June 25, 1935. E. C. DRAKE 2,005,912

WELDING APPARATUS

Filed April 27, 1931

Fig. 1

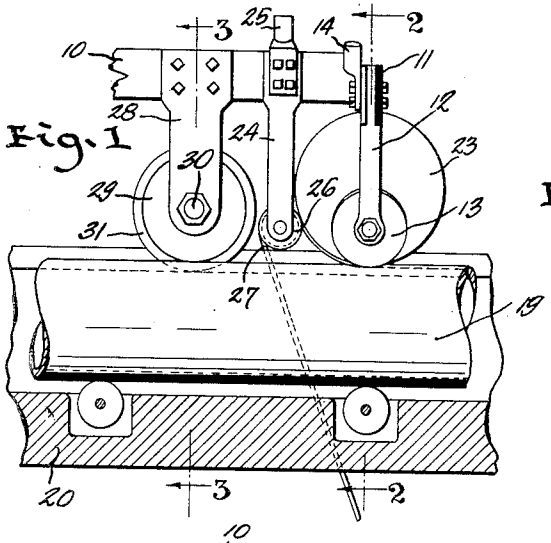


Fig. 2

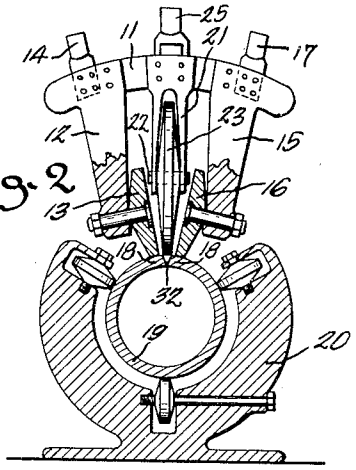


Fig. 3

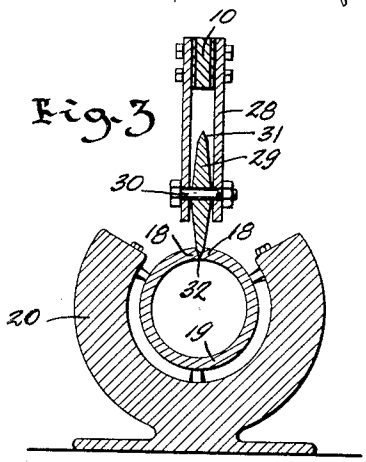


Fig. 4

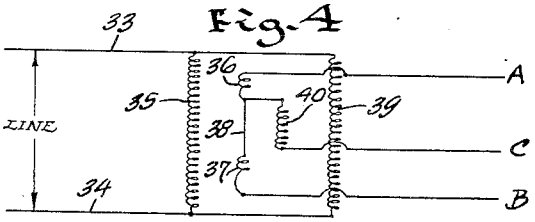


Fig. 5

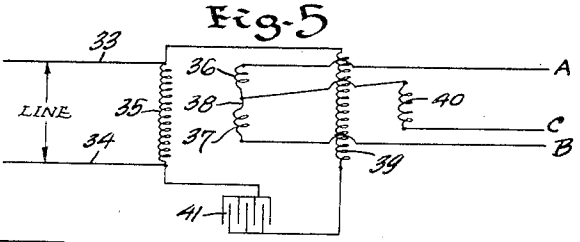


Fig. 6

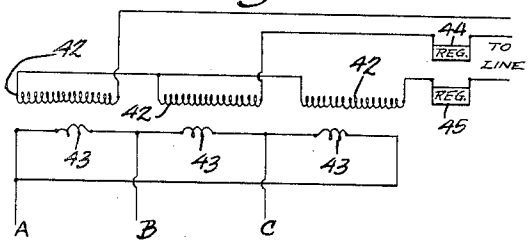


Fig. 8

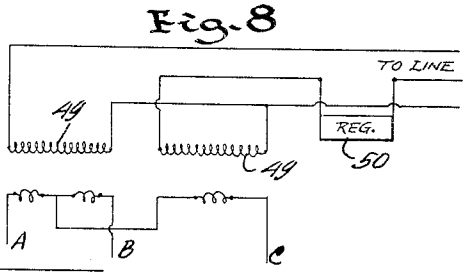
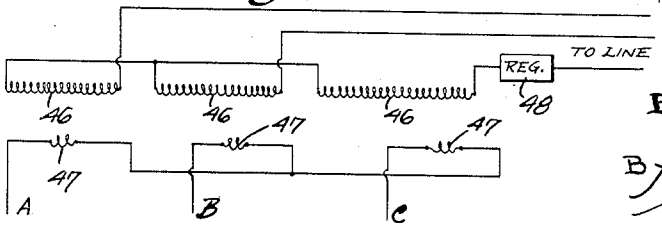


