

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO RESISTANCE ROLL-WELDING MACHINES

(71) We, FAEL S.A., a Swiss Body Corporate, of Musinière 17, CH-2072 Saint-Blaise, Switzerland, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to resistance roll-welding machines.

There have been proposed resistance roll-welding machines comprising two superimposed roller electrodes, by means of which for instance there can be produced longitudinal welded seams in can bodies or blanks from which cans are fabricated, with one roller electrode disposed internally of the blank. Due to the limited space available, the welding current is transmitted to this electrode by a stator arranged at one end of a current-conducting arm and an electrically-conducting liquid to a rotor of the roller electrode. For reasons of manufacturing convenience the second roller electrode which bears against the outside of the can block or body, is constructed in the same manner as the first electrode. Thus both roller electrodes form a unit with their associated stator/rotor current-transmitting means.

The second roller electrode, which is the upper of the two electrodes, is arranged at the end of a pivotally movable overhanging arm, so that during introduction of the workpieces to be welded between both electrodes, it can move up and down in a plane which extends in a direction which coincides with the feed direction of the workpieces. However, this electrode which forms a unit with its associated stator/rotor current transmitting means possesses a relatively large weight which is effective at the free end of the overhanging arm. The upper roller electrode is biased, for instance by means of a spring, against the workpiece in

order to obtain the necessary welding force. During the infeed or introduction of a workpiece between both of the roller electrodes, the upper roller electrode is raised for which purpose is required a large acceleration force due to the considerable mass of this electrode, and such acceleration force can amount to more than fifty percent of the welding force. With increased feed speeds of the workpiece, the relationship becomes increasingly more unfavourable. Additionally, during the infeed of a workpiece between the roller electrodes there are produced furrows or notches or the like at the starting portion of the workpiece, which, during subsequent processing of the workpiece, can have an extremely unfavourable effect or lead to rejection.

According to the present invention, there is provided a resistance welding machine for welding workpieces moving along a predetermined feed direction, said machine comprising a machine frame, a pair of superimposed roller electrodes, one of said electrodes being mounted at the end portion of an arm extending substantially transversely with respect to said predetermined feed direction and mounted pivotally on the machine frame to permit movement of the said one electrode toward and away from the other roller electrode, said arm being in the form of an overhanging arm and comprising a housing, a shaft member rotatably mounted in the housing with the axis of the shaft member extending substantially transversely with respect to said predetermined feed direction, said shaft member having a free end carrying the said one roller electrode and being rotatably drivable by driving means in order to rotate the said one roller electrode at a predetermined speed, a pivot shaft mounting the housing for said pivotal movement on said machine frame, said pivot shaft extending transversely with respect to the axis of the shaft member and

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spaced from the said one roller electrode by a distance which is considerably greater than the distance between the pivot shaft and an end of the housing facing the said one roller electrode in order to permit concentration of the primary mass of the overhanging arm at the pivot shaft, and means for supplying electrical energy to said one roller electrode, said means including said housing, constituting a stationary part of said means, and said shaft member, constituting a rotating part of said means, and electrical coupling means located between said housing and said shaft member at the pivot shaft position.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a fragmentary schematic front elevation of a resistance roll-welding machine according to the invention, and showing the roller electrodes and associated components;

Figure 2 is a top plan view, to a reduced scale, showing an upper one of the two electrodes and its drive system;

Figure 3 is a cross-sectional view taken on line A-A of Figure 1; and

Figure 4 is a section, to an enlarged scale, through the upper roller electrode.

There is shown in Figures 1 and 2, an overhanging arm 10 which comprises a housing 11 and a hollow shaft 12 which is rotatably mounted in the housing 11. The hollow shaft 12 carries a roller electrode 13 at its free end. A suitable drive system is provided for driving the hollow shaft 12 together with the roller electrode 13 as will be described later. The feed direction for the workpiece 15, which may be for instance a can blank or a can body, is indicated by the arrow B in Figure 2. An angle α (Figure 2) is subtended between the roller electrode 13 and the feed direction B and this has been shown exaggerated for the purposes of illustration only; a slight inclined position of the roller electrode serves to ensure that the edges of the workpiece 15, for instance the longitudinal edges of the can blank illustrated in Figure 1, positively remain in the overlapping position when they are located between the roller electrode 13 and a further roller electrode 17 situated therebelow and mounted in an arm 16, in order for these overlapping edges to be welded to one another.

According to Figures 1 and 2, the housing 11, which together with the hollow shaft 12 forms the overhanging arm 10, is pivotally mounted on the machine frame 19 about a pivot shaft 18 extending in spaced relationship from the roller electrode 13 and transversely to its rotational axis.

