R. L. ELLERY.

METHOD OF MAKING VALVES.

APPLICATION FILED FEB. 10, 1914.

1,121,619.

Patented Dec. 22, 1914.

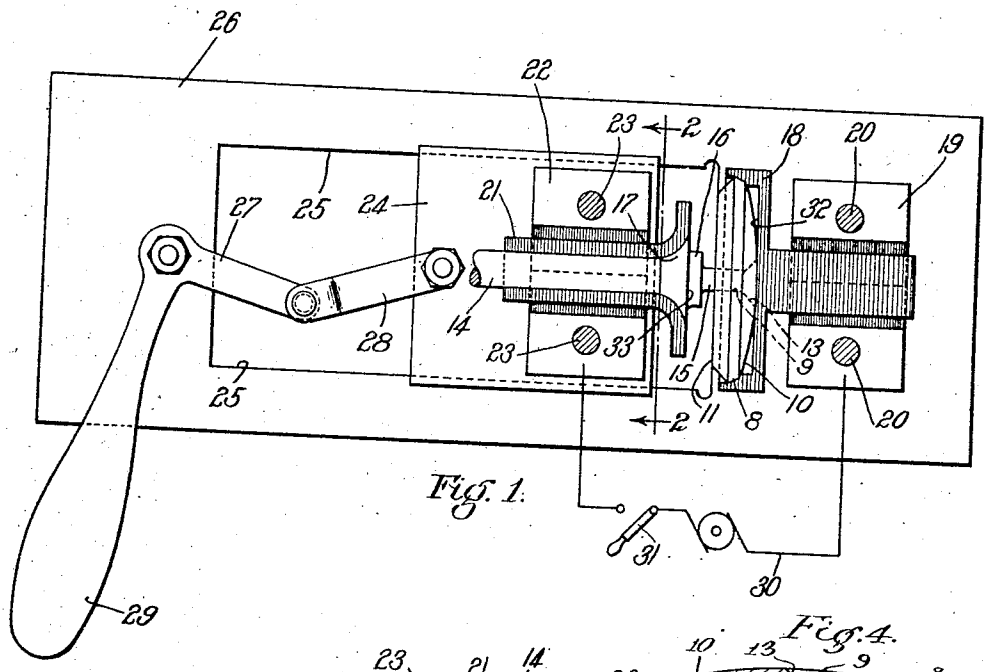


Fig. 1.

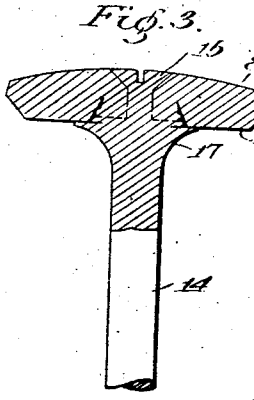


Fig. 3.

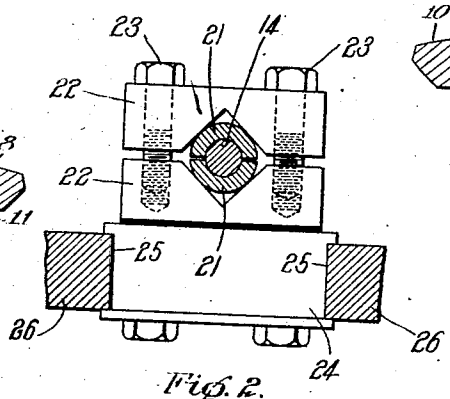


Fig. 2.

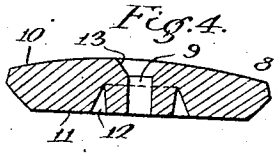


Fig. 4.

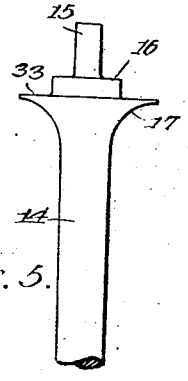


Fig. 5.

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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING VALVES.

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To all whom it may concern:

Be it known that I, ROBERT L. ELLERY, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented new and useful Improvements in Methods of Making Valves, of which the following is a specification.

