United States Patent

Lifshits et al.

[15] **3,681,563**

[45] **Aug. 1, 1972**

[54] **CONTINUOUS FLASH-OFF RESISTANCE BUTT-WELDING**

[72] Inventors: **Viktor Senderovich Lifshits,** Kavkazsky bulvar, 21, korpus 2, kv. 41; **Vladimir Rubenovich Andrianov,** Proezd Zarevy, 3, kv. 19; **Nikolai Nikolaevich Rykalin,** ulitsa Akademika Gubkina, 4, kv. 64; **Tibor Ferentsevich Krasnev,** Starokirpichny pereulok, 4, kv. 1, all of Moscow; **Nikolai Vasilievich Podola,** ulitsa Pushkinskaya, 8, kv. 12; **Vadim Petrovich Kirvonos,** ulitsa Repina, 13, kv. 1, both of Kiev, all of U.S.S.R.

[22] Filed: **Nov. 10, 1971**

[21] Appl. No.: **197,204**

[52] **U.S. Cl.** **219/97,** 219/103

[51] **Int. Cl.** **B23k 11/04**

[58] **Field of Search** 219/97, 101, 103

[56] **References Cited**

UNITED STATES PATENTS

2,790,892	4/1957	Colon	219/97
3,002,082	9/1961	Sheer	219/97

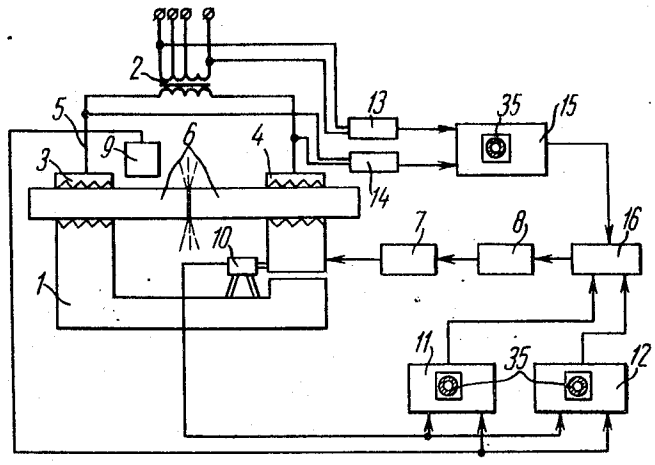
Primary Examiner—R. F. Staubly

Attorney—Holman & Stern

[57] **ABSTRACT**

A continuous flash-off resistance butt-welding machine, comprising: a base; a movable work clamp located on said base; a fixed work clamp located on said base; a hydraulic traversing mechanism for said movable clamp; a follow-up slide to control said hydraulic traversing mechanism for said movable clamp; a barrel of said follow-up slide rigidly connected with one of said clamps of the machine; a plunger for said follow-up slide; an automatic flashing-rate control device; a device for automatic control of the initiation of the upsetting process; a device for automatic control of the amount of upset; actuators of said devices formed as a single unit rigidly connected with the other said clamp of the machine and incorporating a rod, two lengthwise motion drives for said rod, a restrictor of said rod lengthwise motion and a drive for said restrictor; one of said drives for lengthwise motion of said rod being interconnected with the outlet of said automatic flashing-rate control device; the other said drive for lengthwise motion of said rod being interconnected with the outlet of said device for automatic control of the initiation of the upsetting process; said drive for the restrictor being interconnected with the outlet of said device for automatic control of the amount of upset; said rod of the unit being connected to said plunger of the follow-up slide.

