Oct. 19, 1937. J. L. DOSTAL 2,096,092

CAST IRON TAPPET AND METHOD OF MAKING SAME

Filed July 29, 1935

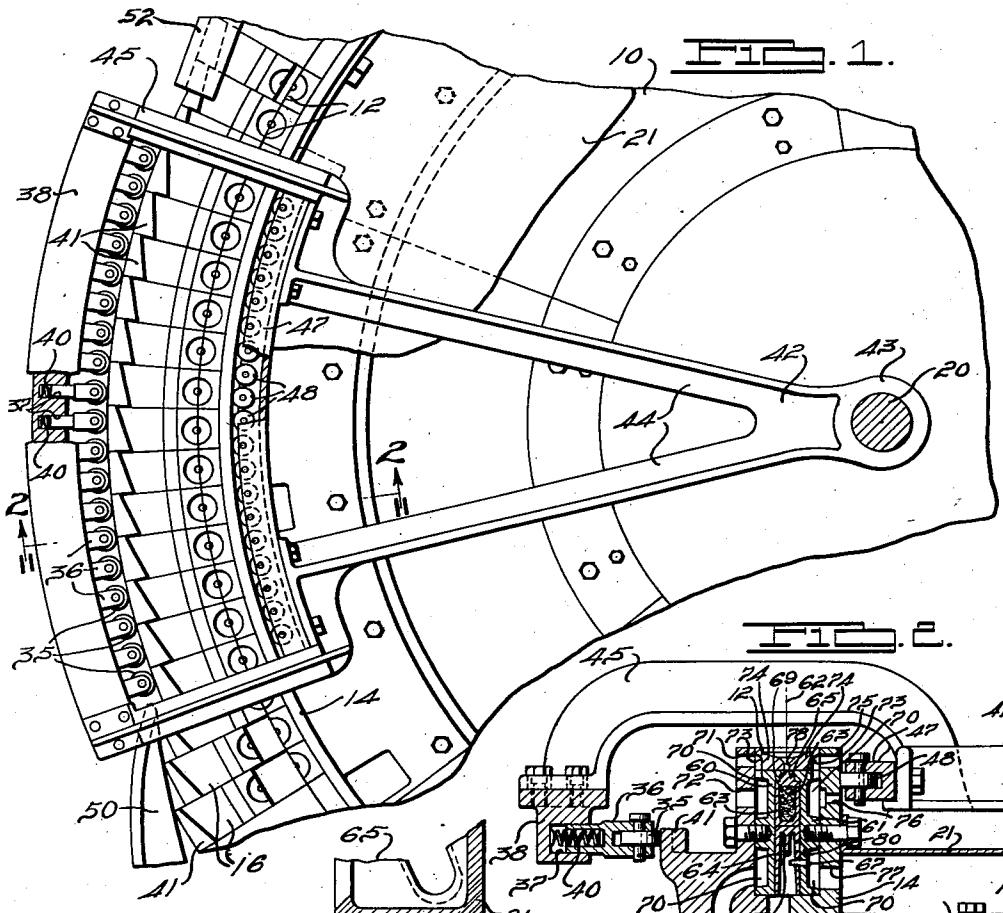


FIG. 1.

