United States Patent

[11] **3,600,545**

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[21] Appl. No. **756,996**
[22] Filed **Sept. 3, 1968**
[45] Patented **Aug. 17, 1971**
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[54] **ELECTRIC WELDER FOR CAN BODY SEAMS**
8 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **219/64,** 219/66, 219/160
[51] **Int. Cl.** **B23k 1/16,** B23k 11/30
[50] **Field of Search** 219/64, 67, 81, 82, 84, 66, 125, 60, 59, 160, 78, 86

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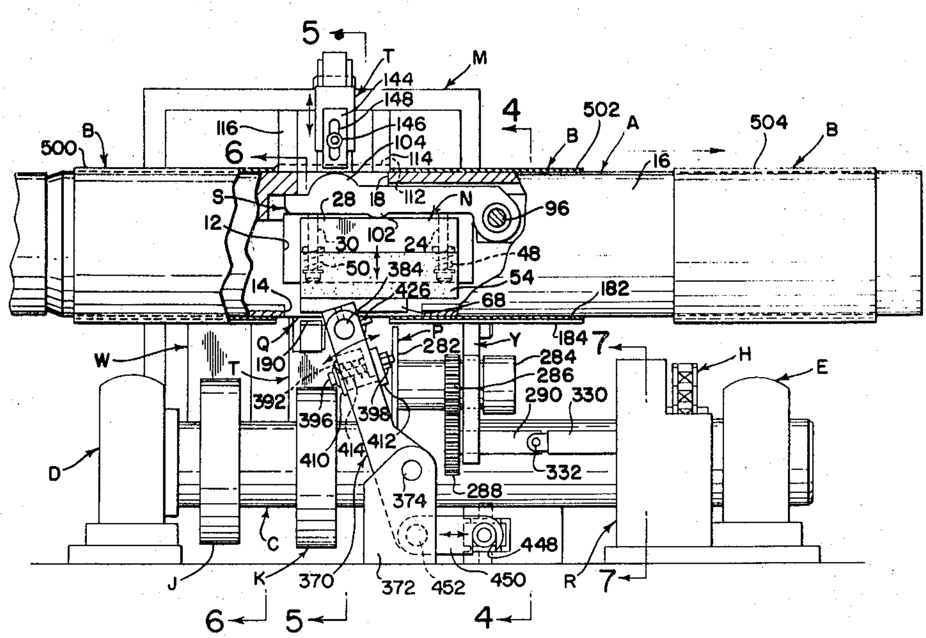
ABSTRACT: A machine for making spot welds along the seam of a tubular can body includes an elongated cylindrical mandrel along which the can bodies are advanced. A reciprocating electrode is mounted in a cavity in the mandrel and selectively contacts the inside of a can seam. Another reciprocating electrode is mounted externally of the mandrel and contacts the outside seam of a can blank. The machine includes a rotatable shaft on which cams are mounted for selectively moving the inner and outer electrodes into engagement with the seam of a can blank. A special scraper is also cam operated to move along the surface of the inner electrode and scrape tin therefrom as the electrodes are moved apart.