2 Claims, 2 Drawing Figures



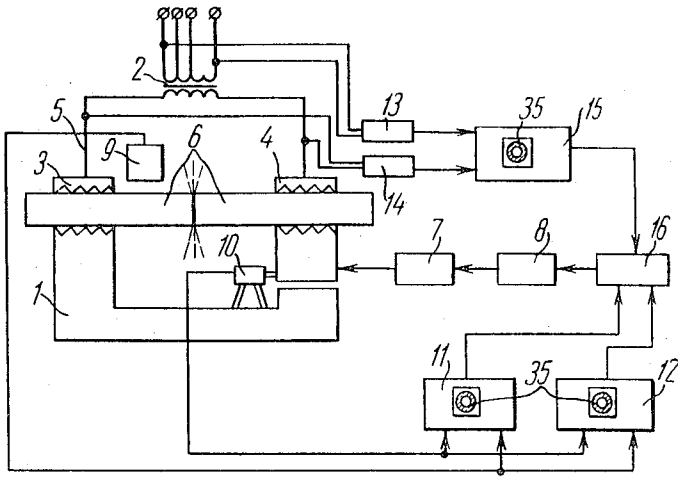

2
5
9
6
4
3
13
35
15
14
7
8
16
10
1
11
35
12

FIG. 1

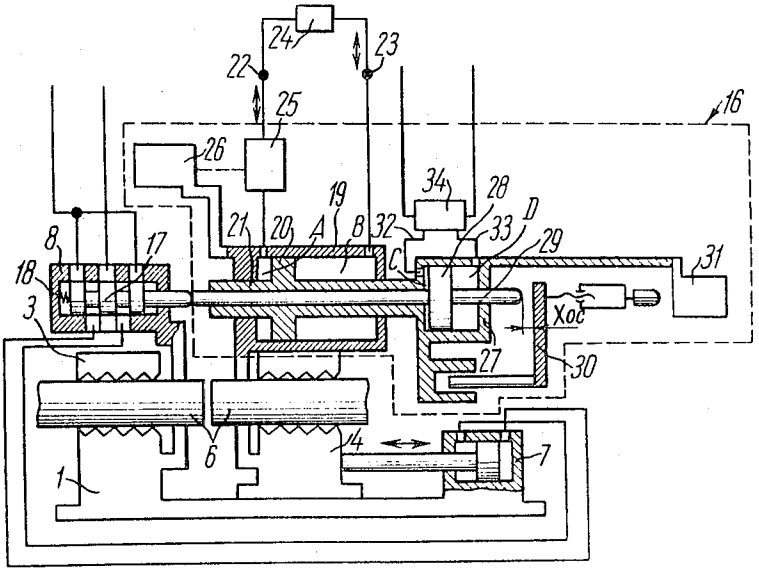

24
23
22
25
16
26
19
34
28
D
21
20
A
B
32
33
29
31
8
17
18
C
3
Xoc
27
30
6
4
7
1

FIG. 2

CONTINUOUS FLASH-OFF RESISTANCE BUTT-WELDING

This invention relates generally to welding equipment and apparatus and, more particularly, to continuous flash-off resistance butt-welding machines.

Known in the prior art are continuous flash-off resistance butt-welding machines, comprising a base carrying a movable and a fixed work clamp, a hydraulic traversing mechanism for said movable clamp, said mechanism being controlled by a follow-up slide with a plunger, and a device for automatic control of flashing rate, initiation of the upsetting process and the amount of upset. Each of said devices has its actuator.

A disadvantage inherent in the known resistance butt-welding machines resides in that each of the devices for automatic control of flashing rate, initiation of the upsetting process and the amount of upset is equipped with its own actuator. This involves the provision of special complicated auxiliary devices to correlate the operation of said actuators that act upon the same plunger of the follow-up slide. Apart from all discussed above the actuators of the three above-mentioned automatic control devices fail to possess the desired versatility, this being due to some design particularities in which the follow-up slides differ from one another.

An object of the present invention is to provide a continuous flash-off resistance butt-welding machine, wherein the actuators of the devices for automatic control of flashing speed, initiation of the upsetting process and the amount of upset are aggregated into a single unit.

The essence of the present invention resides in that in a continuous flash-off resistance butt-welding machine, comprising a base carrying a movable work clamp, a fixed work clamp, a hydraulic traversing mechanism for said movable work clamp, said mechanism being controlled by a follow-up slide with a plunger, and devices for automatic control of flashing speed, initiation of the upsetting process and the amount of upset, each of said devices having its own actuator, according to the invention, said actuators are made as a single unit rigidly connected with one of the clamps of the machine and comprising a rod, two drives to impart lengthwise movement to said rod and a rod lengthwise motion restrictor with a drive, arranged in such a manner that one of the rod lengthwise motion drives is connected to the outlet of an automatic flashing speed control device, the other rod lengthwise motion drive is connected to the outlet of an automatic device to control the initiation of the upsetting process and the restrictor drive is connected to the outlet of an automatic device to control the amount of upset, whereas the other clamp of the machine is rigidly connected with the barrel of the follow-up slide whose plunger is kinematically bound with the rod of said unit.