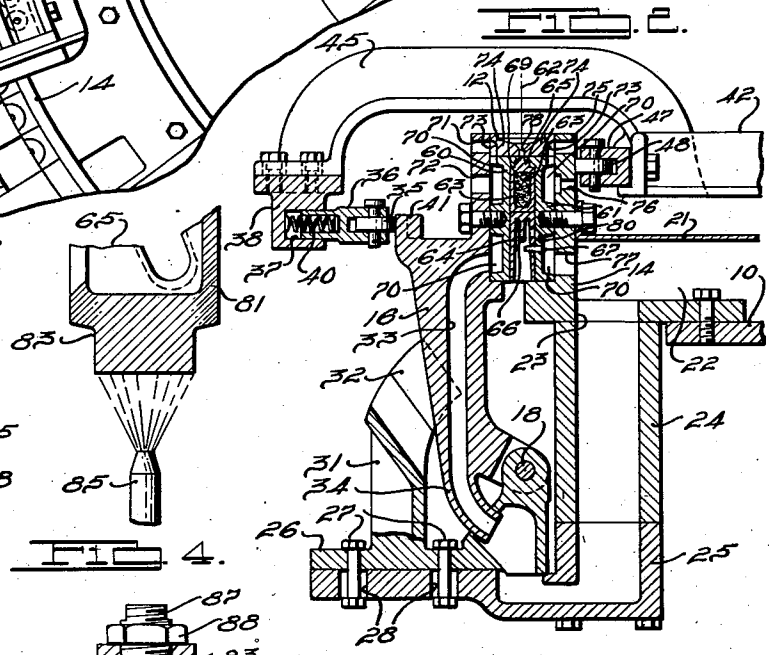


FIG. 2.

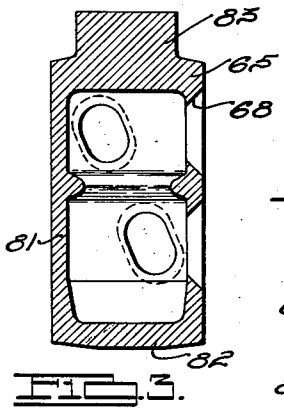


FIG. 3.

FIG. 4.

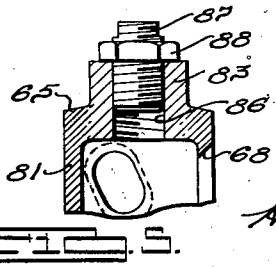


FIG. 5.

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CAST IRON TAPPET AND METHOD OF MAKING SAME

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5 Claims. (Cl. 123—90)

This invention relates to tappets for internal combustion engines and more especially to the barrel type tappet composed of chilled cast iron and to the method of making and heat treating such tappet.

The above type of tappet is preferably made by casting in a permanent molding machine provided with cooled mold sections for obtaining the desired hardness of the tappet parts by properly chilling the bearing surfaces of the tappet while casting the same and then quick annealing the top end portion of the tappet so as to render such portion more easily machinable, thus facilitating drilling and tapping such end portion for the reception of adjusting means.

The principal object of the invention is to improve the art of tappet constructions.

A further object is to provide a barrel type tappet of cast iron chilled completely through the peripheral walls thereof to obtain the desired hardness.

It is also an object of the invention to provide a tappet of the above character in which the top portion has been rendered more easily machinable than the remaining portions of the tappet so that the top end portion may more readily be drilled and tapped for the reception of tappet adjusting means.

A further object is to provide an improved method of constructing the above type of tappet.

Another object is to provide a tappet construction composed entirely of chilled cast iron except for the top or adjusting element receiving portion thereof which is of grey cast iron.

A further object of the invention is to provide an improved method of quick annealing an adjusting element receiving end portion of a tappet.

For the purpose of illustrating the genus of the invention and methods employed in effecting such invention, a typical concrete embodiment of tappet constructions and apparatus employed in making the same is shown in the accompanying drawing, in which:

Figure 1 is a fragmentary top plan of a portion of a permanent molding machine employed in fabricating a tappet according to the principles of this invention;

Fig. 2 is a fragmentary vertical section, on an enlarged scale, taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a further enlarged central vertical section of a tappet formed by the apparatus shown in Figs. 1 and 2;

Fig. 4 is a fragmentary view, similar to Fig. 3, but showing the tappet in an inverted position and over the flame of an open burner in order to depict a step in the heat treatment to which the tappet is subjected; and

Fig. 5 is a fragmentary central vertical section illustrative of the condition of the tappet after being subjected to the above indicated heat treatment step and after being machined and equipped with adjusting means.