This invention relates to an improved method of making valves and more particularly to valves of the type known as puppet valves and employed in internal combustion engines. Valves when used in this connection are subjected to very intense heat often reaching a temperature of 1200° F. and at such a temperature with valves constructed of ordinary tool steel, cast-iron or the like, the metal becomes softened to such an extent that small particles of grit or metal, which happen to lodge between the face of said valve and its seat, cause said valve to become warped and twisted or pitted with the result that they fail to properly close the port of the engine and thus reduce the efficiency thereof.

A remedy for the evils above enumerated has been found to exist in tungsten steel known as high speed steel. As this metal requires a temperature of 2300° F. or thereabout to properly harden the same and as it is seldom that the temperature of the internal combustion engine reaches a temperature beyond 1200° F. it will be seen that little danger from overheating will result. It is also well known to those familiar with tungsten steel that even though this metal is heated to a bright red it retains its hardness, consequently it will not warp nor become pitted when small particles become lodged between the face thereof and the valve seat. But while tungsten steel has been found to embrace the qualities required in valves of the nature set forth, no method has heretofore been devised whereby it may be put into practical use, although many attempts have been made in this direction. For example, valves and their stems have been made entirely of tungsten steel and in one piece and so far as the head of the valve is concerned the result has been successful, overlooking the fact that a valve made from one piece of tungsten steel is far more expensive than the ordinary type of valve and by reason of this fact seldom used. The principal objection to this form of valve however is due to the action of the steel when heated. In the ordinary materials employed in the construction of valves and valve casings, the expansion and contraction, due to the change in temperature, are substantially equal, but in tungsten steel this is not the rule, the expansion always being greater than the contraction, consequently where a bearing is made of the ordinary material such as cast-iron and the valve stem of tungsten steel, the two metals may expand substantially the same amount, but the bearing will invariably contract more than the tungsten steel stem thereby binding said stem and preventing it from working freely and as this happens over and over again, in the operation of an internal combustion engine, it will be readily seen that great inconvenience will be caused thereby. Other attempts have been made to secure the stems and heads of different materials together by riveting or the like, but such methods have invariably proved defective as they soon work loose. Attempts have also been made to weld tungsten steel heads to carbon steel stems, but all attempts along this line have failed owing to the inability to retain sufficient heat at the surfaces of the valve which are being welded, to successfully soften and melt the materials, and furthermore for the reason that the valve head must be hardened at approximately 2300° F. and in so doing the carbon of the stems has been absolutely burnt out or destroyed.

The object of the present invention is to provide a method by which tungsten steel heads may be welded to carbon steel shanks in such a manner that the difficulties hereinbefore mentioned will be overcome.

The invention principally consists in forming the head of tungsten steel and hardening the same and in forming the stem of carbon steel and inserting said stem in said head after said head has been hardened, then applying an electric current to said stem and head to melt the contacting surfaces thereof and simultaneously applying pressure to said members to force the same together.

The invention further consists in the various steps and operations set forth in the following specification and particularly pointed out in the claims.

Referring to the drawings: Figure 1 is a diagrammatic plan view, partly in section, of a device adapted to perform the several operations necessary to assemble the parts of the valve. Fig. 2 is a section taken on

line 2—2 of Fig. 1. Fig. 3 is a sectional elevation of a completed valve. Fig. 4 is a detail section of the head of a valve. Fig. 5 is a detail view of the stem of the valve before said parts have been assembled.

Like numerals refer to like parts throughout the several views of the drawings.

In the drawings, 8 is the head of a valve formed of tungsten steel and preferably embodying in its construction a hole 9 which preferably extends axially therethrough from the upper side 10 to the lower side 11 thereof and an annular recess 12 formed in the under side 11 surrounding the hole 9 and at a distance therefrom and substantially concentric with the axis of said head. The upper side 10 of said head is countersunk at 13.

