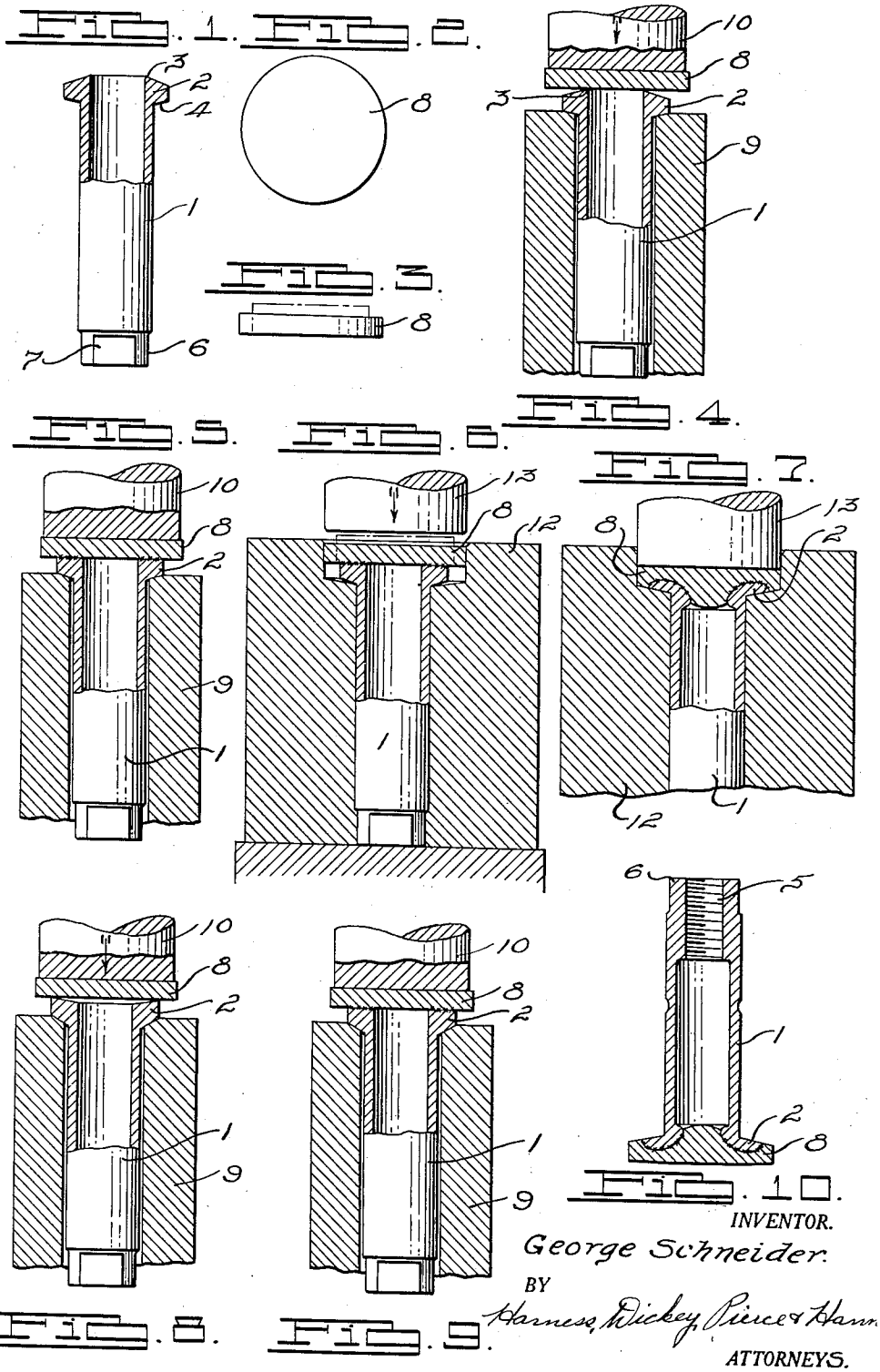
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METHOD OF MAKING VALVE TAPPETS

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METHOD OF MAKING VALVE TAPPETS

