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3,102,827

WELDING ROD

Filed Aug. 10, 1960

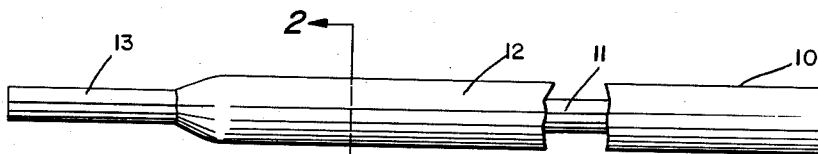


Fig. 1

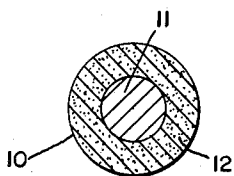


Fig. 2

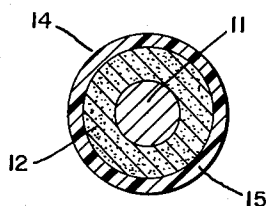


Fig. 3

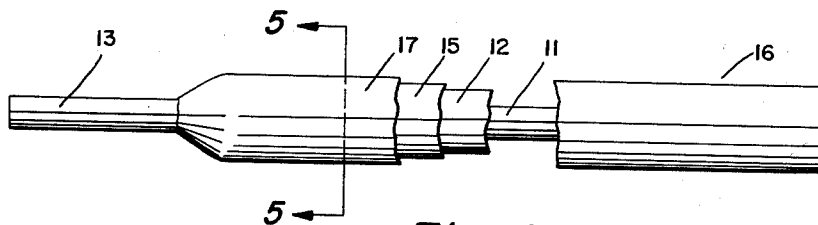


Fig. 4

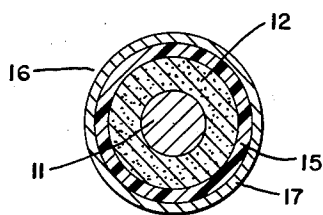


Fig. 5

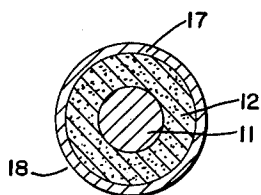


Fig. 6

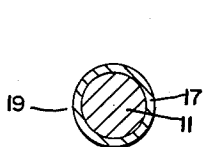


Fig. 7

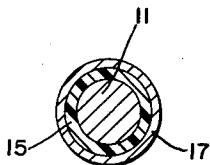


Fig. 8

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3,102,827

WELDING ROD

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The present invention relates generally to metals and metal alloys in the form of sticks, rods, wires, wire coils or special shapes for use in effecting the deposition of a layer of molten metal for the purpose of bonding, joining, surfacing, filling or otherwise treating one or more metallic work pieces, usually referred to as the base metal. For convenience in description, we use the term weldrod herein as a generic designation for such sticks, wires, coils, rods, etc., of deposition metal irrespective of whether they are coated or not, irrespective of whether they are utilized in fusion bonding processes or in non-fusion bonding and irrespective of whether their metallurgy be ferrous or non-ferrous. More particularly our invention relates to an improved form of weldrod having paramount utilization in the field of electric arc welding, but not limited thereto.

It is a primary object of our invention to provide an improved weldrod which will have the following attributes:

- (a) Reduction of gassing, fuming, and spatter in deposition
- (b) Reduction of globular transfer, reduction of length of arc and improved arc stability
- (c) Improvement in physical and molecular characteristics of deposited layer
- (d) Improvement in characteristics and effectiveness of coated weldrods
- (e) Elimination of side-arcing
- (f) Increased durability of coatings
- (g) Increased shelf-life or longevity of the weldrod without deterioration or loss of effectiveness
- (h) Uniformity of performance.

Another object of our invention is to provide a novel method for manufacture of such an improved weldrod.

Other objects and advantages of our invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numerals are employed to designate like parts throughout the same.

FIG. 1 is a view in elevation of a weldrod embodying the features of our invention.

FIG. 2 is an enlarged cross-sectional view taken on line 2—2 of FIG. 1.

FIG. 3 is an enlarged cross-sectional view similar to FIG. 2 showing another form of the invention.

FIG. 4 is a view similar to FIG. 1 of still another form of the invention.

FIG. 5 is an enlarged cross-sectional view taken on line 5—5 of FIG. 4.

FIG. 6 is an enlarged cross-sectional view similar to FIG. 2 of another form of the invention.

FIG. 7 is an enlarged cross-sectional view similar to FIG. 2 showing another form utilizing certain features of our invention.

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FIG. 8 is an enlarged cross-sectional view similar to FIG. 2 of still another form of our invention.

