Aug. 6, 1940. G. F. THOMAS ET AL 2,210,107

METHOD OF MAKING LUBRICANT RECEIVING FITTINGS

Filed April 16, 1937 3 Sheets-Sheet 1

Fig. 1

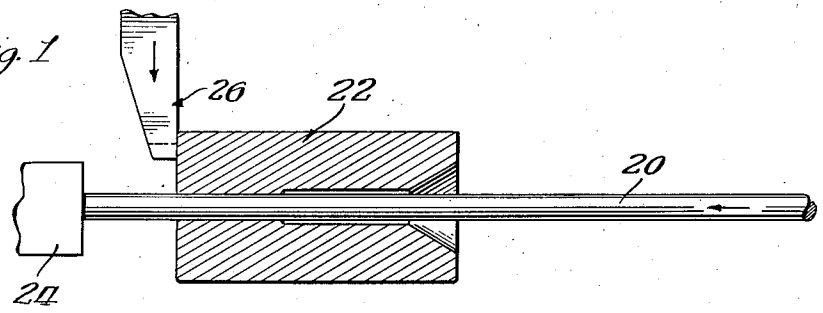


Fig. 2



Fig. 3

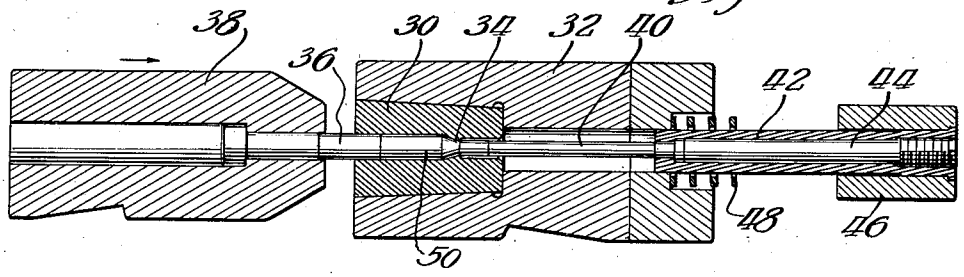


Fig. 4

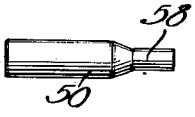


Fig. 5

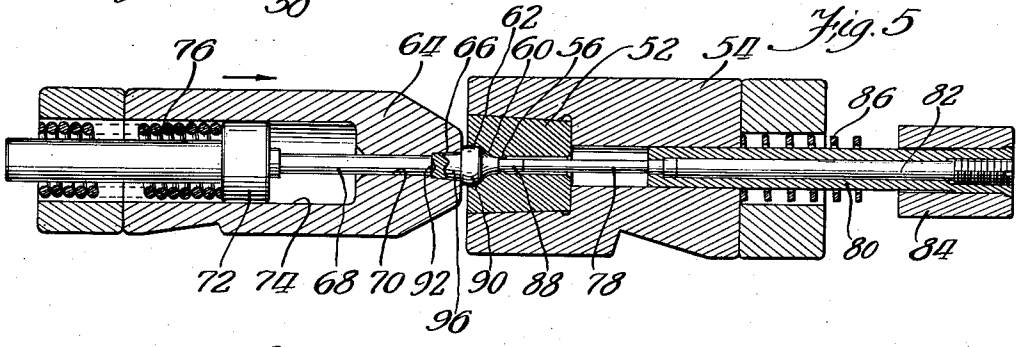
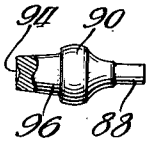


Fig. 6



Inventors:
George F. Thomas,
Frank A. Ross and
Joseph Bystricky

By Williams, Bradbury, McCaleb & Hinkle
Attys.