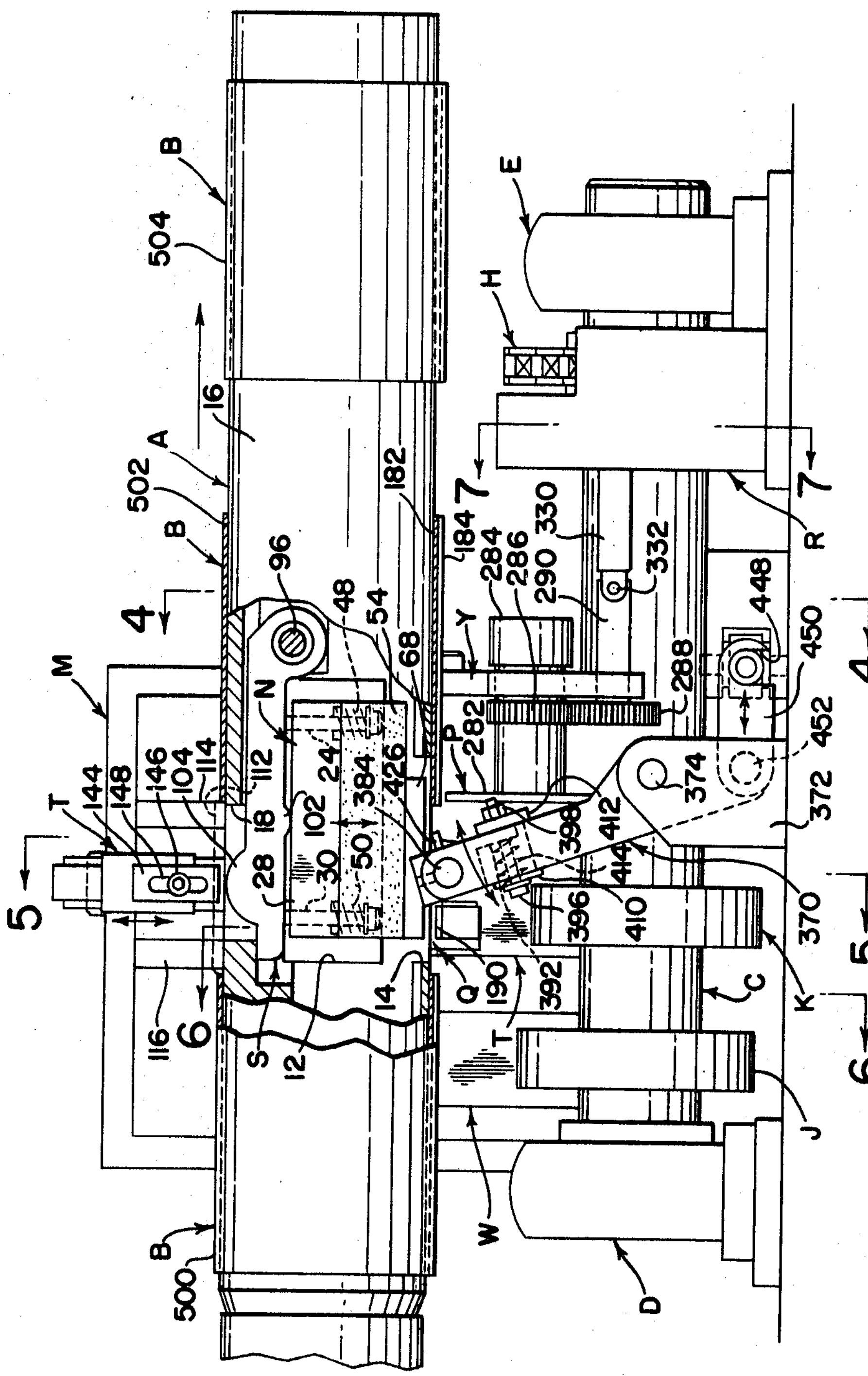


FIG. 1

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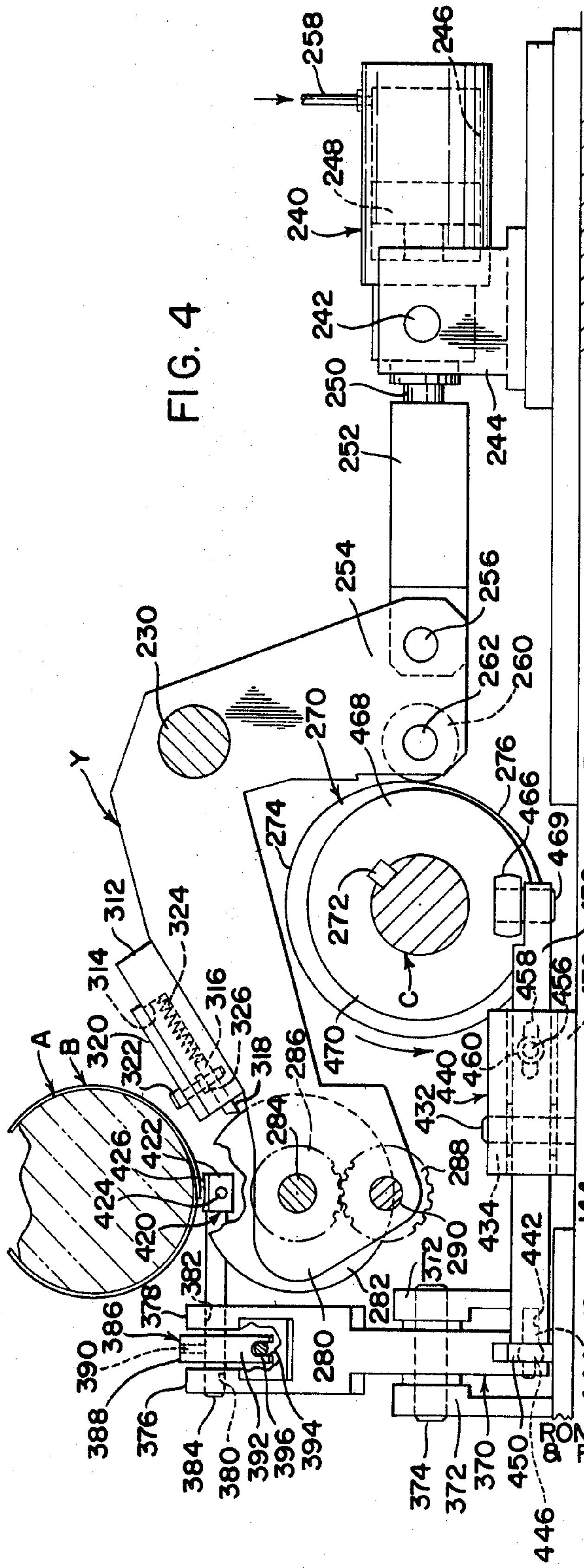