Referring more particularly to FIGS. 1 and 2 of the drawings, we have shown a weldrod 10 having a solid metal core 11 in the form of a wire or rod. The weldrod 10 is here shown in the form of an electrode for arc welding. The core may be steel; a ferrous alloy such as, for example, nickel-iron, nickel-chromium-iron or copper-molybdenum-iron; a non-ferrous metal; or a non-ferrous alloy such as, for example, nickel-copper or aluminum-bronze. The particular composition of the core is a matter of selection by those skilled in the art. The metal core composition per se is not a feature of our invention and is not specifically claimed herein. Our improved weldrod can utilize any of the known metal core compositions.

The core 11 is surrounded by and covered with a suitable flux composition 12, but leaving an end 13 of the core exposed for contact with an electrode holder (not shown). The particular composition of the flux is a matter of selection by those skilled in the art and is not herein claimed as a feature of our invention. Various fluxes are known for particular applications, and our improved weldrod can utilize any flux coating which is considered suitable or desirable for the intended purpose. An example of a representative flux is as follows:

	Percent
Barium carbonate.....	45
Carbonaceous matter.....	25
Fluoride	20
Binder	10
Consisting of:	
Potassium silicate.....	75%
Sodium silicate.....	5%
Potassium hydroxide.....	20%

The flux coating is applied to the core in paste form. Thereafter, the coated core is baked to drive off moisture and volatiles and solidify the flux coating on the core. The baking temperature is normally in the range of 300–500° F. However, the particular temperature selected will depend upon the composition of the flux and the core and may have a range of from 200–100° F. depending upon the character of the compositions involved.

It is of importance to note that the baking process takes place at sub-atmospheric pressures which desirably approach true vacuum and may be on the order of 15 to 29 inches of vacuum (mercury scale), as a practical matter. The sub-atmospheric baking process effectively removes entrapped gases and water vapor, as well as other volatile impurities which could not be effectively removed by the normal range of baking temperatures at atmospheric pressure. The resulting flux coating therefore is more effective in its intended function and generally has a somewhat lower and more uniform melting temperature than flux coatings of the same composition which have not been baked at sub-atmospheric pressure. Smoking, gassing and spatter during the deposition of the filler metal is reduced. Fluidity and melting action is enhanced. Globular metal transfer is minimized so that the transfer occurs as a molecular spray with improved arc stability and a shorter length of arc. The weldlayer itself has improved characteristics as evidenced in better physical properties, less hot-shortness and reduced crack-sensitivity.

In FIG. 3, we have shown a weldrod 14 which includes the core 11 and flux coating 12 and is manufactured by the vacuum baking process previously described or by baking at atmospheric pressures. After the weldrod 14 is baked, the flux coating 12 is covered with a film or coat 15 of a suitable insulating or dielectric material such as sodium silicate or preferably an organic material such as polyethylene, epoxy resin, vinyl resin or the like in liquid form. This may be conveniently accomplished by dipping the flux-coated rod in the liquid, although spraying or other methods of application could also be used. By controlling and maintaining the viscosity of the bath of liquid dielectric material, a predetermined thickness of dielectric coating can be uniformly obtained. A film thickness on the order of .002 inch is adequate. The contact end 13 of the core is, of course, not covered with the film 15. The film 15 is then baked or air-dried, depending on the characteristics of the dielectric material used.

The dielectric film 15 fills the pores of the granular flux coating 12 and provides a smooth uniform seal over the flux coat 12. Although, both the core 11 and flux coat 12 are generally electro-conductive, the dry film 15 is not electro-conductive. Thus, during manipulation of the weldrod 14 in arc welding, particularly when welding in areas such as deep cavities where access is difficult, the possibility of side-arcing of the weldrod is eliminated. Due to the dielectric character of the film 15, no arcing will occur if the side of the weldrod 14 inadvertently comes in contact with the base metal or workpiece.

The film 15 also provides a protective covering for the flux coat 12 and increases the shelf life of the weldrod.

In FIGS. 4 and 5, we have shown a weldrod 16 which is similar to the weldrod 14, but is provided with an additional exterior coating 17 over the dielectric coating 15. After the flux coating 12 and the film 15 have been applied to the core 11 and the weldrod has been baked, under vacuum or at atmospheric pressure, the surface of the film 15 is coated with a thin film of metal by the known process of molten metal spraying or metallizing. Any desired metals may be used such as aluminum, silver, gold, copper, nickel, chromium, tin, etc., which are amenable to a metallizing process. Preferably the metallizing step takes place in a vacuum of at least 15 inches (Hg) so that the undercoats 12 and 15 are sealed under vacuum.