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METHOD OF MAKING LUBRICANT RECEIVING FITTINGS

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Fig. 7

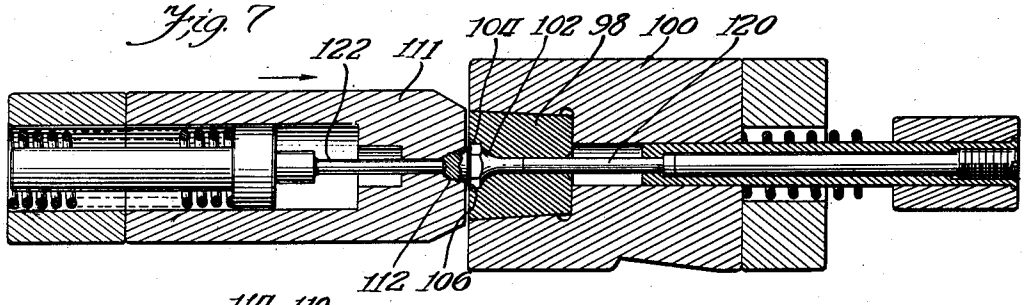


Fig. 8

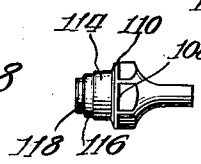


Fig. 9

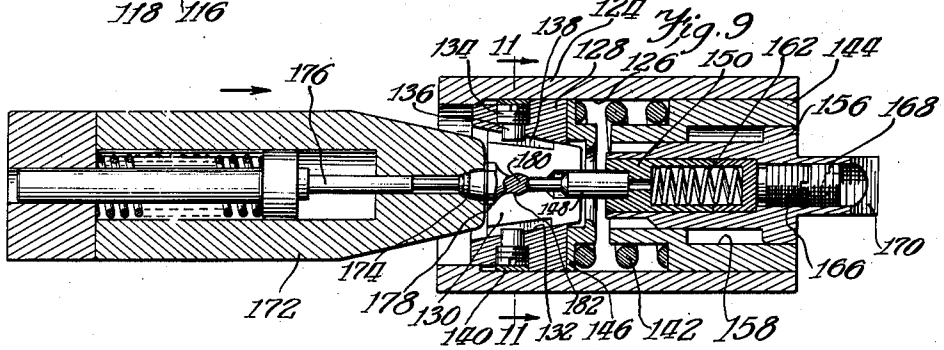


Fig. 10

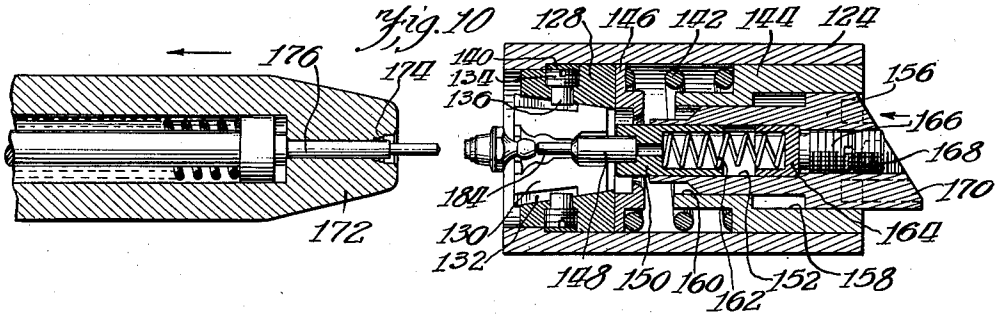
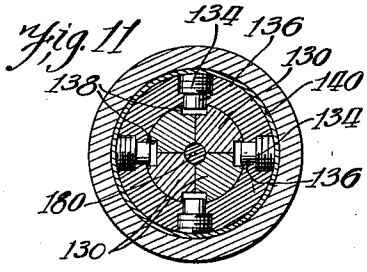


Fig. 11



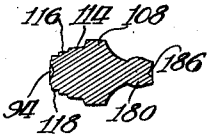


Fig. 12

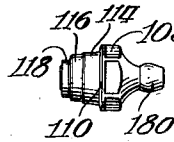


Fig. 13

Inventors:
George F. Thomas,
Frank A. Ross and
Joseph Bystricky.

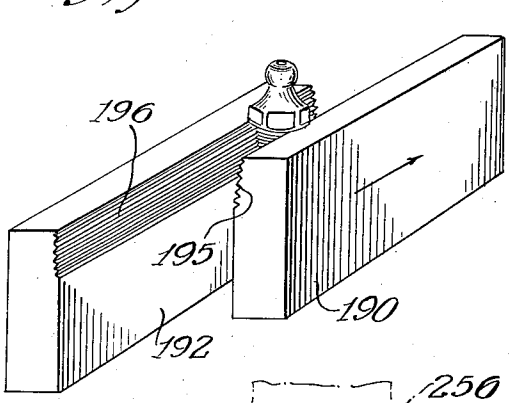
By Williams, Bradbury, McCaleb & Hinkle. Attys.