FIG. 4

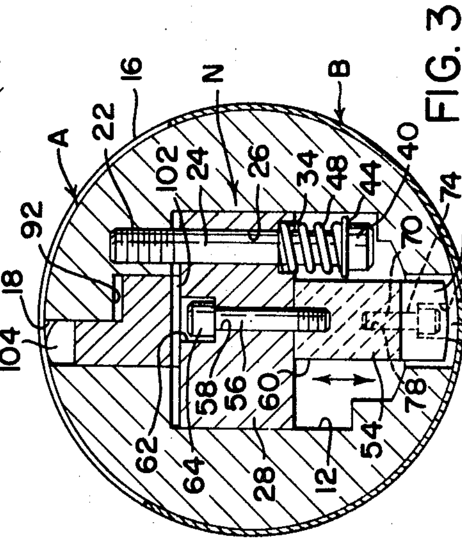

FIG. 3

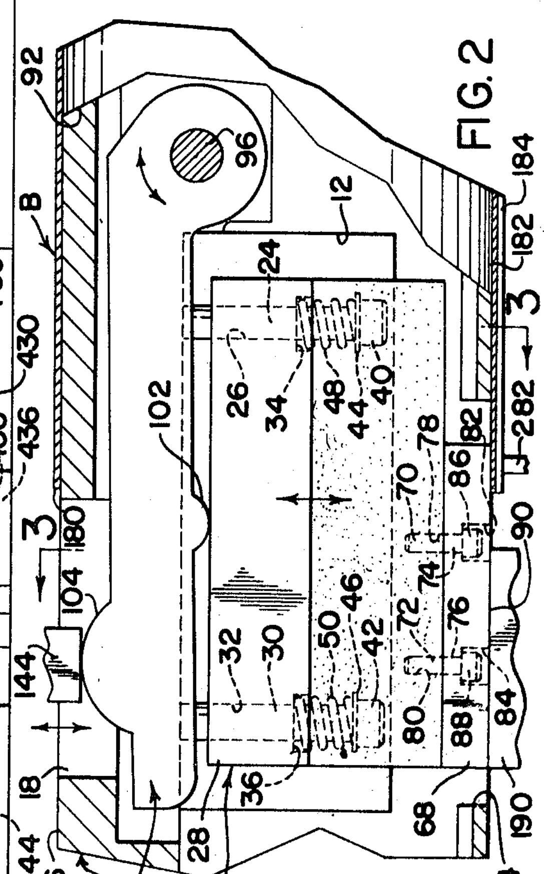

FIG. 2

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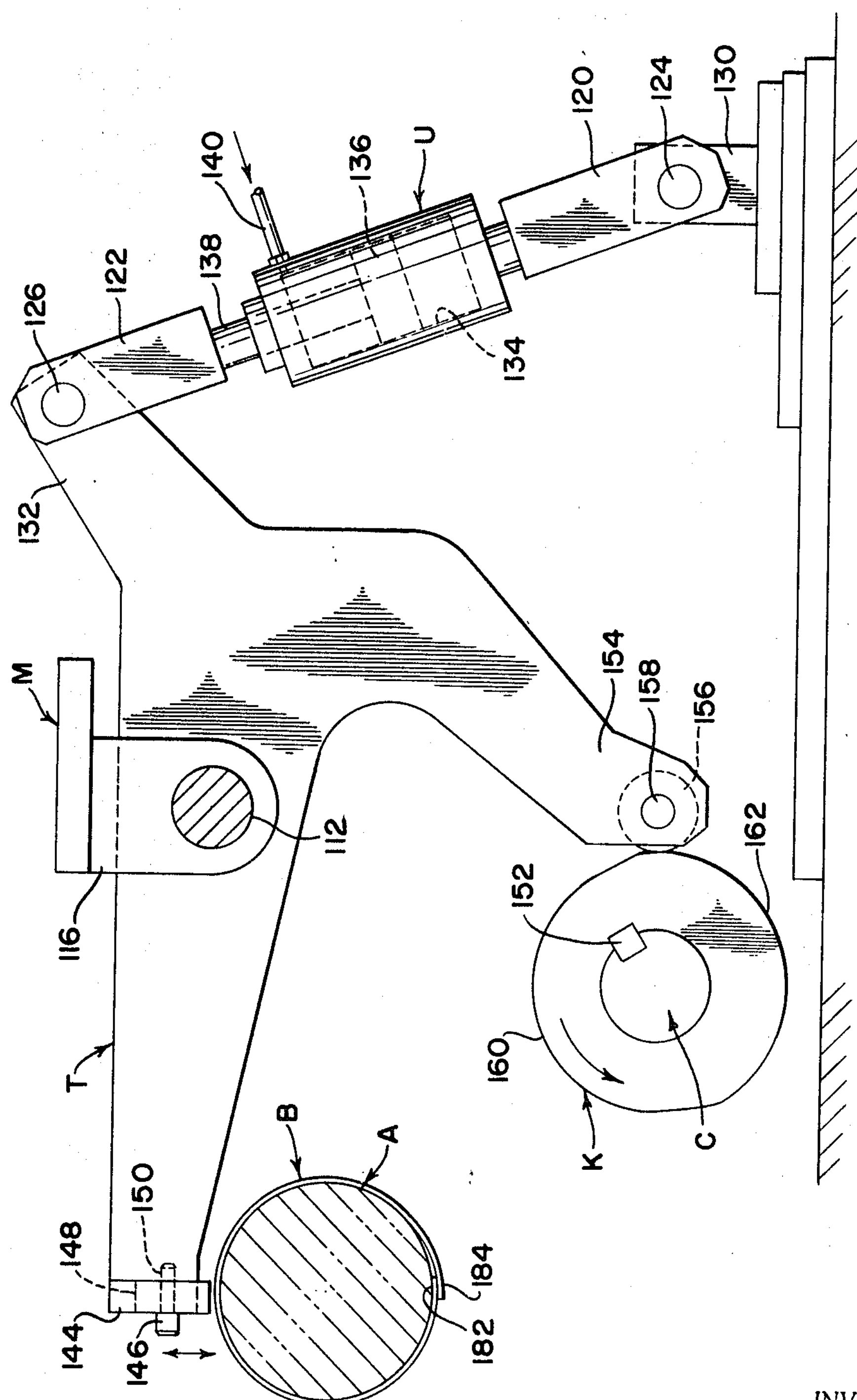

FIG. 5

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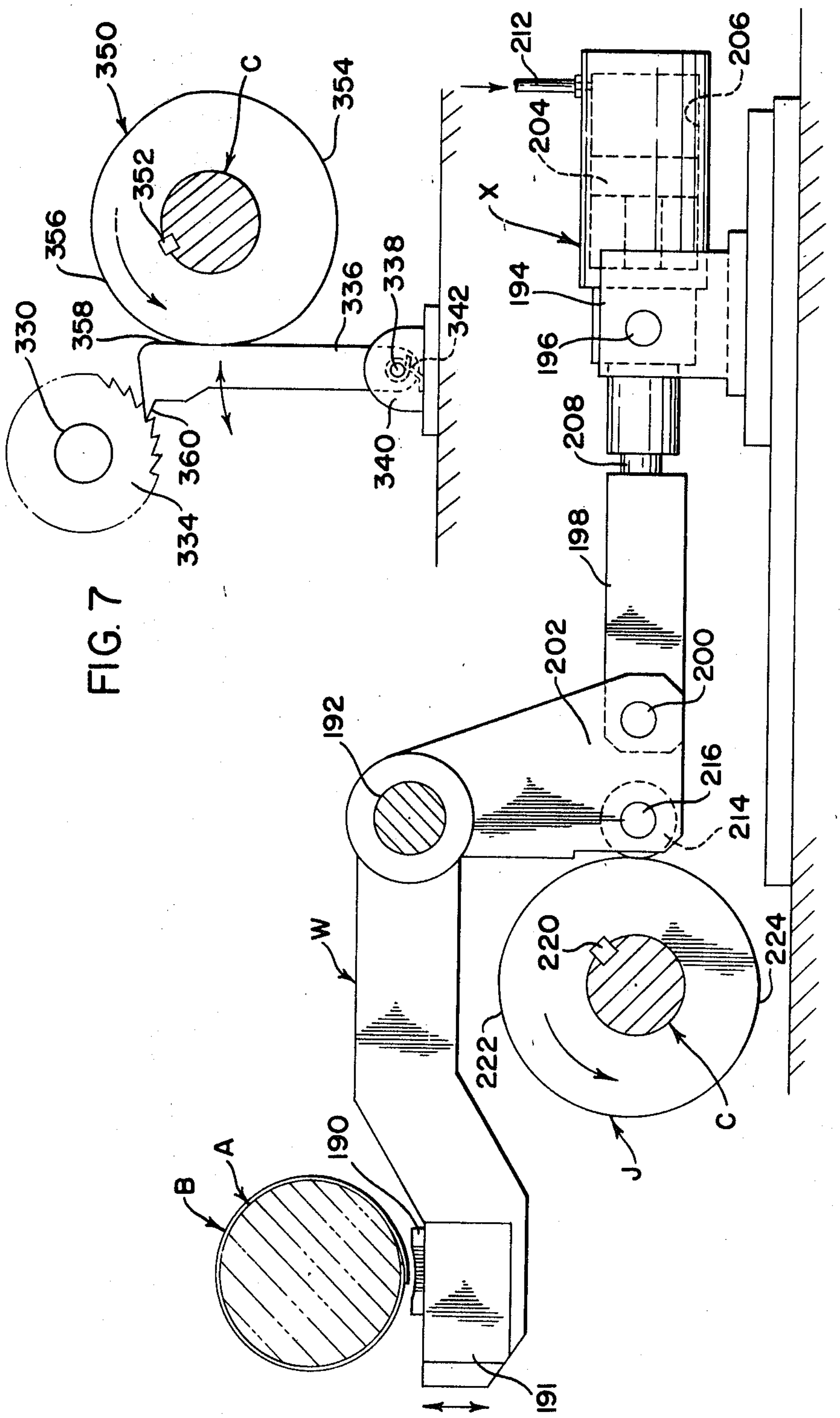