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My invention relates to the construction of valve tappets which are used in internal combustion engines to transmit the thrust of the valve operating cams to the fuel intake valves and to the exhaust valves. These devices require a hard wear-resisting face for contacting the cam and also a face which is not brittle or easily fractured. Heretofore it has been customary to construct tappets of a steel body member and a cast iron head or wearing face for contact with the cam. Chilled cast iron provides as good a wearing surface as is known but it has the disadvantage of being more fragile and brittle than steel. The increase of engine speeds and valve loads have made it necessary and desirable to provide a tappet construction in which the head member has practically comparable wearing qualities to chilled cast iron but is stronger and less subject to fracture by impact. Various steel constructions have heretofore been proposed, among them the construction wherein a piece of relatively hard steel is attached to a solid rod of relatively soft steel of the same size and the combined article is then forged to enlarge the head member to the desired size and to spread the desired hard steel facing material over the surface of the enlarged head member which is usually chiefly composed of the softer steel. This requires a considerable amount of forging and a complete deformation and reworking of the hard steel facing material with the consequent development of flaws and inequalities of distribution which are likely to occur in such forging operations.

One object of my invention is to provide a tappet construction wherein metal or alloy having predominant wear and impact resisting qualities but which is somewhat difficult to forge or machine because of those qualities and characteristics may be utilized as a facing or head member for the tappet and attached to and combined with the preformed body portion of a more easily machined and forgeable metal without the necessity of re-working or reforming the facing or head member to any substantial degree.

Another object of my invention is to provide a method of construction in which the wearing face or head member of wear and impact resisting material is joined to a body portion of more easily machinable and forgeable material in a manner that diminishes substantially the amount of forging or working of the more difficult head material.

Another object of my invention is to provide a method of tappet construction by providing a preformed disc of the wear resisting material which is not fragile or easily machinable, for the wear portion of the head and attaching it by welding and then by forging operations to a material that is more easily forged and machined and which is preformed, in such manner that the head material is not greatly deformed in the forging operation while the body material is deformed and upset to a greater degree to provide strength in the region of strain adjacent its joint with the head portion, to broaden its bearing upon and contact with the head portion, and to strengthen the parts adjacent the joint.

Another object is to provide a method of tappet construction of which a large part of the forging is eliminated, permitting the use of less forgeable and better wearing head materials.

Another object of my invention is to provide a method of tappet construction wherein a preformed head is joined and fitted to a body initially by a welding operation which provides the main bond between two parts and then by a forging operation which accomplishes simultaneously the extrusion of a portion of the head portion and the upsetting of the body portion to broaden its contact and bearing upon the head portion and to thicken and strengthen its wall structure in the region where the greatest stresses are applied to the article in use.

Another object is to lessen the cost of manufacture of such articles.

With these and other objects in view, my invention consists in the combination, arrangement and construction of the various parts of my improved device and the method of making the same described and claimed in the accompanying specification and shown in the drawing, in which:

Figure 1 is a view in elevation and partly in section of the body portion of the tappet made according to my invention.

Fig. 2 is a plan view of the head portion of the tappet made according to my invention.

Fig. 3 is an edge view in elevation of the head portion shown in Fig. 2.

Fig. 4 is a view partly in elevation and partly in section of the body portion and head portion assembled in a welding jig for the initial welding operation.

Fig. 5 is a view partly in elevation and partly in section of the body and head portions mounted in the welding fixture showing their relation to one another after the welding operation has been completed.

Fig. 6 is a view in elevation and partly in section showing the tappet mounted in a forging fixture preparatory to the forging operation which

accomplishes the simultaneous extrusion of the head portion and upsetting of the body portion.

Fig. 7 is a fragmentary elevational view partly in section showing the tappet in the forging fixture after the forging operation has been completed.

Fig. 8 is an elevational view partly in section of a modified form of tappet body mounted in a welding fixture with the head applied thereto, prior to the welding operation.

Fig. 9 is an elevational view partly in section of the tappet shown in Fig. 8 mounted in the welding fixture and after the welding of the head to the body has been completed.

Fig. 10 shows the completed tappet in longitudinal cross-section.

The body portion of the tappet consists of a tubular member 1 preferably steel or alloy thereof preformed by machining and provided with a thickened flanged end portion 2, the upper surface of which is beveled to provide a point contact portion 3. The underside of the flange 2 is also slightly beveled as at 4. The lower end of the tappet is provided with a reduced bore 5, as shown in Fig. 10, which is internally threaded to receive an adjusting screw or stud of the usual type which may be turned in or backed out of the tappet to adjust the clearance between the end of the tappet and the valve stem of the engine, not shown, according to usual practice as well understood by those familiar with the art. The lower exterior end of the body 1 is reduced in outside diameter as at 6 and provided with wrench flats 7 on opposite sides thereof for receiving a wrench in the operation of manipulating the conventional adjusting screw or stud which is not shown. This body 1 is made of relatively easily machinable material such as is customarily used for this purpose.