Aug. 6, 1940. G. F. THOMAS ET AL 2,210,107

METHOD OF MAKING LUBRICANT RECEIVING FITTINGS

Filed April 16, 1937 3 Sheets-Sheet 3

Fig. 14



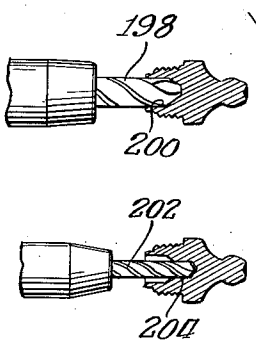
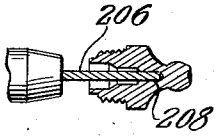
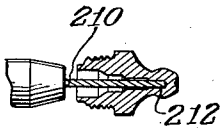


Fig. 16





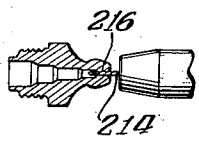


Fig. 21

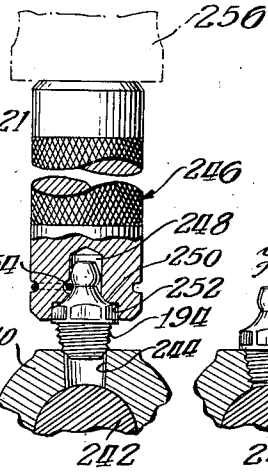


Fig. 15

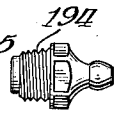


Fig. 22

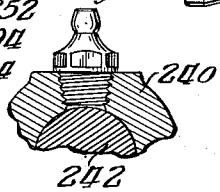


Fig. 17

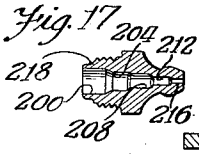


Fig. 18

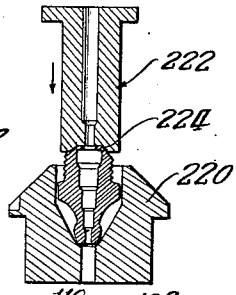


Fig. 19

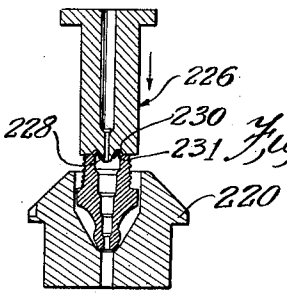
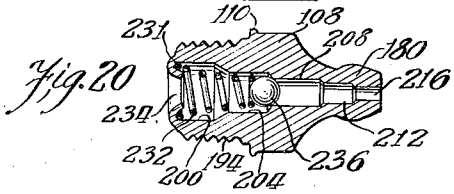


Fig. 20



Inventors:
George F. Thomas,
Frank A. Ross and
Joseph Bystricky

By Williams, Bradbury, McCaleb & Hinkle, Attys.

Patented Aug. 6, 1940 2,210,107

UNITED STATES PATENT OFFICE

2,210,107

METHOD OF MAKING LUBRICANT RECEIVING FITTINGS

George F. Thomas, Riverside, Frank A. Ross, Lake Bluff, and Joseph Bystricky, Chicago, Ill., assignors to Stewart-Warner Corporation, Chicago, Ill., a corporation of Virginia

Application April 16, 1937, Serial No. 137,220

4 Claims. (Cl. 29—157.1)

Our invention relates generally to lubricant receiving fittings and to improved methods of making such fittings. More particularly, our invention relates to the making of an improved form of drive type fitting.

Lubricant receiving fittings of the type used in high pressure lubricating systems have in the past customarily been made upon automatic screw machines, using bar stock and forming the fittings by means of suitable tools in the automatic screw machine. This method of manufacturing lubricant receiving fittings has been relatively expensive with respect to the tool maintenance cost and the labor cost of the automatic screw machine operators, and fittings of the drive type made in this manner have not been as satisfactory as fittings made by the method of the present invention.

According to our present invention, the fitting blanks are formed by a cold-heading machine. The principal advantages of this method of making the fitting blanks are the greater speed with which the blanks may be produced, the decreased amount of scrap metal, the decreased labor cost, and the great superiority of the finished product.