FIG. 7

FIG. 6

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ELECTRIC WELDER FOR CAN BODY SEAMS

BACKGROUND OF THE INVENTION

This application relates to the art of electric welding and more particularly to electric spot welding. The invention is particularly applicable to machines for making electric spot welds at the seams of tubular can bodies, and will be described with particular reference thereto, although it will be appreciated that the invention has broader application such as spot welding any lapped or superimposed members.

Cylindrical can bodies are commonly made by forming flat rectangular metal sheets around a horn or mandrel. Opposite longitudinal edges of the rectangular sheet are overlapped and eventually define the longitudinal seam of a can. Once the cylindrical can bodies are formed, the seam is usually spot welded in at least one place in order to hold the bodies in their desired cylindrical configuration while the entire seam is soldered shut. To accomplish this, the cylindrical bodies are automatically fed along an elongated cylindrical mandrel. The can bodies are commonly fed along the mandrel by reciprocating feed bars having dogs which engage behind one edge of the can bodies to shift the blanks along the mandrel in increments. The mandrel includes a welding station at which each can body stops in one of the incremental movements provided by the reciprocating feed bars and dogs.

At the welding station, the mandrel is commonly provided with a cavity in which an inner welding electrode is mounted. The inner electrode is often a rotatable wheel or simply a stationary electrode. In any event, the inner electrode usually has its welding surface projecting through an opening in the mandrel so as to be flush with the periphery of the mandrel. Having the surface of the inner electrode flush with the outer periphery of the mandrel often interferes with movement of the can bodies past the welding station. In addition, can bodies tend to drag along the inner electrode and the protective tin coating may be scraped from a portion of the inner periphery of the can body. Wearing of the inner electrode also requires frequent adjustment so that the inner electrode will make good contact with the inside of the seam. Poor contact produces excessive arcing which quickly burns out the electrodes and may burn holes in the can body while producing an inadequate weld. Prior devices also include an outer electrode which is moveable toward and away from the mandrel. The outer electrode is moved away from the mandrel as can bodies are advanced past the welding station, and moved into engagement with the seam of a can body opposite the point of contact of the inner electrode with the inside of the seam. These prior arrangements have not been capable of synchronizing movement of both inner and outer electrodes into good welding engagement with a can body seam. Also, the outer electrode of prior devices has been moveable toward and away from the mandrel by very complicated mechanisms.

Prior arrangements commonly include an electric switch to be actuated by engagement with a can body when it is positioned at the welding station. This prevents current supply to the welding electrode when there is no can body at the welding station and reduces the excessive burning of the welding electrodes. Prior devices are arranged for automatic sequential operation so that the feed bars and dogs are reciprocated to move a can body into position at the welding station. The outer electrode is then moved into engagement with the can body seam and an electric switch closed to produce a weld. The switch is then opened and the outer electrode moved away from the mandrel. The feed bars are then reciprocated to move the welded can body past the welding station to a soldering station while a new can body is fed to the welding station by another feed bar.

Examples of the general type of machine described above may be found in the following U.S. Pats.: Toleik 1,733,982 issued Aug. 26, 1930; Murch 2,282,339 issued May 12, 1942; Pearson 2,578,832 issued Dec. 18, 1951; Kreft 2,673,275 issued Mar. 23, 1954; and Cartwright 2,755,366 issued July 17, 1956.

SUMMARY

In accordance with the present invention, a machine for welding a longitudinal seam of a cylindrical can body includes an elongated mandrel having an inner electrode mounted therein. The inner electrode is mounted in such manner that there is no problem of hang-up or scraping between a can body and the inner electrode as the can body is advanced along the mandrel past the welding station. The inner electrode is also arranged so that there is no problem with poor contact between the inner electrode and the inner side of a seam of a can body. In accordance with another aspect of the present invention, a new arrangement is provided for reciprocating both the inner and outer electrode in a can body seam welding machine. This new arrangement is not only simpler and more reliable in operation but also more economical to manufacture and assemble. More specifically, the present invention provides improvements to a machine for spot welding the longitudinal seam of cylindrical can bodies. The machine includes an elongated cylindrical mandrel along which can bodies are advanced to a welding station. The mandrel is formed with a cavity therein and an opening in the periphery of the mandrel enters the cavity. An inner electrode is movably mounted in the cavity and includes an electrode surface. The moveable electrode is reciprocated from a position inside of the cavity inwardly of the opening to a position in which the electrode surface is at the opening and substantially flush with the periphery of the mandrel for engaging the inside of a can body seam. The present invention further includes an actuator opening formed in the mandrel and entering the cavity. An actuator member selectively projects through the actuator opening to reciprocate the inner electrode between its two positions. An outer electrode is provided and also reciprocates toward and away from the mandrel for engaging the outside of a seam opposite the point of engagement of the inner electrode with the inside of the seam. In accordance with a more limited aspect of the invention, both the inner and outer electrodes are reciprocated by cams on a rotatable timing shaft. The cams cooperate with actuator arms for the inner and outer electrodes and the arms may be normally biased to a selected position by air cylinders. In a further aspect of the invention, a moveable scraper is provided for the inner electrode. The moveable scraper is automatically stroked across the electrode surface of the inner electrode as the inner and outer electrodes move apart.