In Figs. 2 and 3 are shown the head portion of the tappet which consists of a preformed annular disc 8 of impact and wear-resisting metal or alloy. Standard specification S. A. E. 52–100 steel being one suitable material. This disc may be punched from sheet stock or cast or otherwise formed to substantially the desired ultimate size of the tappet head which is indicated by the full lines in Figs. 2 and 3. This disc, however, may be made smaller than the ultimate head size, and thicker, as indicated by the dotted lines in Fig. 3, which will be spread and thinned in the forging operation as hereinafter explained.

The body and the head piece having been preformed as described, the method of securing them together consists in first mounting the body member 1 in a hollow welding electrode 9 and then positioning the head member 8 on the flange end 2 of the body with the underside of the disc 8 in contact with the point or ridge 3 formed on the upper surface of the flange 2. The opposite welding electrode 10 is then brought against the upper surface of the head member 8 and the welding circuit closed. Upon the closing of the circuit, the current passes through the point contact 3 between the head member 8 and the body member 1 and melts and welds the metal of the parts together at this point. The welding is continued until the welded joint between the head member 8 and the body 1 extends substantially across the widest portion of the flange 2 as shown in Fig. 5. This is in the nature of a progressive welding operation and is carried out in the manner described to efficiently utilize the welding current and to secure as broad a homogeneous weld between the parts as is possible with the possible area of contact between the two. It is desirable to provide for a point contact between the head and the body member in order to secure this weld on account of the fact that the shape of the flange 2 on the body member will not permit the positioning of the electrode 9 in such a manner as to provide a uniform initial flow of current between a flat upper surface upon the flange 2 and the flat underside of the head member 8; this because of the well known fact that the current will take the shortest path between the electrodes and there would be an uneven distribution of heat produced between the contacting parts of the head and body members, thus making for a non-uniform and very likely defective weld. By providing for the point contact between the two members the heat is initially concentrated in the form shown in Fig. 4 at the point contact between the inner edge of the flange 2 and the head member 8. This melts the metal of the flange 2 with comparative rapidity and of course pre-heats the adjacent parts of the flange 2 and the head member 8 so that when the two parts comes into full contact, as shown in Fig. 5, a substantially uniform weld has been accomplished across the widest portion of the flange member 2. This may also be accomplished with the modified form of the body shown in Fig. 8, wherein the flange 2 is so formed that the point of contact with the head member 8 is at the outer edge of the flange 2. An acceptable weld may be obtained with the form of flange shown in Fig. 8, although the most desirable practice is to so form the flange that the point of contact is at or adjacent the inner edge of the flange. It is also possible to obtain an accepted weld by so forming the flange 2 that the pointed contact between it and the head member 8 will initially occur at a point intermediate the edges of the flange 2. This, however, may necessitate additional machining operations which are undesirable because of cost.

After the head member 8 has been welded to the body member 1, as described, the assembled article is reheated to a desirable forging temperature and placed in the die member 12 shown in Fig. 6. This die member is provided with a longitudinal cavity of a size adapted to closely receive that portion of the body 1 below the flange 2 and with an enlarged upper cavity of a size corresponding to the ultimate desired size of the head member 8. The lower surface of this upper cavity is inclined toward the reduced cavity which receives the lower part of the body 1, the inclination being at a degree slightly less than the bevel 4 on the underside of the flange 2. The inclination of this die cavity may be regulated to control to some extent the direction of displacement or upsetting of the metal of the flange 2 in the forging operation. After the assembled construction has been place in the die member 12, it is struck with the punch 13 and the head member 8 and flange member 2 are forged together, as shown in Fig. 7. This forging operation simultaneously accomplishes several results. The flange 2 is deformed in both directions from the major axis of the body walls to broaden its contact with the underside of the head 8, and to rework the initial weld between the head 8 and the flange 2. This strengthens the weld as well as broadens the bearing between the head 8 and the flange 2. The forging operation also extends the support of the flange 2 outwardly toward the edges of the head member 8 and thickens the walls of the tappet body immediately adjacent and beneath the head member at the point where the

greatest strain occurs in use, thus substantially strengthening the construction. The forging operation also, simultaneously with the upsetting of the body flange 2, causes an extrusion of the metal of the head member 8 into the tubular end of the body member 2, as shown in Fig. 7. This extrusion extends downwardly through the opening between the thickened portions of the walls of the tappet body adjacent the head and in close engagement therewith and provides a solid reinforcement for the walls of the body at this point which, as before mentioned, is the point of greatest strain and use. The amount of this extension may be controlled as desired by controlling the travel of the punch. The purpose being accomplished when an embracing engagement between said members is obtained around the welded joint.