In manufacturing fittings of the drive type, that is, fittings which may be driven into the untapped oil hole of a bearing and are capable of forming a thread in the bearing, it is desirable that the threads on the shank of the fitting be of the maximum feasible hardness and toughness, and these properties of the metal in the threads are enhanced by the improvement in the grain structure as a result of the compacting of the metal in the cold-heading machine.

It is thus an object of our invention to provide an improved lubricant receiving fitting in which the grain structure of the metal is improved during the operation of manufacturing the fitting.

A further object is to provide an improved method of manufacturing lubricant receiving fittings for high pressure lubricating systems by which the cost of manufacture may be reduced and the quality of the fittings improved.

A further object is to provide improved tools and dies usable in the manufacture of headed lubricant receiving fittings by means of a cold heading machine.

Other objects will appear from the following description, reference being had to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of the cutting die and shear blade by which the first step of the operation of making the fitting is accomplished;

Fig. 2 shows a piece of round bar stock illustrating the stock after the completion of the first operation;

Fig. 3 is a vertical cross-sectional view of the punch and die utilized in the cold heading machine for performing the second step in the operation of forming the fitting;

Fig. 4 shows a piece of stock after the second step in the operation has been performed upon it;

Fig. 5 is a vertical sectional view of the die and plunger of the cold-heading machine utilized in performing the third step of forming the fitting;

Fig. 6 is a view partly in section illustrating the stock after the third step of the cold heading operation has been performed upon it;

Fig. 7 is a vertical sectional view of the plunger and die of the cold-heading machine utilized in performing the fourth step of the operation of forming the fitting blank;

Fig. 8 is an elevational view of the blank after the fourth operation has been performed upon it;

Fig. 9 is a central vertical sectional view of the die and plunger used in the cold heading machine for performing the fifth step of the operation of forming the fitting blank;

Fig. 10 is a view similar to Fig. 9 showing the position of the parts of the die and plunger during the return stroke of the latter;

Fig. 11 is a transverse sectional view of the die shown in Fig. 9 taken on the line 11—11 thereof;

Fig. 12 is a sectional view, and Fig. 13 is an elevational view of the fitting blank after the fifth step of the operation of forming the blank has been performed upon the stock;

Fig. 14 is a perspective view diagrammatically illustrating a machine for rolling threads upon the fitting blank constituting the sixth step in the operation of forming the fitting;

Fig. 15 is an elevational view of the fitting blank after the sixth operation has been performed upon it;

Fig. 16 illustrates the succession of drilling operations by which the bores and counterbores are formed in the fitting;

Fig. 17 is a central longitudinal sectional view of the fitting after the drilling operations have been performed upon it;

Fig. 18 shows the first step in crimping the spring seat flange upon the fitting showing the punch and die in longitudinal section;

Fig. 19 is a similar view showing the second step in the operation of crimping the spring seat flange on the fitting;

Fig. 20 is a central longitudinal sectional view

of the completed fitting showing the check valve and spring assembly therein; and

Figs. 21 and 22 are views illustrating the manner of securing the fitting to a bearing.

Generally speaking, the method of our invention comprises twelve steps;

1. Cutting off a suitable length of steel rod stock;

2. Extruding one end of the stock to reduce the diameter thereof;

3. Further reducing the diameter of the previously reduced end of the stock and upsetting the central portion to increase its diameter;

4. Further extruding the reduced end portion of the stock and further upsetting the central portion to form the hexagon-shaped wrench-engaging part of the fitting;

5. Upsetting the reduced diameter end portion of the fitting to form the head of the finished fitting;

6. Tumbling the fitting to polish and remove slight burrs;

7. Rolling a thread upon the shank of the fitting;

8. Drilling the bore through the fitting,—usually in several steps;

9. Crimping the spring supporting flange;

10. Heat treating the fitting;

11. Plating the fitting; and

12. Assembling the ball check valve and spring in the fitting.

The above enumerated operations are preferably performed in the order named, but some variation in the order may be made without departing from the general method of our invention.

The first operation performed upon the stock is illustrated in Fig. 1 wherein the steel rod stock 20 (which is preferably supplied in large coils) is advanced through a die 22 until it abuts against a fixed stop 24. Thereafter, a shear blade 26 is moved in the direction indicated by the arrow in Fig. 1 to shear the required length of stock to form the blank 28 shown to a slightly enlarged scale in Fig. 2. The die 22 is preferably mounted in the cold-heading machine and the shear blade 26 is reciprocated by means of a suitable cam as the reciprocating head of the machine approaches the bed which carries the die 22.