It is a principal object of the present invention to improve a machine for spot welding seams of cylindrical can bodies by providing a moveable inner electrode which is selectively moved into and out of engagement with the inside of a seam so that can blanks do not scrape or hang up on the inner electrode as they are advanced past the welding station.

It is another object of the present invention to provide such a machine with an inner electrode which is mounted for reciprocating movement in a cavity of the mandrel.

It is an additional object of the present invention to provide such a machine with a reciprocating outer electrode and to arrange the reciprocating mechanisms in a simpler and more reliable manner.

It is also an object of the present invention to provide such a machine with a moveable scraper for the inner electrode so that the scraper is stroked across the surface of the inner electrode to remove tin buildup.

It is the further object of the present invention to provide such a machine with moveable inner and outer electrodes arranged in such a manner that arcing and inadequate welds are substantially eliminated by providing positive engagement of both electrodes with a can body seam.

BRIEF DESCRIPTION OF THE DRAWING

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this Specification and illustrated in the accompanying Drawings.

FIG. 1 is a partial front elevational view of a machine for spot welding seams of cylindrical can bodies with the present invention embodied therein and with portions broken away for clarity of illustration;

FIG. 2 is an enlarged front elevational cross-sectional view showing the moveable inner electrode of the present invention mounted in a cavity in a mandrel.

FIG. 3 is a cross-sectional elevational view taken on line 3–3 of FIG. 2;

FIG. 4 is a side elevational cross-sectional view taken on line 4–4 of FIG. 1;

FIG. 5 is a side elevational cross-sectional view taken on line 5–5 of FIG. 1 with portions omitted for clarity of illustration;

FIG. 6 is a side elevational cross-sectional view taken on line 6–6 of FIG. 1 with portions omitted for clarity of illustration;

FIG. 7 is a side elevational cross-sectional view taken on line 7–7 of FIG. 1 with portions omitted for clarity of illustration.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the Drawings, wherein the showings are for purposes of illustrating the preferred embodiment of the invention only and not for purposes of limiting same, there is shown in FIG. 1 a portion of a machine for spot welding seams of cylindrical can bodies. The machine of FIG. 1 is of the same type as disclosed in the patents previously discussed in the summary. The machine includes a horizontally mounted elongated cylindrical mandrel A on which can bodies B are moved by suitable reciprocating feed bars. The machine includes a rotatable shaft C supported by end bearings D and E. Shaft C may be driven by a timing chain H connected to a suitable power source. Shaft C rotatably drives suitable cams such as J and K of FIG. 1 which in turn operate actuating arms for moveable electrodes. The actuating arms may be mounted on a framework M of the machine as will be described in more detail later. The machine includes an inner welding electrode assembly N moveably mounted within a cavity formed in mandrel A. An outer electrode P of return-current electrode Q are also mounted for movement toward and away from mandrel A. A suitable housing R encloses a step drive mechanism for outer electrode P.

Referring now to FIGS. 1—3, cylindrical mandrel A is shown as having a cavity 12 formed therein. A bottom opening 14 in mandrel A provides access to cavity 12 from outer periphery 16 of mandrel A. Another opening 18 at the top of mandrel A enters cavity 12 and defines an actuator opening. At its upper end, cavity 12 is provided with a plurality of upwardly extending threaded bores and only one of which is indicated at 22 in FIG. 3. Bore 22 receives the threaded end of a bolt 24 which loosely extends through a hole 26 in a slide block 28. Additional bolts such as 30 of FIG. 2 are provided and similarly extend through holes in slide block 28, and into threaded bores at the upper end of cavity 12. Bolt 30 may freely extend with a sliding fit through a hole 32 in slide block 28. The bottom surface of slide block 28 is formed with enlarged recesses 34 and 36 which are coincidental with holes 26 and 32. Bolts 24 and 30 are provided with enlarged heads 40 and 42 which support washers 44 and 46. Coil compression springs 48 and 50 are received on bolts 24 and 30, and bear against washers 44 and 46, and against slide block 28 within recesses 34 and 36. Thus, slide lock 28 is normally biased upwardly to the top of cavity 12 by springs 48 and 50.

A refractory block 54 of electrical insulating material is secured to the bottom of slide block 28 by bolt 56 passing through a vertical hole 58 in slide block 28 and threaded into a threaded bore 60 in refractory block 54. The upper surface of slide block 28 may be recessed as at 62 coaxial with hole 58 to countersink enlarged head 64 of bolt 56 as shown in FIG. 3. A plurality of such bolts 56 may be similarly provided along the length of slide block 28 and refractory block 54.

An elongated electric welding electrode 68 is secured to the bottom of refractory block 54 by bolts 70 and 72 which pass through holes 74 and 76 in electrode 68 and into threaded bores 78 and 80 in refractory block 54. Electrode 68 is recessed at 82 and 84 coaxial with holes 74 and 76 to countersink enlarged heads 86 and 88 of bolts 70 and 72.

It will now be seen that inner electrode assembly N includes a slide block 28, a refractory block 54 and an electrode 68 all secured together in a unitary assembly. The entire assembly is slidable within cavity 12 in a vertical reciprocating manner and is normally biased upward by springs 48 and 50. In a normal static position, inner electrode assembly N is biased upward to a position in which electrode surface 90 of electrode 68 is spaced inwardly of opening 14 and outer periphery 16 of mandrel A. This position is shown in FIG. 3.

A cavity 92 of smaller width than cavity 12 is formed in mandrel A at the upper end of cavity 12. An elongated lever S is received in cavity 92 and pivotally secured at one end by pivot pin 96. Lever S includes a downwardly extending projection 102 normally resting against the upper surface of slide block 28. Lever S also includes an upwardly extending projection 104 extending toward actuator opening 18 in the upper portion of mandrel A. Downwardly extending projection 102 acts substantially against the midpoint of slide block 28.