In said unit one of the rod lengthwise motion drives which controls the initiation of the upsetting process, may incorporate a two-position valve to control the initiation of the upsetting process and a cylinder with a piston, said cylinder communicating with said valve through two pipings, said piston of said cylinder being connected to a two-end rod arranged coaxially with the plunger of the follow-up slide so that one end of said

rod is in contact with said plunger during flash-off and at the end of the upsetting process, while the other end of said rod is adapted to thrust against the restrictor of the rod lengthwise motion that controls the amount of upset, when the cylinder piston travels longitudinally during the upsetting process; the other rod lengthwise motion drive which controls the flashing rate may comprise a three-position valve to control the direction of travel of the work movable clamp, another cylinder with a piston, said cylinder communicating with said three-position valve through two pipings, a controlled throttle built-in into one of said pipings, and a reversible electric drive whose frame is connected to the housing of said second cylinder and whose shaft is kinematically connected with said controlled throttle; the piston of the second cylinder is connected to another rod which is made hollow and double-ended and which accommodates said former rod, the housing of the second cylinder being locked-in with one of the work clamps, one of the ends of the second rod is rigidly connected with the housing of the former cylinder and the restrictor drive may be made as a reversible electric motor whose frame is rigidly connected with the former cylinder and whose shaft is kinematically bound with the restrictor of the amount of upsetting.

Further the invention is disclosed in the illustrative embodiments thereof to be taken in due reference with the accompanying drawings, wherein:

FIG. 1 is a block-diagram of a resistance butt-welding machine, according to the invention; and

FIG. 2 is a kinematic diagram of the actuators of the devices for automatic control of welding process formed as a single unit showing its interconnection with the machine, according to the invention.

Continuous flash-off resistance butt-welding machine of the invention comprises a base **1** (FIG. 1), a welding transformer **2**, a fixed clamp **3** and a movable clamp **4** with current leads **5** to hold workpieces **6** being welded. The movable clamp **4** is traversed by a hydraulic mechanism **7** controlled by a three-position follow-up slide **8**. The base **1** carries pickups **9** to measure the temperature field in the workpieces **6** during welding, as well as a pickup **10** of the traversing of the workpieces **6** in the course of welding. The terminals of the pickups **9** and of the pickup **10** are connected to the inlets of a device **11** for automatic control of the initiation of the upsetting process and to the inlets of a device **12** for automatic control of the amount of upset. The primary winding of the welding transformer **2** is connected to a voltage converter **13**, while the secondary winding of the transformer **2** is connected to another voltage converter **14**. The terminals of the converters **13** and **14** are connected to the inlets of an automatic flashing-rate control device **15**. The terminals of the device **11** for automatic control of the initiation of the upsetting process, that of the device **12** for automatic control of the amount of upset and that of the automatic flashing-rate control device **15** are connected with the inlets of the actuators for the automatic control of welding process, said actuators being made as a single unit **16**.

FIG. 2 illustrates a kinematic diagram of the actuators of the devices for the automatic control of welding process made as the single unit **16** and their operative association with the machine equipped with the

hydraulic traversing mechanism 7 controlled by the three-position follow-up slide 8 with a plunger 17 unilaterally springing with a spring 18.

In this case unit 16 is made as a cylinder 19 rigidly connected with the movable clamp 4, said cylinder accommodating a piston 20 with a hollow two-end rod 21. The piston 20 with the rod 21 is arranged coaxially with the plunger 17 of the follow-up slide 8. Pipings 22 and 23 run to each of the respective cavities A and B of the cylinder 19 through which working medium (liquid or gas) is fed from a three-position valve 24 controlling the direction of traverse of the movable clamp 4 that holds workpiece 6. A controlled throttle 25 is built-in into the piping 22, said throttle being mechanically interconnected with the shaft of a reversible motor 26 whose frame is rigidly connected with the cylinder 19. One of the ends of the hollow rod 21 of the piston 20 is rigidly connected with and arranged coaxially of a cylinder 27 which accommodates a piston 28 with a two-end rod 29, one of the ends of said rod passing inside the hollow rod 21 of the piston 20 to be in contact with the plunger 17 of the follow-up slide 8. The other end of the rod 29, as a result of the piston 28 travelling into its second extreme position in the course of the upsetting process, thrusts against a restrictor 30 of its lengthwise motion that controls the amount of upset. The restrictor 30 is mechanically interconnected with the shaft of a reversible motor 31 whose frame is rigidly connected with the cylinder 27. Working medium into the cavities C and D is fed through one of respective pipings 32 and 33 depending upon the position assumed by a two-position valve 34 controlling the initiation of the upsetting process. The valve 34 in the course of flash-off process is operative to communicate the cavity D of the cylinder 27 with the delivery line through the piping 33 and the cavity C with the pressure falling line through the piping 32. In the course of upsetting process the cavity C of the cylinder 27 is under pressure, whereas the cavity D communicates with the pressure falling line. The distance X from the rod 29 to the restrictor 30 of its lengthwise motion corresponds to the amount of upset.