Fig. 7



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UNITED STATES PATENT OFFICE

2,005,912

WELDING APPARATUS

Estes C. Drake, Wheeling, W. Va.

Application April 27, 1931, Serial No. 533,223

16 Claims. (Cl. 219—10)

This invention relates to welding apparatus, and has for an object the provision of new and improved apparatus of this character.

In the drawing accompanying this specification and forming a part of this application I have shown, for purposes of illustration, several forms which my invention may assume, and in the drawing:

Figure 1 is a fragmentary side elevational, part sectional view of an embodiment of the invention,

Figure 2 is a vertical sectional view corresponding to the line 2—2 of Figure 1,

Figure 3 is a vertical sectional view corresponding to the line 3—3 of Figure 1,

Figure 4 is a diagrammatic layout of electrical equipment employed in connection with said embodiment, while

Figures 5 through 8 disclose diagrammatic layouts of different forms of electrical equipment employed in connection with the invention.

The embodiment herein disclosed, comprises a bar 10 adapted to be supported in fixed position by any suitable means, not shown, carrying a cross bar 11, to one end of which is secured a hanger 12, insulated from the cross bar 11, carrying at its lower end a roller 13, which may be water-cooled in any suitable manner, not shown, and at its upper end carrying a terminal member 14, the hanger 12, roller 13 and terminal member 14, providing one electrode member A of the apparatus; and adjacent the opposite end of the cross bar 11 is secured a hanger 15, insulated from the cross bar 11, carrying at its lower end a roller 16, which also may be water-cooled by any suitable means, not shown, and at its upper end carrying a terminal member 17, the hanger 15, roller 16 and the terminal member 17, together providing another electrode member B of the apparatus. The hangers 12 and 15 are arranged so that the rollers 13 and 16 are spaced apart a predetermined distance, and are adapted to engage opposite sides of the meeting edges 18 of a pipe 19, carried by a forming machine 20 of a well known type.

The cross bar 11 also carries a depending bracket 21, having spaced legs carrying an axle 22 on which is mounted a smoothing wheel 23, formed from material having low electrical and heat conductivity, such as carborundum, the smoothing wheel 23 being disposed between the hangers 12 and 15 and operable in a manner presently to appear.

The bar 10 also carries a hanger 24, longitudinally spaced from the hangers 12 and 15, insulated from the bar 10, at its upper end connected to a terminal 25 and at its lower end carrying a roller 26, which also may be water-cooled by any suitable means, not shown, having a grooved rim, the hanger 24, the terminal 25 and the roller 26 constituting still another electrode member C of the apparatus. The roller 26 lies at a higher elevation than the rollers 13 and 16 and in a central position with reference to the work, and carries a filler member 27, which may be of the same material as the material of which the pipe 19 is made, or any other suitable material, preferably triangular in cross-section, riding in the groove in the rim of the roller 26, and is adapted to be fed into the groove between the meeting edges 18 of the pipe 19.

The bar 10 also carries a longitudinally spaced bracket 28, at the lower ends of which is a cutting disk 29, rotatably mounted upon an axle 30, the circumferential periphery 31 of the disk 29 being beveled for engagement with the meeting edges 18 of the pipe 19, and operable to cut said edges so that only small surfaces 32 are actually in contact at the time the welding operation is performed.

Although not shown it will be understood that the various members of the welding apparatus described may be adjustably mounted in any well known manner to facilitate application to the work, and if desired the roller 26 may be positively driven, and the disk 29 also positively driven, preferably in a direction opposite to the travel of the work.