Referring now to FIG. 5, an actuator arm T is pivotally secured by pin 112 to downwardly projecting ears 114 and 116 on frame M. An air cylinder U includes yokes 120 and 122 which are respectively pivoted by pins 124 and 126 to a fixed support 130 and a connecting extension 132 of actuator arm T. Air cylinder U includes a cylindrical bore 134 slidably receiving a piston 136 which is connected with a moveable arm 138 to yoke 122. An air line 140 communicates with the interior of cylindrical bore 134 ahead of piston 136. Piston 136 will move axially within bore 134 as air is supplied to or exhausted from line 140. In the arrangement shown, air cylinder U will act to pivot actuator arm T in a clockwise direction about pivot pin 112 as air is forced through line 140. Actuator arm T includes an actuator 144 secured thereto by bolt 146 passing through a vertical slot 148 in actuator 144 and into a threaded bore 150 in actuator arm T. Vertical adjustment of actuator 144 is provided by means of the vertical slot 148. Cam K is secured to shaft C by a key 152 and normally rotates in a counterclockwise direction to FIG. 5. A lower extension 154 of actuator arm T carries a roller which defines a cam follower 156 rotated on pin 158.

As shown in FIG. 5, pressurized air in line 140 actuates air cylinder U to pivot actuator arm T clockwise and move actuator 144 upwardly. This movement will take place as low side 160 of cam K rotates across cam follower 156. As cam K continues to rotate, high side 162 will act against cam follower 156 to pivot actuator arm T counterclockwise against biasing force of air cylinder U and move actuator 144 downwardly.

As shown in FIGS. 1 and 2, actuator 144 on actuator arm T is positioned directly above actuator opening 18 in mandrel A. Downward movement of actuator 144, through action of cam K against cam follower 156, causes actuator 144 to strike against upper projection 104 on lever S. Continued downward movement of actuator 144 against projection 104 pivots lever S about pin 96 and downward projection 102 on lever S acts against the upper surface of slide block 28 to move inner electrode assembly N downward against biasing force of springs 48 and 50. Actuator 144 may be adjusted by using bolt 146 in vertical slot 148 so that inner electrode assembly N is moved downward until outer surface 90 of electrode 68 is flush with opening 14 and the outer periphery 16 of mandrel A. Electrode 68 will be held in this position as long as raised portion 162 of cam K is rotating against cam follower 156. As cam K continues to rotate, low portion 160 will come in contact with cam follower 156 and air cylinder U will pivot inner electrode assembly N to move upward under biasing force of springs 48 and 50.

As shown in FIGS. 1 and 2, can body B is advanced along mandrel A by increments and is positioned at the welding station as shown. At the top side of mandrel A, left edge 180 of can body B is clear of opening 18 so there is no interference with actuator 144. At the bottom of the mandrel, left hand edge 180 of can body B extends partly over opening 14 so that electrode 68 may contact the inner surface of lapped blank edge 182 which is inside of lapped edge 184.

FIGS. 1 and 6 show a return-current electrode 190 which is positioned below bottom opening 14 in mandrel A. As shown in FIG. 6, electrode 190 is secured to bracket 191 which is mounted on an actuator arm W pivoted on pin 192 and frame M in a manner described with reference to FIG. 5. An air cylinder X is pivoted to a fixed support 194 on pin 196 and has a yoke 198 pivoted by pin 200 to end 202 of actuator arm W. Air cylinder X includes a piston 204 slidably received in bore 206 and connected through shaft 208 to yoke 198. An air line 212 communicates with bore 206 in order to cause movement of piston 204. In the arrangement shown, pressurized air entering bore 206 through line 212 moves piston 204 to the left and pivots actuator arm W clockwise around pivot pin 192. This action moves return-current electrode 190 upwardly toward bottom opening 14 in mandrel A and into engagement with inner electrode 68. End 202 of actuator arm W includes a roller defining a cam follower 214 mounted on pin 216. Cam J is held to shaft C by a key 220 and has high and low sides 222 and 224 respectively. Cam J rotates counterclockwise in FIG. 6, and as low side 224 of cam J contacts cam follower 214, actuator arm W is pivoted clockwise by air cylinder X. As shaft C continues to rotate high edge 222 of cam J comes into contact with cam follower 214 to pivot actuator arm W counterclockwise against biasing force of air cylinder X and moves return-current electrode 190 downwardly.

Outer electrode P of FIG. 1 is also mounted for movement toward and away from mandrel A as shown in FIG. 4. An actuating arm Y is pivotally mounted on a pin 230 in a manner described with reference to FIG. 5. A hydraulic cylinder 240 is pivoted on pin 242 to fixed support 244. Air cylinder 240 includes a bore 246 slidably receiving a piston 248 which is connected with rod 250 and yoke 252. Yoke 252 is connected to end 254 of actuator arm Y by pivot pin 256. An air line 258 communicates with bore 246 and supplies pressure for moving piston 248. In the arrangement shown, pressurized air in line 258 enters bore 246 in air cylinder 240 and causes piston 248 to move to the left which rocks actuator arm Y clockwise about pin 230. End 254 of actuator arm Y has a roller defining a cam follower 260 mounted thereto on pin 262. A cam 270 is secured to shaft C by key 272. Cam 270 includes a high outer edge 274 and a low edge 276. As shaft C rotates cam 270, high edge 274 bears against cam follower 260 to pivot actuator arm Y counterclockwise about pin 230 against the bias of air cylinder 240. When low edge 276 of pin 270 comes against cam follower 260, air cylinder 240 will pivot actuator arm clockwise.

Actuator arm Y includes another end portion 280 rotatably mounting an outer electrode disc 282 on pin 284. A gear 286 is fixed on shaft or pin 284 adjacent electrode disc 282. Another lower gear 288 is rotatably supported on pin 290 and gear 288 meshes with gear 286. Outer electrode disc 282 is positioned with respect to mandrel A so that it will contact the outer surface of lapped edge 184 opposite the point of contact of inner electrode 68 with the inner surface of edge 182 as shown in FIGS. 1 and 2.