Prior to initiation of welding the movable clamp 4 and the fixed clamp 3 of the workpieces 6 being welded are spaced apart at a maximum distance. Such a position of the movable clamp 4 is provided due to the fact that the piston 20 with the rod 21 and the piston 28 with the rod 29 assume their extreme L.H. position (FIG. 2) so that the cavity B of the cylinder 19 and the cavity D of the cylinder 27 are under the pressure of working medium, whereas the cavities A and C of the said respective cylinders communicate with the pressure falling lines.

To effect welding with the use of the herein-disclosed machine a number of preconditioning operations are to be carried out, viz., setting the secondary voltage U_o on the transformer 2, gripping of the workpieces 6 in the movable clamp 4 and fixed clamp 3 of the machine, setting of the initial flashing speed V_o, setting of the upset speed V, adjustment of the setter in the automatic flashing-rate control device 15, adjustment of the setter in the device 11 for automatic control of the initiation of the upsetting process and adjustment of the setter in the device 12 for automatic control of the amount of upset.

The secondary voltage U_o on the transformer 2 is set by means of a switch (not shown) in the primary winding of the transformer. The initial flashing rate V_o is set by manually opening the throttle 25. The setters in the devices 11, 12 and 15 for the automatic control of welding process are adjusted to the required position by rotating potentiometer knobs 35 which are conventionally shown in FIG. 1 as circle symbols. The upset rate is controlled by varying the pressure in the hydraulic system which feeds the hydraulic traversing mechanism 7 of the movable clamp 4.

Depending on the regulating methods of the welding process the setters adjust the corresponding welding parameters. In said considered particular case FIG. 1 illustrates as one of possible embodiments of the present invention, the machine carrying out welding method according to the invention, wherein the flashing rate is regulated depending upon the preset level of power developed in the workpieces being welded in the course of flash-off process; the initiation of the upsetting process is determined by the moment corresponding to reaching the required temperature on the flashed surfaces, while the amount of upset is specified as the distance between the cross-sectional areas of the workpieces being welded at the given temperature.

Thus, in the above-cited example the setters of the devices 11, 12 and 15 adjust respectively the power level, the temperature of flashing-off butts at the moment of upset and the temperature of the cross-sectional areas of the workpieces being welded, the distance between which is equal to the amount of upset.

When the above preliminary operations have been carried out, the pickups 9 are put onto one of the workpieces (in said particular case) to measure the temperature field in the workpieces being welded. Then the transformer 2 is energized and the three-position valve 24 is put in the position wherein the pressure of the working medium is delivered into the cylinder 19 along the piping 22, while the pressure of the working medium is relieved from the cylinder 19 through the piping 23. Thus, the welding process is initiated, and the voltage of the primary circuit of the transformer 2 is fed to the converter 13, while the secondary voltage (of the welding circuit) is supplied to the converter 14. The converted voltages are applied to the inlet of the automatic flashing rate control device 15. According to the functional algorithm of the device 15, predetermined before welding and the current values of the electrical welding parameters arrived at the device during the welding process, a corresponding signal appears at the outlet of the device 15 to set in motion the reversible motor 26 mechanically connected with the plunger of the throttle 25. As a result, the plunger of the throttle 25 occupies such a position wherein the travelling speed of the piston 20 with the rod 21 in the cylinder 19 of the control unit 16 assumes the values at which the secondary voltage in the welding circuit is reduced due to the voltage drop across its intrinsic resistance down to the value which depends on the position of the setter in the automatic flashing rate control device 15.

During the flash-off process the areas adjacent to the flashing butts of the workpieces 6 being welded, get heated and signals appear at the outlet of the pickups 9

to arrive at the inputs of the devices **11** and **12**. At the same time another signal appears at the outlet of the pickup **10** as a result of traversing of the movable clamp **4** of the machine in the course of flashing process, said signal likewise arriving at the inlets of the devices **11** and **12**.