Tappets are preferably constructed according to the principles of this invention by means of a permanent molding machine including a rotatable table 10, illustrated in Figs. 1 and 2, as carrying a plurality of molds 12. The conveyor 10 supports a stationary mold carrier 14 and swingable mold carriers 16, the latter being pivoted as indicated at 18. The table 10 is journaled for rotation with respect to a shaft 20 and may be operated from a suitable driving means, not shown. An air shield 21 is carried by the table 10 and in conjunction therewith provides a suction chamber 22 adapted to communicate with a suitable source of suction, not shown, for drawing cooling air through the molds 12. Openings 23 extend downwardly through the base portion of the stationary mold carrier 14 to provide communication between the suction chamber 22 and the interior of a trough-like partial annulus 24 open at the bottom and communicating with the interior of a plurality of headers 25. The headers 25 each carries a number of support members 26 for each of the pivots 18. Bolts 27 extending through elongated openings 28 permit the support 26 for pivots 18 to be connected to the headers 25 and adjusted so as properly to align the swingable mold carriers 16 with respect to the stationary mold carrier 14. The pivot support members 26 also carry upstanding guide members 31 each having a forked upper end 32 for guiding and bracing as well as limiting the outward swinging movement of the movable mold carriers 16. The swingable mold carriers 16 are each provided with a passage 33 extending from a mold 12 to the interior of a pivot support element 26 which communicates with the interior of a header element 25. The lower ends of the passages 33 terminate in conduits 34 curved about the axis of a pivot pin 18 as a center and projecting through suitable openings to the interior of a pivot support element 26. Cooling air is thus drawn through the molds 12, through passages 33 and curved conduits 34, through the interiors of pivot support elements 26, headers 25 and the annulus 24, and through the openings 23 to the suction chamber 22 by the suction producing means, not shown.

The molds 12 are adapted to be maintained in

closed condition at certain times during the rotation of table 10 by a circular series of rollers 35 carried by slide members 36 and arranged for reciprocation in recesses 37 provided in a holder 38, with springs 40 interposed within suitable bores in the slide members and between the slide members and the holder so that the rollers engage the outer periphery of cam contacts 41 provided adjacent the upper end of the swingable mold carriers 16. The pressure exerted by springs 40 for maintaining the swingable mold carriers 16 in closed condition is prevented from causing a lateral thrust upon the shaft 20 by a support member 42 including a bearing 43 within which the shaft is journaled, a pair of radially extending arms 44 and a bridge member 45 upon which the holder 38 is secured. The support member 42 also has fixed thereto a roller carrier 47 which pivotally supports a series of rollers 48 arranged on an arc of a circle having the axis of shaft 20 as a center. The rollers 48 bear upon the back of the stationary mold carriers 14 so that bridge member 45 carries the entire load of the springs 40 in maintaining the molds 12 in closed condition. Rotation of the table 10 in a clockwise direction, as viewed in Fig. 1, causes the cam contacts 41 on each of the swingable mold carriers 16 successively to engage a closing cam 50 so that the latter swings the mold carriers 16 inwardly toward the shaft 20 to close the molds and allow the rollers 35 and springs 37 to maintain the molds in closed condition under spring pressure. The cam contacts 41 are beveled outwardly on the inner face thereof as indicated in Fig. 1 and are adapted to engage an opening cam 52 beyond the series of rollers 35 to cause opening of the molds as the cam 52 causes outward swinging of mold carriers 16. The cams 50 and 52 are supported by or in fixed relation with respect to the support member 42.

Referring more especially to Fig. 2, the molds 12 are illustrated as comprising main mold sections 60 and 61 separable with reference to a vertical parting line 62. The main mold sections are each provided with a substantially semi-cylindrical mold cavity 63, reduced in size at one end and adapted to cooperate with the mold cavity of the other main mold section to form a tappet 65 of the general outline indicated in Figs. 3, 4, and 5. A separate mold section 64, substantially in the form of a hollow piston closed at its upper end and provided with a cooling fin 66 integral with such closed end and extending downwardly within the interior of the piston, is adapted to form the lower or cam-engaging end of the tappet 65. A guide pin 67 extending from the stationary main mold section 61 is adapted to project through an opening in the separate section 64 to determine its correct vertical elevation. A plurality of such openings may be provided in the separate section 64 to effect desired variations in the length of the tappets produced. The separate section 64, which forms the cam-engaging end of tappet 65 is hollow to form an air passage for the circulation of cooling air therethrough and the length of this separate section is made several times its diameter in order to increase the area of contact of the separate section with the cooling medium so as to obtain the desired chill and thus effect the desired hardness of the cam-engaging end of tappet 65. In this manner the production of tappets very close to the finished diameter is facilitated so that a considerable amount of grinding of the outside surfaces of the tappet is eliminated. Inwardly directed projections extending toward the center of the mold cavity from the walls of the mold impressions 63 form openings on windows 68 in the walls of tappet 65 and also serve axially to align a dry sand core 69 which produces the hollow interior of tappet 65, thus insuring diametrically correct positioning of the core 69. The correct vertical position of the core 69 may be attained by providing a pin which extends inwardly from one of the projections formed in the mold impression and cooperates with a suitable opening arranged in a predetermined position in the core 69.