As shown in FIG. 4, a supporting block 312 may be welded or otherwise secured to actuator arm Y as shown. Support block 312 includes a longitudinal groove 314 which receives a scraper 316 having a knife edge 318. A cover 320 is provided for groove 314 and is held in place by bolt 322. Coil spring 324 acts against scraper 316 and normally biases knife edge 318 against the outer periphery of electrode disc 282. Scraper 316 may have a longitudinal slot therein through which bolt 322 passes and an adjustable nut 326 on bolt 322 will slidably hold scraper 316 in proper position.

Referring now to FIG. 7, there is shown a stepping mechanism for rotating outer electrode disc 282 in stepped increments so that tin will be scraped from the periphery thereof by scraper 316. As shown in FIG. 1, a connecting shaft 330 is connected with shaft 290 by a universal joint 332 which allows some axial and angular separation of shafts 290 and 330 while still transmitting rotational force. FIG. 7 shows a toothed gear 334 mounted on shaft 330. A pawl 336 is pivoted on pin 338 to a fixed support 340 and is normally biased clockwise by a torsion spring 342. A cam 350 held on shaft C by key 352 has a high peripheral edge 354 and a low edge 356. As shaft C rotates counterclockwise, high cam edge 354 will contact cam follower edge 358 of pawl 336 to pivot pawl 336 counterclockwise against spring 342 and cause pawl nose 360 to engage a tooth of gear 334 to rotate gear 334 clockwise. As best seen in FIG. 4, clockwise movement of gear 334 rotates shaft 290 by means of shaft 330 to turn gear 288 clockwise and gear 286 counterclockwise. This also moves outer electrode disc 282 counterclockwise a certain angular increment so that the outer periphery thereof is scraped by scraper 316. As cam 350 continues to rotate by means of shaft C, low cam edge 356 moves against cam follower edge 358 of pawl 336 and allows pawl 336 to pivot clockwise under force of spring 342 to reposition pawl 336 for another incremental movement of gear 334 and electrode disc 282 in the manner described.

Referring now to FIGS. 1 and 4, there will presently be described a scraper means for electrode surface 90 of inner electrode 68. A lever 370 is pivotally secured to a fixed support 372 by pin 374. Lever 370 includes a bifurcated end providing a pair of spaced apart arms 376 and 378. Arms 376 and 378 are provided with holes 380 and 382 rotatably receiving a shaft 384. An arm member 386 includes a hub portion 388 secured on shaft 384 as by means of a set screw 390. Arm member 386 further includes an extension portion 392 integral with hub portion 388. Extension portion 392 has an elongated slot 394 formed therein through which a bolt 396 extends. A nut 398 is threaded on bolt 396 and cooperates with plates 410 and 412 to hold bolt 396 in a fixed position on arms 376 and 378. A coil spring 414 biases against the inside surface of plate 410 and the inside surface of extension portion 392 of arm 386 to normally bias arm and shaft 384, counterclockwise as viewed in FIG. 1. A scraper element 420 includes a hub portion 422 secured to shaft 384 as by set screw 424. A knife edge 426 integral with hub portion 422 is provided for scraper 420. A pivot arm 430 pivots on pin 432 extending through arms 434 and 436 of a C-shaped bracket 440. Arm 430 includes a cylindrical bore 442 slidably receiving shaft 444 secured to a ball 446. Ball 446 is held within a recessed groove 448 in a link member 450. As shown in FIG. 1, link member 450 is pivotally connected with lever 370 by pin 452. C-shaped bracket 440 has an elongated pin 456 secured thereto and extending through a slot 458 in arm 430. A coil spring 460 received on pin 456 biases against the inside surface of C-shaped bracket 440 and the face of arm 430 to normally pivot arm 430 counterclockwise around pivot pin 432. This action also tends to pivot lever 370 counterclockwise about pivot pin 374 as shown in FIG. 1. The other end of arm 430 carries a roller 466 on pin 469. Cam 270 includes cam face means acting against roller 466 defined by high cam face 468 and low cam face 470. High cam face 468 is displaced 90° ahead of high cam edge 274 so that high cam face 468 will begin acting against roller 466 at the same time that high cam edge 274 begins acting against cam follower 260. Low cam face 470 is similarly displaced relative to low cam edge 276. At the same time that high cam edge 274 begins acting against cam follower 260 on actuator arm Y, high cam face 468 begins acting against roller 466 to pivot arm 430 clockwise about pin 432 against the bias of spring 460. This pivotal movement of arm 430 also pivots lever 370 clockwise about pivot pin 374 in FIG. 1. Knife edge 426 of scraper 420 will then move in an arcuate path into engagement with surface 90 of inner electrode 68 to scrape tin therefrom. The biasing force maintained on scraper 420 by spring 414 acting against arm 392 will maintain knife edge 426 in good scraping contact with surface 90 of electrode 68 while permitting the knife edge to move down if scraping pressure is too great.