Although the selected metal can be deposited in any desired thickness, we have found that film 17 having a thickness on the order of .0005 to .003 inch is generally adequate for the intended function. The metal film 17 has a high degree of purity and may serve as a means for introducing small percentages of the metal into the weld-layer composition, particularly where the metal cannot be successfully introduced in the flux coating 12. The metal coating 17 also acts to seal the undercoat of flux 12 against deterioration in storage and acts as a vapor barrier to prevent moisture take-up by the flux coating 12 or the dielectric coating 15.

The exterior coating 17 also acts as a physical protection or enclosure for the underlying coatings 12 and 15 to minimize physical damage to the coatings 12 or 15 during shipment, storage and handling. Chipping, chunking, crazing and like inadvertent physical damage to the flux coating 12 is substantially eliminated thus maintaining physical uniformity of the coating 12 throughout its length with consequent uniformity of performance in deposition of the weldlayer.

The purity of the metallic coating 17, which may be on the order of 99.8%, causes the coating 17 to have a significant and desirable deoxidizing effect during the deposition process, which augments the deoxidizing effect of the flux coating 12. During the deposition of the weld-metal, the coating 17 also tends to combine in some degree with the flux coating 12 to decrease the melting point of the flux coating and thus approach a condition where the rate of consumption of the flux 12 and the core 11

are more nearly equal, than would otherwise be the case.

The coating 17 will have a characteristic color or hue which will depend upon the particular metal used. This provides a convenient visual means for identification of a weldrod so as to distinguish it from weldrods of different composition.

Thus the metallic coating 17 provides several distinct and desirable attributes to the weldrod 16 which improve weldrod performance, durability and shelf life.

In FIG. 6, we have shown a weldrod 18 which is similar to the weldrod 16 of FIGS. 4 and 5, except that the dielectric coat 15 is eliminated. The metallic film 17 is applied directly to the baked flux coat 12 under a high degree of vacuum, as previously described. The weldrod 18 is characterized by the same advantages heretofore described, except that the weldrod 18 is not insulated against side-arcing. The structural arrangement of the weldrod 18 is desirable where the weldrod is to be used for torch welding; for automatic welding; for production welding where no side-arcing problem is encountered; for non-fusion bonding such as atmosphere or bath brazing; and the like.

In FIG. 7, we have shown another form of weldrod 19 which can be utilized in those applications where the work piece or base metal is fluxed directly or where for other reasons, no flux coating is required or desired on the core 11. In the weldrod 19 the metal film 17 is applied directly to the core 11, although it will be understood that a dielectric film 15 may also be applied either to the film 17 or intermediate the core 11 and the film 17, as shown in FIG. 8, if the insulating characteristic is desired.

The metal coating 17 may be an element which is already present in the flux, but the coating serves to compensate for the oxidation loss of the metal element in the flux during the deposition process. Or the coating 17 may be a metal which it is not practicable to introduce by means of the flux. In some instances, it may be desirable to use the metallic coating to introduce more than one metallic element into the deposition layer. In that event, the rod of FIGS. 5-8, inclusive, may have a second film 17 of a dissimilar metal applied thereto over the first film 17. Alternatively, the form of FIG. 7 may be used with the addition of a flux coat 12 and an exterior film 17, but of dissimilar metal, as indicated in FIG. 6.

Our process also contemplates the preparation of a metal coated flux independent of the core 11. Such a flux can be used in certain forms of welding, such as submerged-arc welding, where the granular flux is applied directly to the base metal. The flux 12 is baked, as previously described. It may be in the form of a self-sustaining flat sheet or tube or cylinder, as desired. After it has been baked, say in a very thin sheet form, the metal film 17 is applied to all the exposed surfaces of the sheet by the metallizing process previously described. Thereafter, the flux may be crushed or otherwise reduced to a granular form suitable for submerged arc-welding. Such a metal-coated flux will have the attributes and advantages heretofore mentioned in connection with the provision of such a coating directly on a metal core.

Although we have illustrated the invention as applied to an electrode for arc welding, it will be apparent that the principles disclosed are equally usable for coils, rods and various forms of deposition metal in any form of high temperature bonding process. Highly advantageous results are obtained even where the flux coating is baked at atmospheric pressures and then exposed to vacuum during the metallizing process. However, superior results are obtained if the flux coating is also baked under vacuum.

It is to be understood that the forms of our invention, herewith shown and described, are to be taken as preferred examples of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of our invention, or the scope of the subjoined claims.

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Having thus described our invention, we claim:

1. In a weldrod, the combination of a metal core, a flux coating on said core and a sealing coating overlying said flux-coating, said sealing coating comprising one layer of a dielectric material and another layer of a metal film adjacent to said dielectric material. 5
2. In a weldrod, the combination of a metal core, a film of dielectric material on said core, and a coating of a substantially pure metallic element on said dielectric film. 10
3. A combination as defined in claim 2, including a second coating of a metallic element dissimilar to said first-named metallic element.

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