The stem 14 of the valve is constructed of carbon steel and preferably embodies in its construction a reduced end portion 15, which is adapted to fit the hole 9 in said valve head. A shoulder 16 is also provided adjacent the base of said end portion and surrounding said stem, said shoulder being preferably formed substantially equal in diameter to the inside diameter of the annular recess 12 formed in said head. The stem 14 also embodies in its construction a flange 17 likewise surrounding said stem and at the base of the shoulder 16, said flange being substantially larger in diameter than the outside diameter of the annular recess 12.

The head 8 and the stem 14 are constructed or formed, as hereinbefore stated, the head of tungsten steel and the stem of carbon steel after which said head is hardened at 2300° F. or thereabout. After these steps in the operation have been completed, the head 8 is clamped within a suitable holder 18 preferably by V-shaped copper jaws 19 fastened together by screws 20, while the stem 14 is inserted in a holder 21, which is clamped to said stem preferably between V-shaped copper jaws 22 by means of screws 23. One of the sets of jaws, preferably 22, is mounted upon a slide 24 which in turn is adapted to be reciprocated in guides 25 formed in a frame 26 of the machine, by any suitable means, which for convenience consists of a lever 27 pivoted to said frame 26 and connected by a link 28 to said slide 24. A handle 29 is provided whereby said lever 27 may be rocked upon its pivot and the slide 24 reciprocated along said guides.

The median axial line of the holder 18 is preferably concentric with the axis of the valve 8 and also alines with the median axial line of the holder 21, said latter median axial line being coincident with the median axial line of the stem 14, consequently as the jaws 22, which contain the stem 14, are reciprocated toward the jaws 19 containing the head 8, the reduced end portion 15 of said stem will enter the hole 9 in said head.

The copper jaws 19 and 22 constitute terminals for an electric circuit 30 which includes a switch 31. After the head 8 and stem 14 have been formed, as hereinbefore stated, and inserted in their respective holders, the switch 13 is closed and the lever 27 operated by the handle 29 to reciprocate the jaws 22 whereupon the reduced end portion 15 of the stem 14 will be forced into the hole 9 and as soon as said stem and said head contact one with the other the closing of said circuit 30 will be completed as the electric current will pass from one member to the other. As a result of this the extremity of the reduced portion 15 will be first effected by said current and softened or melted and as it comes in contact with the wall 32 of the holder 18 the pressure thereof spreads said end and causes the same to occupy the countersunk portion 13 of said head.

A continued movement of the stem in the direction of the head causes the shoulder 16 to engage the under side 11 of said head between the hole 9 and the recess 12 and immediately upon such an engagement the contacting portions thereof will be melted by said electric current to such an extent that the continued pressure or movement of said stem toward said head will cause the material of said shoulder and the adjacent portion of said head to spread out and occupy the annular recess 12 or at least the greater portion thereof. The pressure upon the stem is continued until the face 33 of the flange 17 contacts with the under side 11 of said valve after which the current is shut off and the pressure relieved.

The difficulty in welding carbon steel stems to tungsten steel heads has been due to the fact that it has been impossible to maintain the parts to be welded at a sufficient temperature to melt the metal comprising the contacting portions thereof, but by forming in the head a recess 12 the heat applied to the head by the electric current will not be permitted to spread over such a large area but will be confined substantially inside of the recess 12 and will be maintained at the surface between the hole 9 and said recess and likewise at the end of the shouldered portion 16 of said valve which contacts with the portion of the head referred to, thus the portions referred to will alone be melted and fused, the flange 17 being provided to cover up any recess which may remain in said head after the metal constituting said shoulder and the adjacent portion of said head have been spread to fill or substantially fill said recess. Another cause for failure in constructing the valves of the material referred to, has been largely due to the attempt to harden the tungsten head of the valve after the stem has been welded thereto with the result that the carbon in the stem was practically destroyed by the intense heat

required in hardening said tungsten steel, which usually runs as high as 2300° F. This difficulty has been entirely eliminated by adopting applicant's method, as hereinbefore stated, which includes the hardening of the head before the stem is inserted therein.