As best seen by referring to Figure 2, the

spacing a of the roller electrode 13 from the pivot shaft 18 is considerably greater than the spacing b of the end of the housing 11 facing the roller electrode 13, from the aforementioned pivot shaft 18. The housing 11 with the section of the hollow shaft 12 located therein constitutes the predominant part of the weight of the overhanging arm 10, since the shaft 12 and also the roller electrode 13 are both hollow, as best seen by referring to Figure 4.

The hollow shaft 12 is rotatably mounted in the housing 11 by means of roller bearings 20 or equivalent structure. The portion of the housing 11 between the two roller bearings 20 possesses a large wall thickness extending from the outside of the housing 11 up to the hollow shaft 12 and constitutes a stationary part of means for transmitting current to the electrode whereas the hollow shaft 12 constitutes a rotary part of the current-transmitting means. In a ring-shaped or annular gap 21, which is sealed in any convenient fashion in axial direction and which is located between the housing 11 and the hollow shaft 12, there is contained an electrically-conducting liquid, for instance mercury, for transmitting the welding current from the stationary part to the rotating part of the current-transmitting means. As best seen by referring to Figure 1, the housing 11 is conductively connected with a current rail or busbar 22 which extends from one side transversely over the entire housing 11.

Furthermore, as also will be seen from Figure 1 the overhanging arm 10 can move up and down, due to its pivotal mounting about the pivot shaft 18, in a plane which is disposed perpendicularly to the feed direction of the can blank or body 15.

The hollow roller electrode 13 itself only possesses a low mass, so that no furrows or notches are formed at the edge of the blank or body 15 during its infeed between both of the roller electrodes 13 and 17. The requisite welding pressure is produced by a spring 23 supported by the machine frame 19 and effective at the end of the shaft 12.

As shown in Figures 2 and 3, the hollow shaft 12 contains an inflow duct 25 and a return flow duct 26 for a cooling agent, for instance cooling water, for cooling the roller electrode 13. The coolant inflow duct 25 is annular and is located adjacent the inner surface of the hollow shaft 12, whereas the coolant return duct 26 is arranged at the centre of the hollow shaft 12 concentrically with the duct 25. Between the ducts 25, 26 there is located an annular air-containing space 27. This concentric arrangement of the inflow duct 25 and the return flow duct 26 for the cooling agent, with the annular space 27 located therebetween is provided only in the front part of the hollow shaft 12

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which extends up to the roller electrode roll 13 in order to thereby beneficially obtain a further reduction in weight, whereas the rearward part of the hollow shaft 12 does not include the annular space between the inflow duct and the return flow duct for the cooling agent.

The hollow shaft 12 is operatively connected by means of an angularly movable coupling 30, for instance a multiple disc clutch, with an intermediate tube 31 through which extends the inflow duct 25 and the return flow duct 26 in the form of separate and mutually parallel extending pipes 32 and 33. At the region of the coupling 30 there are provided flexible pipe connections 34 and 35 for the inflow duct and the return flow duct.

The intermediate tube 31 is connected by means of a further angularly movable coupling 36 with a hollow drive shaft 37 of a geared transmission 38 to which there is flanged a suitable electric drive motor 39, preferably a stepping motor. The inflow duct and return flow duct for the cooling agent extend through the transmission 38 and the hollow drive shaft 37. The infeed and discharge of the cooling agent is accomplished by means of a rotary throughpassage means of conventional construction which has not been shown in the drawing. The arrangement and construction of the drive for the hollow shaft 12, apparent from Figure 2, is predominantly selected in this manner because of space saving considerations, but it would be also conceivable with another construction of machine to provide the drive directly at the end of the hollow shaft 12.

Finally, as will be seen from Figure 4, the roller electrode 13 comprises a flange 41 formed in one-piece with the hollow shaft 12 and a disc body 43 which is connected by screws 42 or equivalent fastening means with the flange 41. The disc body 43 fixedly clamps a replaceable ring-shaped electrode 44 against the flange 41. The interior of the roller electrode has a chamber 45 in flow communication with the infeed duct 25 and the return flow duct 26 for the cooling agent, so that the cooling agent can circulate within the roller electrode roll and come into direct contact with the ring-shaped electrode 44 where there appears the most pronounced heating-up effect.