The blank 28 shown in Fig. 2 is next transferred to a die 30 which is mounted in a suitable holder 32 mounted upon the cold-heading machine. The die 30 has a tapering neck portion 34 into which the end portion of the blank 28 is pressed by means of a plunger 36 secured in a plunger carrier 38 mounted on the reciprocating head of the machine. A knock-out pin 40 is suitably secured in a holder 42 by means of a stud 44, the holder 42 having a head 46 secured thereto by a force fit. A compression coil spring 48 surrounds the holder 42 serving as a cushion for the head 46. The piece of stock is thus formed by means of the extruding die 30 into the blank 50 shown to slightly enlarged scale in Fig. 4.

The blank 50 is then automatically transferred from the extruding die 30 to a die 52 mounted in a suitable holder 54. The neck 56 formed in the die 52 is of slightly lesser diameter than the neck 34 on the die 30 so that the reduced diameter end portion 58 of the blank 50 is further reduced in diameter and lengthened by being forced past the throat 56 of the die 52. The die 52 has a flaring mouth 60 leading to the throat 56, and a substantially cylindrical recess 62 is provided to permit upsetting the central portion of the blank. The punch 64 has a frusto-conical recess 66 formed therein which is effective to form the shank of the fitting.

A knock-out pin 68 is mounted for sliding movement in a bore 70 formed in the punch and is further guided by a head 72 secured to the knock-out pin 68, the head being reciprocable in a cylindrical bore 74 formed in the punch 64. The knock-out pin 68 is retractable against the compression of a coil spring 76 which engages the rear face of the head 72 and serves to move the knock-out pin outwardly upon completion of this step in the operation. The die 54 is likewise provided with a knock-out pin 78 which is carried by a holder 80 into which a holding stud 82 is threaded, and over which a head 84 is secured. A compression spring 86 acts as a cushion for the leftward (Fig. 5) movement of the knock-out pin 78. In addition to extruding the end portion 88 of the fitting blank and upsetting the central portion 90 thereof by means of the die 52, during this operation, the knock-out pin 68 which has a central conical tip 92 for this purpose, makes a central conical indentation 94 in the base of the shank portion 96 of the fitting blank.

Fig. 6 shows the fitting blank to a slightly enlarged scale, showing its form after completion of the operation upon it of the punch and die shown in Fig. 5.

The blank of Fig. 6 is then automatically transferred to a die 98 (Fig. 7) secured in a die holder 100. This die has a smoothly flaring throat 102 into which the fitting blank is pressed further to extrude and extend the reduced diameter portion of the blank and has a hexagonal shaped recess 104 and a very narrow cylindrical recess 106 which form the hexagonal wrench engaging portion 108 and the slight rib 110 respectively on the blank as shown in Fig. 8. The punch 111 has a stepped recess 112 which further upsets the shank portion 96 of the blank of Fig. 6 to form a tapered shank portion 114, a pilot portion 116, and a lip portion 118 on the blank as shown in Fig. 8. The die is provided with a suitable knock-out pin 120 and the punch with a knock-out pin 122 which are mounted in the die and punch respectively in a manner similar to that shown in Fig. 5 and previously described.

The blank shown in Fig. 8 is then automatically transferred to the heading die and punch shown in Figs. 9 and 10. This die comprises a sleeve 124 having a bore 126 within which a die holder 128 is reciprocable. A plurality (here illustrated as four) of collapsible die elements 130 are mounted for sliding movement within the tapering bore 132 formed within the die holder 128. Set screws 134 threaded in the die holder 128 have their ends 136 projecting into suitable grooves 138 formed in the external tapered edges of the die elements 130. It will be noted that the grooves 138 are formed one half in each of two adjacent die elements 130. The ends 136 of the set screws 134 thus prevent the die elements 130 from being pushed out of the die holder 128 and serve to guide these elements in their reciprocatory movement. The set screws 134 are locked in place by a ring 140 which passes around the periphery of the die holder 128.