The following analysis of iron has been found particularly suitable for producing an all chilled tappet; Carbon 2.75 to 3.50 percent, silicon 1.70 to 2.60 percent, manganese 0.40 to 1.10 percent, phosphorus 0.20 to 0.30 percent, sulphur 0.115 percent, and the balance iron.

The main mold sections 60 and 61 and the separate bottom section 64 are all composed of metal so that all parts of the tappets produced will be chilled entirely through the walls thereof as long as the main and separate sections of the mold are kept in a sufficiently cool condition.

The cooling of the mold 12 is effected by providing hollowed out cavities in the backs of the main mold sections 60 and 61, which cavities, in conjunction with the stationary and swingable mold section carriers 14 and 16, provide cooling passages 70. The cooling passages 70 of the swingable mold sections 60 communicate at its lower ends with the passages 33 to the swingable mold carriers 16 so as to exhaust air through the latter at all times regardless of whether the molds 12 are in open or closed condition. Cooling air is admitted to the passages 70 of the swingable main mold sections 16 through openings 71 and 72 provided in the swingable mold carriers. The air inlet passages 72 lead directly into the cooling passages 70 while the air in the passages 71 lead through hollowed out spaces 73 provided in each block of pairs of pouring blocks 74 separable along the parting line 62 and constituting two piece pouring basin at the top of the mold. Air is admitted at all times to the cooling passages 70 of the stationary main mold section 61 through air inlet passages 75 and 76 provided through the stationary mold carrier 14, the inlet passages 76 leading directly to the cooling passages 70 while the air inlet passages 75 communicate through passages 73 in the other pouring blocks 74 and then to the cooling passages 70. Air is exhausted from the cooling passages 70 of the stationary main mold sections 61 through passages 77 leading directly from the cooling passages 70 to the suction chamber 22 of the cooling system. The pouring blocks 74 are provided centrally with cooperable recesses forming a gate 78 adapted to serve as a sprue and gate for pouring the casting. Air is admitted through the open ends of the hollow piston-like separate mold sections 64 and drawn upwardly so as to wipe the cooling fins 66 and then through passages 80 provided through the walls of the separate mold sections 64 and through the stationary mold sections 61 to the cooling passages 70 thereof, and then exhausted through the passages 77 to the suction chamber 22 of the cooling system. The mold surfaces of the main mold sections 60 and 61 are preferably treated with a thin refractory facing and sooted in the manner disclosed in the Maloche Patents 1,453,593 and 1,492,694.

Reference may now be had to Figure 3, which discloses the tappet 65 as formed by the casting apparatus illustrated in Figures 1 and 2. The