If it is desired, the head member 8, as previously mentioned, may be preformed to a disc of a greater thickness and less diameter than the ultimate size of the head, as shown by the dotted lines in Fig. 3, and by the dotted lines in Fig. 6. The process of welding this thickened head to the body is the same as previously described, and the process of forging is also the same, except that the forging operation instead of merely extruding the metal of the head member into the open end of the tubular body 1 will also spread the metal of the head member laterally to the ultimate size of the head which is the size of the cavity in the die member 12. It may be desirable to use this smaller form of disc on account of the size of stock readily available from which the discs may be punched and also for the purpose of spreading the flange 2 of the body member in the forging operation so that it will have a somewhat greater area of contact with the underside of the head than in the construction where the preformed disc of ultimate size is used. The ultimate construction of the tappet will be the same as shown in Fig. 10, except that the flange 2 may extend slightly closer to the outer edge of the head 8.

After the forging operation has been completed, the tappet is complete except for finishing operations such as tapping the reduced bore 5, final heat treatment, rough and finish grinding the stem or body portion of the tappet, and finish grinding the face of the head 8. The forging operation may be accomplished cold or with such heat as remains in the parts after the welding operation, although it is preferable to re-heat the assembly before forging.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit and substance of the broad invention, the scope of which is commensurate with the appended claims.

I claim:

1. The method of making a tappet which comprises preforming a tubular metal body portion and providing a thickened flanged end thereon, superposing a head of relatively harder metal in the shape of a preformed and flat disc on the thickened flanged end of said tubular body and welding the same together, and then forging the welded assembly of head and body to simultaneously re-work the welded joint and extrude part of the head member into the tubular opening in the body member to reinforce the walls of said body member beneath the overhanging portion of said head member.

2. The method of making a tappet comprising applying a preformed disc of hard steel and of substantially uniform thickness to a preformed tubular body member of relatively softer steel and having a thickened flanged end, by welding said disc to and over said thickened flanged end of said body, and then forging said assembled head and body to broaden the bearing and joint between the two and simultaneously extrude part of the disc into the tubular opening in the end of said body, and in tight engagement with the inner walls of said body beneath said head.

3. The method of making a tappet comprising applying a preformed disc of hard steel and of substantially uniform thickness to a preformed tubular body member of relatively softer steel and having a thickened flanged end, by welding said disc to and over said thickened flanged end of said body, and then forging said assembled head and body to broaden the joint between the two and simultaneously extrude part of the disc into the tubular opening in the end of said body and to upset and thicken said body wall beneath said flange portion to force a part of said thickened portion of said body to the inside of the walls of said body member to close bearing with the extruded portion of said head, thereby solidifying the upper end of said tubular body member beneath said head.

4. The method of making a tappet which comprises preforming a tubular body member of relatively soft steel and providing a pointed flanged end thereon, superposing a flat disc of relatively harder steel having wear-resisting qualities comparable to those of white cast iron but having greater resistance to fracture under impact than cast iron on said pointed flanged end of said body, applying localized welding heat to the points of contact between said disc and said body, and maintaining the same until the said disc and body are welded together over substantially the greatest transverse dimension of the flange on said body, and forging the assembly to re-work the weld and broaden the bearing between said disc and body in both directions transverse to the major axis of said body walls, and simultaneously to extrude part of the metal of said disc into engagement with said tubular body.

5. The method of making a tappet comprising preforming a tubular metal body member and forming an annular flange on the end thereof having a pointed upper extremity, superposing a flat disc of relatively harder but less easily machinable and forgeable metal than that of said body member upon the pointed extremity of said flange, electrically welding said disc to said flange by applying one electrode on the underside of said flange and another electrode on the top of said disc, and maintaining said welding contact until the weld between said disc and said flange extends substantially over the width of said flange.

6. The method of making a tappet comprising preforming a tubular steel body member, superposing a flat disc of relatively harder steel and of substantially the ultimate desired head size upon the open end of said tubular body and welding the same thereto, and then forging said assembly to simultaneously extrude a portion of said head member and upset a portion of said tubular body member into embracing engagement around said welded joint.

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