Referring to Figure 4 of the drawing, one form of electrical equipment adapted to cooperate with the welding apparatus is disclosed. In this arrangement an alternating single phase current is utilized, one line wire being indicated at 33 and another at 34, and connected in parallel are two transformers, one comprising a primary coil 35 and secondary coils 36 and 37 connected in series by a conductor 38, one end of the coil 36 leading to the electrode A, while the opposite end of the coil 37 leads to the electrode B; the other transformer comprising a primary coil 39 and a secondary coil 40 tapped in at the conductor 38, of more turns than both the coils 36 and 37, and leading to the electrode C.

Due to this arrangement, in effect two circuits are provided, one being made through the electrodes A and B, of one predetermined welding value, adapted to pass through the pipe 19, through the reduced surfaces 32 of the meeting edges 18 of the pipe 19, and sufficient to bring the temperature up to a point just short of fusing temperature, while the other circuit, of a

higher predetermined welding value, is made through the electrode C, through the filler member 27, and through the electrodes A and B, the higher welding value of this circuit resulting in fusing temperature in the filler member 27, melting, however, being delayed somewhat, or until the filler member 27 comes into contact with the already highly heated meeting edges 18 of the pipe 19, so that the filler member 27 and the meeting edges 18 simultaneously fuse at contact.

Relative travel of the work and of the apparatus, in this instance the pipe 19 moving through the forming apparatus 20, causes the following operations to take place: the cutting disk 29 being first to enter the groove between the meeting edges 18 of the pipe 19 prepares the work in advance of welding, cleaning and reducing the meeting edges 18 so that only the small surfaces 32 remain in contact, which localizes and concentrates the heat during the welding operation; the disk 29 also serves as a guide member as will be understood; the filler member 27 is fed in the groove provided by the meeting edges 18 of the pipe 19 while substantially at fusing temperature as before mentioned, is pressed into the groove by the smoothing wheel 23, fusion taking place as soon as contact is effected between the filler member 27 and the preheated edges 18 of the pipe, and the smoothing wheel 23 smooths the weld thus effected.

In Figure 5, the electrical equipment shown is identically similar to that described in connection with Figure 4 and similar reference characters will be employed to designate like parts of each; however, capacity, as indicated at 41, is thrown into the circuit containing the coil 39, resulting in phase displacement of the electrical energy traversing the circuit through electrodes A and B and that traversing the circuit through electrode C and electrodes A and B. The different phase relation of the electrical energy traversing these circuits results in an increased "stitching" effect in the weld, providing marked efficiency in welding, and resulting in a weld of great mechanical strength.

The additional "stitching" effect of the different phase relation of the current traversing the welding circuits may be increased by the use of a three-phase hook-up such as that shown in Figure 6, wherein transformers are provided the primaries 42 and the secondaries 43 of which are arranged in the well known Star-Delta formation, and the secondaries 43 connected to provide circuits through the electrodes A, B, and C as shown; for the purpose of regulating the welding values of the respective circuits regulators 44 and 45 of any well known type, employing resistance, reactance or induction, may be employed.

In Figure 7 there is shown another three-phase hook-up, wherein transformers are provided having primaries 46 and secondaries 47 arranged in the conventional Star-Star formation, and the secondaries 47 are connected to provide circuits through the electrodes A, B and C, as shown, a suitable regulator 48 being employed for controlling the relative welding values of the respective circuits.

In Figure 8 a two-phase three wire arrangement is shown, wherein the transformers 49 have their secondaries connected to provide circuits through the electrodes A, B and C, as before explained, and a suitable regulator 50 may be employed for controlling the relative welding values of the respective circuits.

In some cases, and particularly in connection with any of the electrical circuits described, frequencies higher than standard may be employed for obtaining enhanced "stitching" effect in the weld.

From the above description it will be appreciated that electrical energy is supplied to the two circuits through the electrodes A, B and C at different welding values, resulting in high welding efficiency; also electrical energy supplied to the welding circuits in displaced phase or polyphase relation, provides a multiple stitching effect in the weld, effects more rapid and localized heating and more rapid welding, more equally balances the load on generating and transforming equipment, assures more even temperatures through the passing of the current in three directions at the point of welding, and in the case of pipes eliminates any necessity for applying high pressure to bring the meeting edges to be welded into close butting relation.