According to the functional algorithms of the devices **11** and **12** as preset before welding on each of the devices **11** and **12** and the running values of the signals delivered from the pickups **9** and **10** to said devices,corresponding signals appear at the output of the devices **11** and **12**. The signal from the outlet of the device **12** for automatic control of the amount of upset puts in motion the reversible motor **31** mechanically connected with the restrictor **30** of the lengthwise motion of the rod **29**. As a result the restrictor occupies such a position, wherein at any given instance the distance between the R.H. portion of the rod **29** and the restrictor **30** is equal to the instantaneous amount of upset. The latter is under constant variation during the welding process, being the function of the temperature field arising in the course of flashing occurring in the workpieces under welding. The signal from the outlet of the device **11** for the automatic control of the initiation of the upsetting process is transmitted upon the control winding of the two-position valve **34**. When the temperature of the flashing butts of the workpieces **6** under welding reaches the value predetermined by the setter in the device **11** before welding, this causes operation of the two-position valve **34**. At the same time the pickups **9** are brought out of contact with the workpieces **6** under welding,the position of the piston **20** is fixed by the rod of the three-position valve **24** occupying the neutral position, the working medium is fed under pressure into the cavity C of the cylinder **27** and is released from the cavity D. As a result the piston **28** and the plunger **17** of the slide **8** traverse intermittently towards the restrictor **30** at a speed by one order exceeding that of upset. It is therefore evident that when the valve **34** operates the restrictor **30** is fixed in position and the piston **28** with the rod **29** travels till getting in contact with the restrictor **30**.

The movable clamp **4** of the machine, due to the provision of the follow-up system of the traversing mechanism **7**,follows the travel of the rod **29**, i.e., the workpieces **6** under welding will be upset for a length equal to the distance between the rod **29** and the restrictor **30** at the moment preceding the upsetting process.

To set up the machine into the initial position after the welded-up workpieces **6** have been released from the clamps **3** and **4**, the throttle **25** is fully open and the working medium is fed under pressure via the three-position valve **24** into the cavity B of the cylinder **19**, while the cavity A gets communicated with the drain outlet. Simultaneously the working medium is fed under pressure via the two-position valve **34** into the cavity D of the cylinder **27** and the cavity C gets communicated with the drain outlet. As a result, the plunger **17** of the follow-up slide travels leftward and the hydraulic traversing mechanism **7** of the movable clamp **4** travels rightward to the initial position.

What we claim is:

1. A continuous flash-off resistance butt-welding machine, comprising: a base; a movable work clamp located on said base; a fixed work clamp located on said base; a hydraulic traversing mechanism for said movable clamp; a follow-up slide to control said hydraulic traversing mechanism for said movable clamp; a barrel of said follow-up slide rigidly connected with one of said clamps of the machine; a plunger of said follow-up slide; an automatic flashing-rate control device; a device for automatic control of the initiation of the upsetting process; a device for automatic control of the amount of upset; actuators of said devices formed as a single unit rigidly connected with the other said clamp of the machine and incorporating a rod, two lengthwise motion drives for said rod, a restrictor of said rod lengthwise motion and a drive for said restrictor; one of said drives for lengthwise motion of said rod being interconnected with the outlet of said automatic flashing-rate control device; the other said drive for lengthwise motion of said rod being interconnected with the outlet of said device for automatic control of the initiation of the upsetting process; said drive of the restrictor being interconnected with the outlet of said device for automatic control of the amount of upset; said rod of the unit being connected to said plunger of the follow-up slide.

2. A machine of claim **1**, wherein said drive of the rod lengthwise motion that controls the initiation of the upsetting process of the workpieces under welding in response to the signal from said device for the automatic control of the initiation of the upsetting process, comprises a two-position valve to control the initiation of the upsetting process, two pipings, a first cylinder communicating with said valve to control the initiation of the upsetting process through said pipings, a piston of said first cylinder interconnected with said rod of the control unit; said rod of the control unit made double-ended and arranged coaxially with said plunger of the follow-up slide so that with its one end said rod is in contact with said plunger of the follow-up slide during the flash-off process and at the end of the upsetting process, while with its other end the rod thrusts against said restrictor of its lengthwise motion as a result of lengthwise motion of said piston of the first cylinder in the course of the upsetting process; the other said drive of lengthwise motion of the rod of the control unit that controls the flashing speed of the workpieces under welding in response to the signal from said automatic flashing-rate control device, incorporates a three-position valve to control the direction of travel of the movable clamp for the workpiece under welding; two pipings; a second cylinder communicating with said valve controlling the direction of the movable clamp travel via said pipings; the shell of said second cylinder locked-in with one of said clamps for the workpieces under welding; the piston of said second cylinder; a controlled throttle built-in into one of said pipings; a reversible electric drive having a frame and a shaft; said frame of said reversible electric drive interconnected with said housing of the second cylinder; said shaft of the reversible electric drive mechanically interconnected with said controlled throttle; a second hollow rod interconnected with said piston of the second cylinder and accommodating said rod of the control unit; one of the ends of said second rod rigidly connected with said housing of the first cylinder; said drive of the restrictor made as a reversible electric motor

whose frame is rigidly connected with said first cylinder, while its shaft is mechanically interconnected with said restrictor.

* * * * *