C. PFANSTIEHL.

METHOD OF WELDING.

APPLICATION FILED DEC. 17, 1917.

1,292,037. Patented Jan. 21, 1919.

FIG. 1

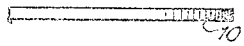



FIG. 2

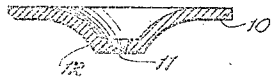



FIG. 4

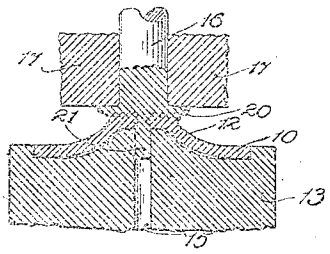



FIG. 5

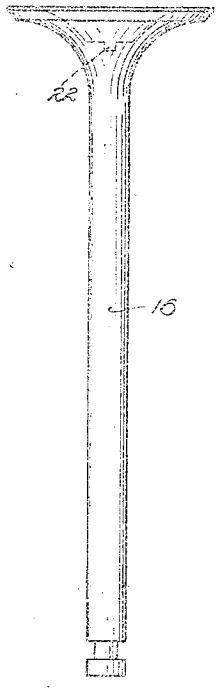
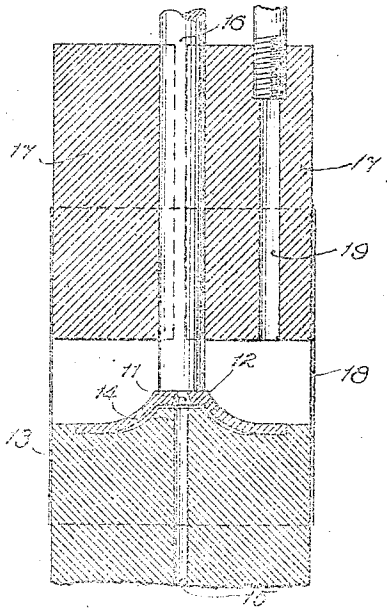



FIG. 3




WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## METHOD OF WELDING.

1,292,037. Specification of Letters Patent. Patented Jan. 21, 1919.

Application filed December 17, 1917. Serial No. 207,481.

*To all whom it may concern:*

Be it known that I, CARL PFANSTIEHL, a citizen of the United States, residing at Highland Park, in the county of Lake and State of Illinois, have invented a certain new and useful Improvement in Methods of Welding, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to a method of welding. The invention is particularly concerned with and is illustrated in connection with the method of uniting a valve head of high speed steel to a valve stem of low speed steel.

Heretofore considerable difficulty has been experienced in securing an efficient weld between high speed steels and low speed steels, the term high speed being used to include tungsten and other similar alloys of steel, and the term low speed being used to designate carbon and nickel steels having varying percentages of carbon or nickel. It is one of the objects of this invention to provide a method for welding steels of the kind referred to which will produce a substantially homogeneous joint between the two metals, the joint being characterized by a blending of the two different metals into each other rather than by a distinct line of separation such as has resulted from methods heretofore in use.

Further objects will appear as the description of my improved process progresses, reference being made to the accompanying drawings in which,

Figure 1 is a side elevation of the disk from which the head of my improved valve is formed;

Fig. 2 is a central section through the head formed from the disk shown in Fig. 1;

Fig. 3 is a more or less diagrammatical cross section through the apparatus I employ for carrying out my improved process showing the valve stem and head in the position they occupy at the beginning of the welding process;

Fig. 4 is a view similar to Fig. 3, portions of the apparatus being broken away, showing the valve stem and head at the end of the welding operation; and

Fig. 5 is a side elevation of the completed valve.

Similar characters of reference refer to similar parts throughout the several views.

In carrying out my improved process the valve heads are formed by first punching disks 10 from a sheet of the alloy of which it is desired to construct the valve head. These disks are then placed in suitable dies and are conformed, as shown in Fig. 2, and at the same time an aperture 11 is formed in the bottom of the conical boss 12 which tapers outwardly. The head thus formed is placed upon the massive copper electrode 13 in an inverted position. The electrode 13 is provided with a central conical boss or projection 14 the curvature of which substantially corresponds to the curvature of the head when finished. The curvature of the head shown in Fig. 2 is such, however, that when placed in inverted position upon the electrode 13 only the outer edges thereof contact with the electrode thus leaving the central portions of the concave side of the valve head spaced from the adjacent surfaces of the electrode. The electrode 13 is provided with a bore 15 which registers with the tapered hole 11 in the valve head.