It will be apparent to those skilled in the art that the embodiments herein disclosed accomplish at least the principal object of the invention; it will also be apparent to those skilled in the art that the embodiments disclosed, in addition to being particularly well adapted for welding the meeting edges of pipes, may also be employed for joining plates, Z-bars, angle bars, channel bars, and the like, and is further adapted for uses and purposes not herein particularly mentioned; it will also be understood that various changes and modifications may be made in the invention without departing from the spirit thereof; accordingly it will be appreciated that the embodiments herein disclosed are illustrative only and the invention is not limited thereto.

I claim:

1. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; and causing current to flow between said portions, in an amount to heat said portions to one temperature, and along said strip and between said strip and at least one of said portions, in an amount to heat said strip to a substantially different temperature.

2. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; and causing current to flow between said portions, in an amount to heat said portions to one temperature, and along said strip and between said strip and at least one of said portions, in an amount to heat said strip to a substantially higher temperature.

3. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; applying potential between said portions, to cause current to flow between said portions in an amount to heat said portions to one temperature; and applying a substantially different potential between said strip and at least one of said portions, to cause current to flow therebetween in an amount to heat said strip to a substantially different temperature.

4. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the

weld; applying potential between said portions, to cause current to flow between said portions in an amount to heat said portions to one temperature; and applying a substantially higher potential between said strip and at least one of said portions, to cause current to flow therebetween in an amount to heat said strip to a substantially higher temperature.

5. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; applying potential to said portions to cause current to flow between said portions in an amount to heat said portions to one temperature; and applying a substantially different potential between said strip and at least one of said portions, to said strip at a point spaced from the welding point, to cause current to flow along said strip and between said strip and one or both of said portions in an amount to heat said strip to a substantially different temperature.

6. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; applying potential to said portions, to cause current to flow between said portions in an amount to heat said portions to one temperature; and applying a substantially higher potential between said strip and at least one of said portions, to said strip at a point spaced from the welding point, to cause current to flow along said strip and between said strip and one or both of said portions in an amount to heat said strip to a substantially higher temperature.

7. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions and to said strip, connected to said strip at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions, in such respective amounts that said strip is heated to a temperature substantially different from that to which said portions are heated.

8. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions and to said strip, connected to said strip at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions, in such relative amounts that said strip is heated to a temperature substantially higher than that to which said portions are heated.

9. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising means connected to said portions and to said strip, to cause current to flow between said portions, and to cause current to flow between said strip and at least one of said portions, imposing between said portions a potential substantially different from the potential imposed between said strip and said one or both portions, whereby said strip is heated to a temperature substantially different from that to which said portions are heated.

10. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising means connected to said portions and to said strip, to cause current to flow between said portions, and to cause current to flow between said strip and at least one of said portions, imposing between said portions a potential substantially lower than the potential imposed between said strip and said one or both portions, whereby said strip is heated to a temperature substantially higher than that to which said portions are heated.

11. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions and to said strip, connected to said strip at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions, imposing between said portions a potential substantially different from the potential imposed between said strip and said one or more portions, whereby said strip is heated to a temperature substantially different from that to which said portions are heated.

12. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions, and to said strip at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions, imposing between said portions a potential substantially lower than the potential imposed between said strip and said one or more portions, whereby said strip is heated to a temperature substantially higher than that to which said portions are heated.

13. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions and to said strip, connected to said strip at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions.

14. A welding system, using a filler strip to be interposed between the edge portions of the work to be welded, and to furnish material for the weld, comprising: means for continuously moving said work relatively; means for progressively feeding said strip, between said portions, during the operation; and means connected to said portions and to said strip, connected to said strip

at a point spaced from the welding point, to cause current to flow between said portions, and to cause current to flow along said strip and between said strip and at least one of said portions, imposing between said portions a potential substantially different from the potential imposed between said strip and said one or more portions.

15. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; and causing current to flow between said portions, and along said strip and between said strip and at least one of said portions.

16. A method of welding, comprising: interposing a filler strip between the edge portions of the work to be welded, to furnish material for the weld; moving said work continuously relatively; progressively feeding said strip between said portions, during such movement; applying potential to said portions to cause current to flow between said portions; and applying a substantially different potential between said strip and at least one of said portions, to said strip at a point spaced from the welding point, to cause current to flow along said strip and between said strip and one or both of said portions.

ESTES C. DRAKE.