The die holder 128 is pressed outwardly by a relatively heavy compression coil spring 142 which is compressed between a guide 144 pressed in the sleeve 124 and a seat 146 which pushes against the die holder 128. The knock-out pin 148 for the die is secured in a plunger 150. The plunger 150 is slidable in a bore 152 formed in

the knock-out pin actuator 156, which in turn is guided for sliding movement in bores 158 and 160 formed in the guide 144. The plunger 150 is normally urged outwardly by a compression coil spring 162 which is seated in a cup 164 which may be adjusted by means of a set screw 166, the latter being locked in position by a socket set screw 168. The inner end of the knock-out pin actuator 156 has a beveled cam face 170 which may be engaged by a suitable cooperating cam to force the knock-out pin actuator 156 outwardly (to the left, Figs. 9 and 10). The punch 172 which is illustrated in Figs. 9 and 10 has a recess 174 which is similar in shape to the recess 112 formed in the punch 111 (Fig. 7). The punch is provided with a knock-out pin 176 which may be generally similar to the knock-out pin 122 used with the punch illustrated in Fig. 7.

It will be noted that the punch and die of Fig. 9 will first cause the reduced diameter end portion of the fitting to force the knock-out pin 148 rearwardly from the position in which it is shown in Fig. 10 to the position in which it is shown in Fig. 9. During the latter portion of this movement of the fitting to the right (Fig. 9) the hexagonal portion 198 of the fitting blank will engage in the complemental hexagonal recess 178 formed collectively by the die elements 130, and, since the inward movement of the knock-out pin 148 is limited by the engagement of the inner end of the plunger 150 with the cup 164, further pressure exerted upon the fitting blank by the punch will cause the die elements 130 to be forced inwardly. As a result of this inward movement, the die elements 130 are contracted about the fitting blank thereby forming the head 180 thereon, which head is formed by upsetting the reduced diameter portion of the blank of Fig. 8, the die elements 130 having suitable recesses 182, which together conform the upset metal to the shape of the head on the fitting blank shown in Figs. 12 and 13.

The outer end of the knock-out pin 148 is provided with a conical tip 184 which forms a central conical indentation 186 in the end face of the head 180 to aid in centering the drill during the subsequent drilling operation.

Upon separation of the punch and die as illustrated in Fig. 10, the knock-out pin 176 in the punch will press the shank portion of the fitting from the recess 174 in the punch 172 and the spring 162 will press the die holder 128 to the left. At the same time, spring 162 will force the knock-out pin 148 outwardly, and the latter, by exerting an outwardly directed force (to the left Fig. 10) first upon the fitting and later upon the die elements 130, will cause the latter to move outwardly both longitudinally and radially to permit the head of the fitting to escape from the recess 182 formed by the die elements. As soon as the die elements 130 have been moved to the left (Fig. 10) sufficiently to permit escape from the head of the fitting, the knock-out pin actuated by its spring 162 will eject the fitting from the die elements 130, thereby completing the cold-heading and extruding operations formed upon the cold-heading machine. The resultant fitting shown in Figs. 12 and 13 will thus be formed with a head 180, a hexagonal portion 108, a rib 110, a tapered shank portion 114, a generally cylindrical pilot portion 116, and a lip portion 118.

All of these forming operations are preferably successively performed upon a single cold-heading machine equipped with automatic means for transferring the blanks from one punch and die set to the next set. Thus, one formed blank (Figs. 12 and 13) will be produced for each forward and return stroke cycle of the reciprocating head of the machine. All of these operations are performed without the application of external heat. Of course some heat is developed in the metal due to the working of it, but the metal never exceeds its critical temperature or becomes sufficiently hot to form a scale upon its surface. If it were attempted to heat the blanks, the forming operations might be performed more easily, but the formation of scale upon the surface of the fitting blank would result in irregularities in the surface of the fitting and interfere with the operation of the dies.

After the operations performed upon the stock of the cold-heading machine, the fitting blanks of Figs. 12 and 13 are put in a tumbling barrel to remove any slight burrs or fins which may have resulted from the cold-heading operations.

After the tumbling operation, the fitting blanks are inserted in the hopper of a thread rolling machine, from which they are fed one at a time to a position between a pair of dies 190 and 192. In Fig. 14, the die 192 is represented as fixed and the die 190 as movable relative thereto. As the die 190 moves to the end of the die 192, the fitting is rotated and sufficient pressure brought to bear upon it by the dies 190 and 192 to roll a thread 194 (Fig. 15) upon the shank of the fitting. As the die 190 completes its forward stroke, the fitting will drop from between the two dies and the die 190 will return to receive another fitting. The threading surfaces of the dies 190 and 192 are provided with a plurality of serrations 195, 196 respectively. These serrations are of particular form to produce a certain desired thread form, as is more particularly disclosed in the copending application of George F. Thomas and Joseph Bystricky, Serial No. 42,746, filed September 30, 1935.

