 5, characterised by the fact that the said pipe (10) also comprises a radial hole (32) and an axial hole (33) formed through the said piston (5), and that the said truncated-cone seat (13) is formed inside the said piston (5) on the said active surface (31).

9) - Hydraulic tappet (1) according to Claim 8, characterised by the fact that the said inner coupling (18) is provided at the bottom with limit stop means (34) for the said piston (5).

(Dr. Ing. PRATO Roberto)

0160287

Fig.1

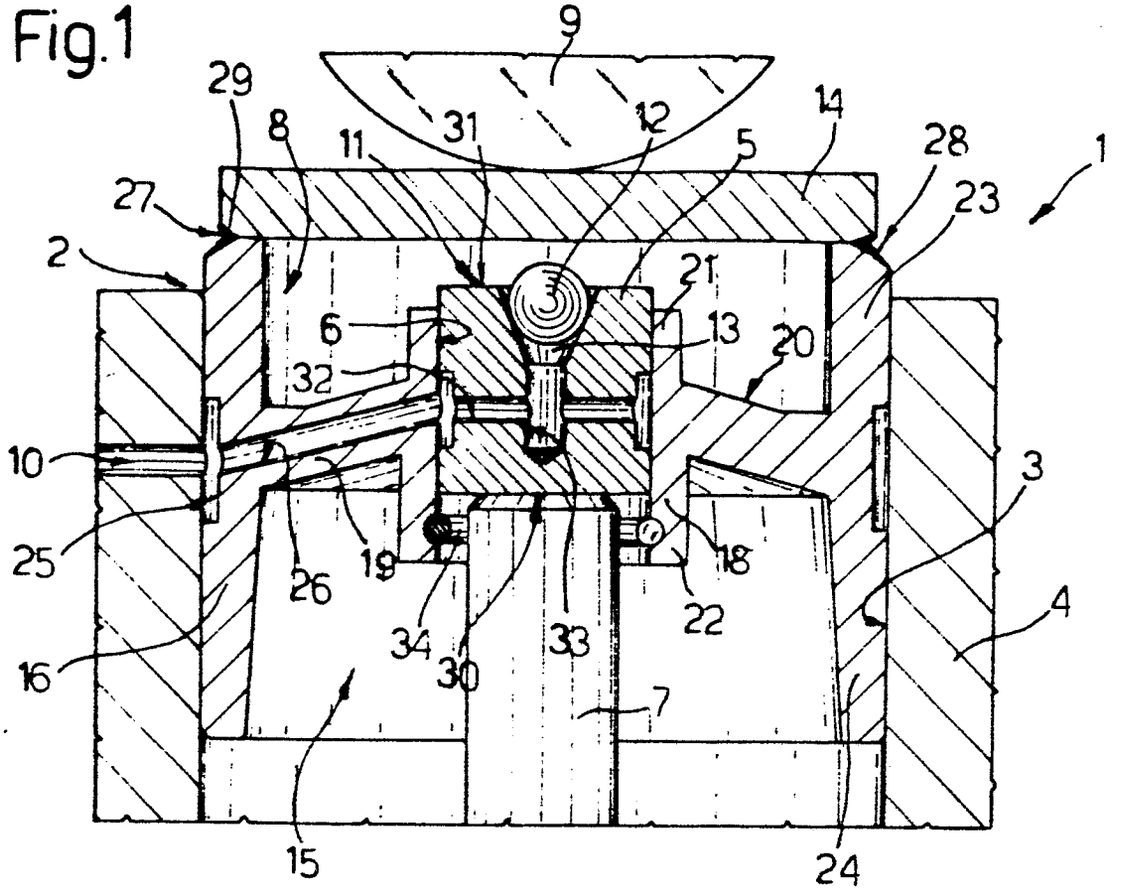


Fig.2