Having thus described my invention what I claim and desire by Letters Patent to secure is:

1. The herein described method of making a valve which consists in forming a head with a hole extending therethrough, and with a recess in the under side of said head surrounding said hole, then forming a stem with a reduced end portion adapted to fit said hole, and with a shoulder surrounding said stem at the base of said end portion, and with a flange surrounding said stem at the base of said shoulder; then inserting said reduced portion in said hole, then applying an electric current to said head and said stem to melt the contacting portions thereof and simultaneously applying pressure to said stem to force said shoulder into said recess, and said flange against the under side of said head.

2. The herein described method of making a puppet valve which consists in forming a head of tungsten steel with a hole extending therethrough, and with a recess in the under side of said head surrounding said hole, then forming a stem of carbon steel with a reduced end portion adapted to fit said hole, and with a shoulder surrounding said stem at the base of said reduced portion, and with a flange surrounding said stem at the base of said shoulder, then inserting said reduced portion in said hole, then applying an electric current to said head and said stem to melt the contacting portions thereof and simultaneously applying pressure to said stem to force said shoulder into said recess and said flange against the under side of said head.

3. The herein described method of making a valve which consists in forming a head with a hole extending therethrough, and with an annular recess in the under side of said head surrounding said hole, then forming a stem with a reduced end portion adapted to fit the hole in said head, and with a shoulder surrounding said stem adjacent the base of said reduced end portion, then inserting said reduced end portion in the hole in said head, then applying an electric current to said stem and said head to melt the contacting portions of said head and stem and simultaneously applying pressure to said stem to force said shouldered portion and the adjacent portion of said head into said annular recess.

4. The herein described method of making a valve which consists in forming a head with a hole extending therethrough, and with an annular recess in the under side of said head surrounding said hole at a distance therefrom, then forming a stem with a reduced end portion, and with a shoulder on said stem at the base of said end portion, and with a flange surrounding said stem at the base of said shoulder, then inserting said reduced end portion in the hole in said head, then applying an electric current to said stem and said head to melt the contacting surfaces of said head and stem and simultaneously forcing said stem into said head, whereby the melted portions of said shoulder and the adjacent melted portion of said head will be united and forced into said annular recess, and the flange on said stem will be forced against the under side of said head.

5. The herein described method of making a puppet valve which consists in forming a head with a hole extending therethrough, and with an annular recess in the under side of said head surrounding said hole and at a distance therefrom, then forming a stem with a reduced end portion and with a shoulder surrounding said stem at the base of said end portion substantially equal in diameter to the inside diameter of said recess, and with an annular flange arranged in close proximity to said shoulder, said flange being substantially larger in diameter than the outside diameter of said recess, then inserting said reduced end portion in the hole in said head, then applying an electric current to said stem and said head to melt the contacting portions thereof, then applying pressure to said stem to unite said contacting surfaces and to force the melted portions of said shoulder and the adjacent portions of said head into said recess, and said flange against the under side of said head.

6. The herein described method of making a valve which consists in forming a head with a hole extending therethrough, and with a countersunk portion in the upper side of said head surrounding said hole, and with an annular recess in the under side of said head surrounding said hole and at a distance therefrom, then forming a stem with an end adapted to fit the hole in said head, with a shoulder on said stem at the base of said end, and with a flange on said stem adjacent said shoulder, then inserting said stem in said hole, then applying an electric current to said stem to melt the end thereof and said shouldered portion and the portion of said head contacting with said shouldered portion, and simultaneously applying pressure to said stem to force the melted portion of said stem into said countersunk portion of said head and the melted shouldered portion of said stem and the adjacent portion of said head into said recess, and to force said flange against the under side of said head.

7. The herein described method of mak-

ing a valve which consists in forming a head of tungsten steel with an axial hole therein, and with an annular recess in the under side of said head at a distance from said hole, then hardening said head, then forming a stem with a reduced end portion adapted to fit said hole, and with a shoulder at the base of said end portion, then inserting said reduced end portion in the hole in said head, then applying an electric current to said head and said stem to melt the contacting surfaces thereof and simultaneously forcing said stem into said head and the melted portions of said shoulder together with the adjacent melted portions of said head into said annular recess.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

ROBERT L. ELLERY.

Witnesses:
F. K. DENNY,
CHARLES HARTMANN.