After the thread 194 has been rolled upon the fitting blank, the fitting is subjected to successive drilling operations as shown in Fig. 16, wherein the drill 198 drills a counterbore 200 of largest diameter in the shank portion of the fitting, drill 202 drills an intermediate bore 204, drill 206 drills a second intermediate bore 208 in the fitting blank, drill 210 drills a third intermediate bore 212, and drill 214 forms the inlet hole 216 in the head of the fitting. The fitting, after the completion of the drilling operations, is illustrated in Fig. 17.

After the drilling operations, the lip 218 is crimped over to form the spring seat as indicated in Figs. 18 and 19, wherein a die 220 is suitably conformed to receive the fitting, head end first, and a punch 222, having a recess 224 formed therein, will bend the lip 218 inwardly to form a flange. Thereafter, a punch 226 having a point 228 and an annular recess 230 surrounding the point 228 is brought down upon the flanged lip and the flange curled inwardly to form an annular groove 231 generally V-shaped in cross-section for the reception of the outermost coil of a conical compression coil spring 232 as shown in Fig. 20.

Upon completion of the lip curling operation, the fitting is heat-treated so as to further harden and toughen it.

The heat-treating is preferably case-hardening, so that while the skin surface of the fitting is rendered very hard, the fitting is not made brittle, and especially the thread will retain the

strength acquired during the cold-working operations.

After the heat-treating operation, the fitting blanks are suitably plated with cadmium or other suitable plating metal and then the manufacture of the fitting is completed by assembling a ball check valve 236 and the spring 232 in the fitting. Due to the fact that the lip 234 is curled inwardly, it is possible to insert the conical compression coil spring 232 by pressing it into the opening in the lip 234, preferably turning it slightly so as to aid the spring in passing the reduced diameter opening in the lip. After the spring has passed the lip, its outermost turns will expand and snap into the annular groove 231, generally V-shaped in cross-section, which is formed by the lip 234 as best shown in Fig. 20.

The fitting thus produced is adapted to be driven into an untapped oil hole of a bearing in the manner indicated in Figs. 21 and 22, wherein the bearing 240 for shaft 242 is provided with a drilled oil hole 244. The lowermost turn of the thread 194 on the fitting forms a pilot to aid in guiding the fitting coaxially into the oil hole 244. A suitable drive tool 246 may be conveniently utilized in applying the fitting to the oil hole. This drive tool has a recess 248 to receive the head of the fitting, a flaring surface 250 complemental to the curved tapering surface on the body of the fitting, and a cylindrical counterbore 252 which is of slightly larger diameter than the maximum diameter of the hexagonal wrench-engaging portion 108 of the fitting. The driving tool 246 is provided with a spring 254 which acts as a resilient grip beneath the head of the fitting to hold the fitting within the drive tool. Having positioned the drive tool and fitting, as shown in Fig. 21, the end of the drive tool is struck with a hammer 256, whereupon the fitting will be driven into the oil hole 244. During this driving operation, the fitting will swage threads complemental to the threads 194 of the fitting upon the internal surface of the bearing oil hole 244, as is more particularly disclosed in the aforesaid copending application, Serial No. 42,746, filed September 30, 1935.

The fitting may, with excellent results, be driven into bearings of various metals, such as cast iron, wrought iron, brass, cold rolled steel, cast steel, and forged steel. The threads 194 on the fitting are rendered so tough by the compacting of the metal during the operations of making the fitting that they will not be deformed or break when the fitting is driven into such hard and tough metals as steel forgings.

By the method of manufacture herein described, the toughness of the metal is materially increased, as compared with a fitting made from the same stock which is formed by screw machine operations.

The thread 194 of the fitting is preferably of standard pipe thread pitch so that a drive type fitting as herein disclosed may be unscrewed from a bearing into which it has been driven and replaced by a fitting having a standard pipe thread.