tappet 65 comprises a cylindrical body portion 81 having an integral end closure 82 constituting the cam-engaging end of the tappet and an integral end closure 83 constituting the head end which may, if desired, be drilled and threaded to constitute the adjustment receiving end of the tappet. As previously indicated, the tappet is provided with windows 68 for the purpose of lightening the tappet, permitting circulation of air through the interior of the tappet, and for clearing the interior of the tappet of oil which may be forced therein. To clear the tappet of oil, the windows 68 are provided with outwardly beveled margins as indicated in Figure 3, which will tend to cause a radially outward movement of oil or oil vapor contained within the interior of the tappet and will trap oil at the bottom margins of the windows so as to lubricate the periphery of the tappet and the bore of the tappet guide, as well as permitting a certain amount of oil to drip from the packets at the bottom margins of the windows and follow the outside surface of the tappet to lubricate the cam engaging end thereof. The cylindrical portion 81 of tappet 65 and the cam engaging portion 82 are of comparatively thin metal sections and since they are formed by casting within a cooled metal mold, these metal sections will be chilled completely through to the hollow interior of the tappet. The tappet composed of the iron of the analysis above described will be hardened upon chilling as it is cast so that the tappet will have the desired hardness and wearing qualities to adapt it for the purpose intended. The separate section 64 of the mold, due to the extensive interior surface area and the area of the cooling fin 66, all of which areas are wiped by the cooling air, or other desired cooling medium, receives a somewhat greater chill and is hardened to a greater extent than the peripheral wall portion 81. The end closure 83 also receives a chill since this is in contact with the metal of the main mold sections 60 and 61 and receives a sufficient hardness so that it is rather difficult to machine. When a non-adjustable tappet is desired, finish grinding of tappet 65 remains to be done.

Where an adjustable tappet is desired, the tappet, after casting and cooling, has the end closure 83 reheated and annealed to render the same more machinable. As indicated in Fig. 4, the tappet 65 has the end closure 83 thereof exposed directly to the flame of an open burner 85 until the end closure 83 is heated to an annealing temperature of from 1670 to 1700 degrees Fahrenheit, and then the tappet 65 is allowed to cool in air. The temperature to which the top portion 83 of the tappet is heated lies within the critical range of temperatures of iron of the composition above indicated so that when allowed to cool in the air, the top portion has its hardness reduced so that it may be readily machined.

Referring to Figure 5, the top portion 83 of the tappet is then drilled and threaded as indicated at 86 for the reception of a threaded adjusting element 87 adapted to be secured in adjusted position by means of a lock nut 88. The exterior surfaces of the tappet 65 may then be finished ground to the dimensions desired. Since all bearing portions of the tappet 65 have been chilled completely through to the hollow interior of the tappet, the grinding operation does not materially change the hardness of the surface presented by the finished tappet. The thin refractory and soot facings of the mold cavities prevent too rapid cooling of the exterior surface of the tappet so that the peripheral walls and cam-engaging portion of the tappet will cool more uniformly, but with sufficient rapidity due to the cooling of the mold sections so that the desired hardness of metal will be obtained throughout all bearing portions of the tappet. The quick annealing of the top portion 83 of the tappet, when an adjusted tappet is to be formed, as indicated in Fig. 4, converts the chilled cast iron to softer or grey cast iron, the major portion of the latter being removed in drilling the bore 86, so that the completed tappet with the exception of the threaded walls of the bore 86 is of chilled cast iron. The softer iron portion is indicated in Figs. 4 and 5 by wider spaced section lines.

As many changes could be made in the above construction and methods, and many apparently widely different embodiments of this invention could be had without departing from the spirit thereof, it is intended that all matter shown in the accompanying drawing and contained in the above description is to be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A hollow-cast tappet for internal combustion engines comprising a hollow cylindrical body having relatively thin peripheral wall portions composed entirely of chilled iron.

2. A hollow-cast tappet for internal combustion engines comprising a hollow cylindrical body including an integral end closure, said body and end closure being of relatively thin metal sections composed entirely of chilled iron.

3. A hollow-cast tappet for internal combustion engines comprising a hollow cylindrical body including parts adapted to make bearing engagement with a valve guide and a valve operating element, all of said bearing portions of the tappet being composed of chilled iron.

4. A hollow-cast tappet for internal combustion engines comprising a hollow cylindrical body having relatively thin peripheral wall portions composed entirely of chilled iron and an end portion having relatively thicker wall portions annealed to a lesser hardness than that of said peripheral wall portions.

5. A hollow-cast tappet for internal combustion engines comprising a hollow cylindrical body with relatively thin peripheral wall portions and a relatively thin wall end portion both composed entirely of chilled iron, and a second end closure having relatively thicker wall portions and annealed to a lesser hardness than that of said peripheral wall portions and said first-named closure.

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