In operation of the device, cylindrical can bodies B are fed along mandrel A in a well-known manner by reciprocating feed bars and dogs. Each reciprocating forward stroke of the feed bars will shift can body B a certain distance from a position represented by numeral **500** to a position at the welding station represented by numeral **502** and then to a further advanced position represented by numeral **504**. The reciprocating feed bars are driven by the same source which drives timing chain H and shaft C. When the feed bars complete a forward reciprocating stroke to position a can blank B at position **502**, the feed bars begin to retract to grab another can blank. At the forwardmost stroke of the feed bars, the high cam edges of cams J and **270** are acting against their respective cam followers to pivot actuator arms W and Y counterclockwise about their pivot points to move return-current electrode **190** and electrode disc **282** away from mandrel A. At the same time, the low cam edge of cam K is acting against its cam follower so that air cylinder U is biasing actuator arm T clockwise about its pivot to hold actuator **144** away from mandrel A. Springs **48** and **50** on inner electrode assembly N are also biasing the electrode assembly upward within cavity **12**. When the feed bars begin their rearward stroke, the low cam edges of cams J and **270** come in contact with their respective cam followers so that air cylinders X and **240** bias actuator arms W and Y clockwise about their respective pivot points to bring return-current electrode **190** and outer disc electrode **282** into engagement respectively with surface **90** of inner electrode **68** and the outer surface of lapped edge **184** on a can blank B. At the same time, the high cam edge of cam K will come into contact with its cam follower and pivot actuator arm T counterclockwise about its pivot against biasing force of air cylinder U to move actuator **144** downwardly. Actuator **144** then strikes upwardly extending projection **104** on lever arm S and moves inner electrode assembly N downward until surface **90** of electrode **68** contacts return electrode **190** and also the inner surface of lapped edge **182** of can body B. In this position, as shown in FIG. **2**, a welding current path is established from outer electrode disc **282**, through outer edge **184** of can body B, through inner edge **182** of can body B, through inner electrode **68** and to return-current electrode **190**. Outer electrode disc **282** and return electrode **190** are suitably connected to a welding transformer in a well-known manner. As soon as the electrodes are properly positioned for a welding operation as described with reference to FIG. **2**, another suitable cam on shaft C will actuate an electric switch to complete the welding circuit. The switch will then be opened well before the electrodes begin separating in order to prevent arcing. Once the welding operation has taken place, the feed bars for can bodies B will have completely retracted and be ready to begin another forward reciprocation. Shaft C has continued rotating so that the high cam edge of cams J and **270** will begin to come against their respective cam followers at the same time that the feed bars begin their forward reciprocation. This will cause actuator arms W and Y to pivot counterclockwise about their respective pivot points against the bias of air cylinders X and **240**. At the same time, the low cam edge of cam K will come against its cam follower and allow air cylinder U to pull actuator arm T clockwise about its pivot point and move actuator **144** away from mandrel A so that inner electrode assembly N can move upward in cavity **12**. At the same time that high cam edge **274** of cam **270** in FIG. **4** comes against cam follower **260**, high cam face **468** will begin acting against roller **466** to swing lever **370** clockwise in FIG. **1** and stroke knife edge **426** of scraper **420** across surface **90** of inner electrode **68**. High cam face **468** is active over only a 90° arc so that roller **466** comes into contact with low cam face **470** while high cam edge **274** is still acting against its cam follower **260**. This allows scraper **420** and lever **370** to swing back counterclockwise in FIG. **1** under the bias of spring **460** in FIG. **4** to be out of the way of a new can body which is being moved into welding position by the reciprocating feed bars.

This operation is continuously repeated and the seam of can bodies B is automatically welded as they are moved along in increments from station to station by the reciprocating feed bars. At the same time that high cam edge **274** of cam **270** comes against cam follower **260** to move outer electrode disc **282** away from mandrel A, cam **350** of FIG. **7** will have its high cam edge **354** begin acting against cam follower edge **358** of pawl **336** to rotate gear **334** a small increment to rotate outer electrode disc **282** across scraper **316** to remove tin buildup from the welding operation.

In addition to an electrical switch to be operated by a can body moving into position at a welding station, as previously described with reference to the prior art, it is possible to have a solenoid similarly actuated by a can body at the welding station in order to close valves in the lines supplying air to the air cylinders. This would prevent the air cylinders from being active to move the electrodes when no can body was in position. Instead of biasing inner electrode assembly N into engagement with a can seam by means of a cam as described with reference to FIG. **5**, it is possible to position the cam on the other side of the cam follower so that the inner electrode would be biased into engagement by the air cylinder and moved out of engagement by the cam as described with respect to the outer disc electrode and return-current electrode of FIGS. **4** and **6**. It is also possible to arrange the cams and air cylinders in any desired manner so that they are either biased into or out of engagement by the air cylinders. In a preferred arrangement, the air cylinders bias all electrodes into engagement so that there is a somewhat resilient engagement, and movement of the electrodes will be stopped when in engagement with the proper surface by limiting the pressure supply to the air cylinders.

While the invention has been described only with reference to a preferred embodiment, it is obvious that modifications and alterations will occur to others upon reading and understanding this Specification.

What we claim is:

1. In an apparatus for spot welding seams of hollow metal shells supported on a mandrel, said mandrel having an outer peripheral surface, a cavity in said mandrel, welding electrode means movably mounted in said cavity, an opening in said peripheral surface entering into said cavity, said electrode means being movable between first and second positions relative to said opening, said first position being spaced further from said opening than said second position, lever arm means pivotally mounted in said cavity for moving said electrode means from said first position to said second position, actuator means movably mounted on said apparatus for movement toward and away from said lever arm means to pivot said lever arm means against said electrode means and move said electrode means from said first position to said second position and biasing means urging said electrode means to said first position and against said lever arm means.

2. The apparatus of claim **1** and further including an actuator opening in said peripheral surface into said cavity, said lever arm means extending adjacent said actuator opening.

3. The apparatus of claim **2** wherein said actuator means is movable between a first position spaced from said actuator opening and out of engagement with said lever arm means, and a second position within said actuator opening and in engagement with said lever arm means, and further including operating means for moving said actuator means between said first and second positions.

4. The apparatus of claim **3** wherein said operating means includes rotatable cam means cooperating with cam follower means on said actuator means.

5. The apparatus of claim **4** wherein said operating means further includes resilient means normally biasing said actuator means to one of said first and second positions and said cam means moves said actuator means from said one position to the other of said positions.

6. The apparatus of claim **5** wherein said electrode means has an electrode surface, and said electrode means reciprocates on an axis substantially normal to the longitudinal axis of said mandrel, and further including movable scraper means, said scraper means being movable across said electrode surface as said electrode means moves from said second position to said first position.

7. In a spot welding apparatus having first and second electrodes, support means mounting said electrodes for movement toward and away from one another, first biasing means cooperative with said support means for biasing said electrodes toward one another, second biasing means cooperative with said support means for biasing said electrodes away from one another, first and second pivoted arm means having first and second electrode moving ends, said first and second biasing means cooperating with said first and second arm means to pivot said arm means and move said electrode moving ends to selectively move said electrodes toward and away from one another, one of said first and second biasing means including rotatable cam means, cam follower means on said arm means, said cam means cooperating with said cam follower means to pivot said arm means during each rotational cycle of said cam means, and movable scraper means for scraping at least one of said electrodes as said electrodes move away from one another, said cam means including cam edge means cooperating with said cam follower means on said arm means and face cam means cooperating with said scraper means for moving said scraper means across said one electrode.

8. The device of claim 7 wherein said scraper means includes scraper knife means and said scraper means moves in an arcuate path to scrape said electrode, said knife means being movably mounted on said scraper means, and biasing means for biasing said knife means in the direction of movement of said scraper means during scraping of said electrode.