The small recess formed in the die 98 (Fig. 7) by which the rib 110 (Fig. 8) is formed, serves as relief means for receiving excess metal. Without providing this space into which excess metal may flow, the dies might frequently be broken because the weight of metal in the blank 28 (Fig. 2) may vary slightly due to slight variations in the diameter of the stock and possibly also to very minor variations in the length of the blank 28. The ribs 110 thus formed adjacent the flat surfaces of the hexagonal portions 108 of the fitting serve several useful purposes. These ribs make it easy to distinguish a drive type fitting from the usual fittings which are otherwise generally similar in appearance. They also serve as a means to prevent a socket or other wrench from sliding down and away from the hexagonal portion of the fitting.

As previously stated, we have found that lubricant receiving fittings produced by the above described method are far superior to similar fittings produced by machining operations. Apparently, the cold-working of the metal increases its density by compacting the metal. Furthermore, it appears that the grain structure is altered and the fibers or flow lines are made to conform to the shape of the fitting. This effect is particularly advantageous in the threaded shank of the fitting where the great increase in tensile strength of the metal, due to the cold-working operations, makes it possible for the thread to maintain its shape even when driven into the oil hole of a bearing made of a very had and tough metal.

The heat treatment of the fitting is such that the so-called fibrous grain structure of the metal is not greatly altered except at the surface where it is case-hardened. The fitting may be considered as comprising a shell or skin which is extremely hard, but in which any tendency to brittleness is overcome because this hard shell is backed by compacted metal of high density in which the flow lines or fibers extend generally parallel to the surface.

The method of the present invention results in a fitting which is superior to one which might be made out of much more expensive high-grade steel. While such high-grade steel, by heat-treating, might be given the desirable hardness, such hardness would ordinarily be accompanied by undesirable brittleness. By cold-working a relatively inexpensive low-grade steel in the manner herein set forth, a fitting having the desired surface hardness and interior strength and toughness may be uniformly and cheaply produced.

While the construction of the dies may be varied somewhat from the forms disclosed herein, these forms have been found to be highly satisfactory after extended experimentation and use. The fiact that the fitting is relatively small, the stock which is used is very tough, and that the fitting must have two portions of increased diameter separated by a neck portion, presented difficult problems in the design of the necessary dies. For example, in the die of Figs. 9 and 10, it was found that it was very desirable to utilize four sliding elements 130 instead of two or three, as is customarily done in die construction, in order to make it possible to withdraw the fitting from these die elements without requiring too great reciprocatory travel of the die elements.

While we have shown a particular product and a particular form of apparatus utilized in performing the method of our invention and have described a method as constituting operations performed in definite order, it will be understood by those skilled in the art that the method, apparatus, and the product may be varied, and the various operations modified or performed in different order without departing from the salient features of our invention. In the accompanying claims, we therefore intend to include all

such equivalent apparatus and methods and products wherein substantially the same results are obtained by substantially the same means or methods.

We claim:

1. The method of making a headed drive type fitting which comprises extruding a portion of a cylindrical bar of steel to reduce its diameter, upsetting the remaining portion of the bar to form the shank and hexagonal wrench-engaging part of the fitting, and upsetting the extruded portion to form the head of the fitting.

2. The method of making a headed drive type fitting which comprises extruding a portion of a cylindrical bar of steel to reduce its diameter, upsetting the remaining portion of the bar to form the shank and hexagonal wrench-engaging part of the fitting, upsetting the extruded portion to form the head of the fitting, and rolling a thread upon the shank of the fitting.

3. The method of making headed lubricant receiving fittings from steel rod of less diameter than the greatest diameter of the fitting which comprises, severing a short length from a supply of rod stock, extruding a portion of said rod to form an extension thereon of less diameter than the rod, increasing the diameter of the remaining part of the short length of rod by longitudinal compression, forming said increased diameter part to the external shape of the shank portion of the finished fitting by cold-heading operations, and upsetting the extension portion to form a head part while retaining a part of said extension portion as a neck joining the head with the shank portion of the fitting.

4. The method of making headed lubricant receiving fittings from steel rod of less diameter than the greatest diameter of the fitting which comprises, severing a short length from a supply of rod stock, extruding a portion of said rod to form an extension thereon of less diameter than the rod, increasing the diameter of the remaining part of the short length of rod by longitudinal compression, forming said increased diameter part to the external shape of the shank portion of the finished fitting by cold-heading operations, and upsetting the extension portion to form a head part while retaining a part of said extension portion as a neck joining the head with a shank portion of the fitting, all of said operations being performed without applying external heat to the rod stock.

GEORGE F. THOMAS.
FRANK A. ROSS.
JOSEPH BYSTRICKY.