For conducting current to the valve stem 16 a pair of electrodes 17 are employed which are provided with opposed grooves for receiving the valve stem 16. Means, not shown, are provided for pressing the valve stem 16 downwardly upon the valve head 10. These means are not illustrated for the reason that various means for performing this function are in use and well known to those skilled in this art. A sleeve 18 is slidably mounted upon either the electrode 13 or the electrode 17 so that it may be displaced to permit the valve head and stem to be inserted in the machine. The function of this sleeve is to hold hydrogen or other non-oxidizing gas which is used for displacing the air from the space about the valve head during the welding operation, the air escaping between the sleeve and the electrodes or through any other suitable opening. The hydrogen gas is introduced into the sleeve through the bore 19 in one of the electrodes 17.

After the valve head and stem have been brought into the relation shown in Fig. 3 the electrodes 13 and 17 are connected with the opposite terminals of a suitable source of electricity and pressure is applied to the

valve stem 16 to urge it toward the electrode 13. When the current is first turned on it passes through the valve stem 16 to the valve head and flows from the center of the valve head to the outer edges thereof, being confined to this path by reason of the fact that the central portion of the valve is spaced from the electrode 13 while the edges thereof are in contact with the said electrode. The current continues to flow in this path until the valve head is heated up to the point where the pressure exerted on the valve stem 16 is sufficient to push the central portion of the valve head down against the central portion of the electrode 13. Most of the current then flows straight across the central portion of the valve head from the valve stem 16 to the end of the conical extension 14 of the electrode 13 although sufficient current still flows through the outer portions of the valve head to maintain these portions at a substantially red heat. As the current continues to flow through the central portion of the valve head it causes the lower end of the valve stem to fuse and the pressure being constantly exerted upon the valve stem the fused metal is forced outwardly, as shown in Fig. 4, forming a collar 20 which hardens as it comes in contact with the comparatively cool portions of the electrodes 17. The metal is thus confined by this collar 20 from escaping in this direction and a portion of the fused metal is extruded through the opening 11 in the valve head and passes into the bore 15 of the electrode 13. As the forward end of this extruded metal comes in contact with the walls of the bore 15 a new path for the current is established and the current flowing through this extruded portion of the valve stem maintains it at a very high temperature and as the metal passes along in contact with the walls of the hole 11 the latter are gradually heated up to the fusing point of the metal from which the valve head is formed. The movement of these two metals relative to each other causes a certain mixing of the fused metals and at this point the current supply is shut off. The collar 20, by preventing the escape of metal outwardly, causes sufficient heat to be retained at the contacting surfaces of the stem and valve head to bring this surface of the valve head to the fusing point and inasmuch as the fusing point of the metal of the valve head is considerably higher than that of the metal of the valve stem the fused metal of the valve stem is heated to such a degree that it boils, thereby causing a mixture of the metals of the valve stem and the valve head. After the current is shut off and the valve cooled there is a substantially homogeneous mixture of the metals of the two members all along the contacting surfaces thereof. The collar 20 is then removed by a suitable turning operation and the head of the valve machined and ground as desired. The extruded metal 21 is removed and if desired a slot 22 can be milled in the head of the valve to assist in the turning operation.

The spacing of the central portions of the valve head from the lower electrode during the preliminary heating of the valve head is of importance for the reason that if it was attempted to heat the central portion of the valve head up to the fusing or welding point without heating the outer portions of the valve head very severe internal stresses would be set up in the valve upon the cooling of the central portion thereof which would cause the valve head to be fractured very easily. This condition, however, is avoided by first heating the outer portions of the valve up to a substantially red heat.

The projection 14, in addition to constituting a part of the path for the current flowing across the valve head, serves to withdraw heat from the lower side of the valve head and thus prevents the central portion of the valve head from being fused entirely through.