Thus, in contrast to the previously proposed machine discussed earlier, in which the stator/rotor current transmitting means forms a unit with the upper movable electrode, in the machine described this current-transmitting means is supported directly on the machine frame in the form of a mass which is concentrated at the pivot shaft of the overhanging arm, and as a result thereof the mass of the roller electrode which

performs an up and down movement is considerably reduced. Further the movement of the overhanging arm no longer is carried out in a plane extending in the same direction as the feed direction, but in a plane extending substantially transversely with respect to the feed direction. Due to the displacement of the current-transmitting means, constituting the primary mass, from the roller electrode to the pivot shaft of the overhanging arm, there is also achieved the advantage that less constraint is imposed on the design of the roller electrode and this can advantageously be of hollow construction to further reduce the mass. A further reduction in the mass is obtained by using a hollow drive shaft for driving the upper electrode. In addition to the weight reduction which is achieved by using a hollow drive shaft, it also permits the feed of coolant directly to the interior of the electrode so that this can be cooled in a very effective manner.

The shifting of the current-transmitting means to the zone of the overhanging arm-pivot shaft additionally renders it possible to drive the roller electrode free of play by means of its hollow shaft. A drive free of play is necessary when the machine is equipped with a computer control for the regulation of the speed of the workpiece-feed movement through the transport device and through the roller electrodes. The speed of a drive motor of the transport device is regulated by means of a computer in such a manner that the first weld point or spot is located at an adjustable spacing from the front or leading end of the workpiece, for instance a can body or blank, and furthermore, the speed of the drive motor of the roller electrode, by means of which the workpiece is further conveyed, is regulated by means of the computer in such a manner that the last weld point always is located at an adjustable spacing from the rear end of the workpiece. This speed regulation has the purpose of preventing one of the weld points or spots, produced during each half-wave of the welding current, from being directly deposited upon the leading or trailing edge of a workpiece, which could result in scorching or burning of the material at such locations and rendering exceedingly more difficult further processing of the workpiece.

The described welding machine welds workpieces in an extremely reliable, rapid and efficient manner, permits increased feed speed of the workpieces while reducing the probability of forming poor welded seams, and reduces the number of rejects. The machine is of relatively simple construction, is economical to manufacture, extremely reliable and efficient in operation, not readily subject to malfunction and

breakdown, and requires a minimum of maintenance and servicing.

WHAT WE CLAIM IS:-

1. A resistance welding machine for welding workpieces moving along a predetermined feed direction, said machine comprising a machine frame, a pair of superimposed roller electrodes, one of said electrodes being mounted at the end portion of an arm extending substantially transversely with respect to said predetermined feed direction and mounted pivotally on the machine frame to permit movement of the said one electrode toward and away from the other roller electrode, said arm being in the form of an overhanging arm and comprising a housing, a shaft member rotatably mounted in the housing with the axis of the shaft member extending substantially transversely with respect to said predetermined feed direction, said shaft member having a free end carrying the said one roller electrode and being rotatably drivable by driving means in order to rotate the said one roller electrode at a predetermined speed, a pivot shaft mounting the housing for said pivotal movement on said machine frame, said pivot shaft extending transversely with respect to the axis of the shaft member and spaced from the said one roller electrode by a distance which is considerably greater than the distance between the pivot shaft and an end of the housing facing the said one roller electrode in order to permit concentration of the primary mass of the overhanging arm at the pivot shaft, and means for supplying electrical energy to said one roller electrode, said means including said housing, constituting a stationary part of said means, and said shaft member, constituting a rotating part of said means, and electrical coupling means located between said housing and said shaft member at the pivot shaft position.

2. A machine as claimed in claim 1, wherein the shaft member is hollow, and coolant inflow and return ducts are provided in the hollow shaft member for the infeed and outfeed of a coolant for cooling the said one roller electrode.

3. A machine as claimed in claim 2, wherein the coolant inflow and return ducts are concentrically arranged within the hollow shaft member and are separated by an annular space.

4. A machine as claimed in any one of claims 1 to 3, wherein the shaft member extends through the housing and an angularly movable coupling is provided for the transmitting drive to the shaft member.

5. A machine as claimed in claim 2 or claim 3, wherein a drive motor, transmission means and coupling means is provided for driving the hollow shaft member, and infeed line means and return flow line means for

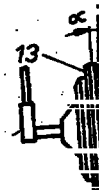
the cooling agent extend axially through said transmission means and said coupling means and are connected to the coolant infeed duct and return duct.

6. A machine as claimed in claim 2 or any claim dependent thereon, wherein the said one roller electrode contains a space in communication with said coolant inflow and return ducts, and is provided at its periphery with an exchangeable electrode ring cooled by the coolant circulating through said hollow space.

7. A resistance welding machine substantially as hereinbefore described with reference to the accompanying drawings.

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the cooling agent extend axially through said transmission means and said coupling means and are connected to the coolant infeed duct and return duct.

6. A machine as claimed in claim 2 or any claim dependent thereon, wherein the said one roller electrode contains a space in communication with said coolant inflow and return ducts, and is provided at its periphery with an exchangeable electrode ring cooled by the coolant circulating through said hollow space.

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