While I have described my invention in connection with the manufacture of a valve comprising a valve head and a valve stem formed of different metals it is to be understood that my improved process is capable of being used for uniting other pieces of metal having either different or substantially the same melting points and it is not confined to the joining of rod shaped pieces of metal with pieces of sheet metal. My invention is, therefore, not to be limited except by the scope of the following claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The process of welding a plate of one metal to a rod of another metal which comprises the steps of forming a tapered hole through the plate, bringing one end of the rod adjacent the plate so as to cover the small end of the tapered hole, applying pressure to said rod to press it against said plate, passing an electric current through the contacting portions of said rod and plate while the pressure is being applied, conducting the heat away from the side of the plate opposite the rod after the plate has been heated to a substantially red heat and allowing the current to flow until the metal of the rod flows through the hole in said plate and fuses the walls thereof.

2. The process of welding a plate of one metal to a rod of another metal which comprises the steps of forming a tapered hole through the plate, bringing one end of the rod adjacent the plate so as to cover the small end of the tapered hole, applying pressure to said rod to press it against said plate, passing an electric current through

the contacting portions of said rod and plate while the pressure is being applied, and allowing the current to flow until the metal of the rod flows through the hole in said plate and fuses the walls thereof.

3. The process of welding a plate of one metal to a rod of another metal which comprises the steps of forming a hole through the plate, bringing one end of the rod adjacent the plate so as to cover the end of the hole, applying pressure to said rod to press it against said plate, passing an electric current through the contacting portions of said rod and plate while the pressure is being applied, conducting the heat away from the side of the plate opposite the rod after the plate has been heated to a substantially red heat and allowing the current to flow until the metal of the rod flows through the hole in said plate and fuses the walls thereof.

4. The process of welding a plate of one metal to a rod of another metal which comprises the steps of forming a hole through the plate, bringing one end of the rod adjacent the plate so as to cover the end of the hole, applying pressure to said rod to press it against said plate, passing an electric current through the contacting portions of said rod and plate while the pressure is being applied, and allowing the current to flow until the metal of the rod flows through the hole in said plate and fuses the walls thereof.

5. The process of welding a rod to a plate which comprises the steps of forming a tapered hole in said plate, bringing the end of the rod into contact with said plate so as to cover the small end of said hole, applying pressure to force said rod and plate together, heating the rod and plate at their juncture until the metal of the rod passes through said hole and fuses the walls thereof, and then cooling said joint.

6. The process of welding a rod to a plate which comprises the steps of forming a hole through said plate, bringing the end of the rod into contact with said plate so as to cover one end of said hole, and applying pressure and heat to the rod and plate at the point of contact until the metal of the rod flows through said hole and fuses the walls thereof.

7. The process of joining two pieces of metal which comprises the steps of forming a hole in one piece, bringing the other piece into contact therewith so as to close said hole, and applying pressure to force said pieces together while current is caused to pass through said pieces at their point of contact until the metal of the piece of lower melting point fuses and flows into the hole of the other piece.

8. The process of uniting pieces of metal which comprises the steps of forming a hole in one piece, and simultaneously fusing and extruding a portion of the metal of lower melting point through the said hole until the metals of the two pieces become mixed.

9. The process of uniting pieces of metal of different melting points which comprises the steps of simultaneously fusing and extruding a portion of the metal of lower melting point through the metal of higher melting point.

10. The process of uniting two pieces of metal which comprises the steps of simultaneously fusing and extruding a portion of one piece through the other piece.

11. The process of uniting two pieces of metal which comprises the steps of forming a hole in one of said pieces, bringing the pieces together, fusing the metal of the other piece and causing it to pass through said hole until the walls of the hole reach a welding temperature.

12. The process of uniting two pieces of metal which comprises the steps of forming a hole through one of said pieces, extruding a portion of the other piece through said hole in close contact with the walls thereof, and causing an electric current to pass through said extruding portion until the walls of the hole are heated to welding temperature.

In witness whereof, I hereunto subscribe my name this 11th day of December, A. D. 1917.

CARL PFANSTIEHL.

Witnesses:
MARGARET GROBBEN,
IRENE SCHUMANN.