

Nov. 28, 1961

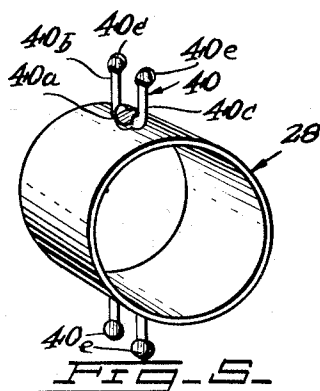
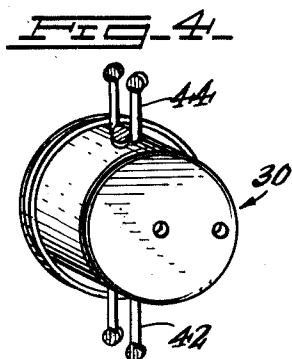
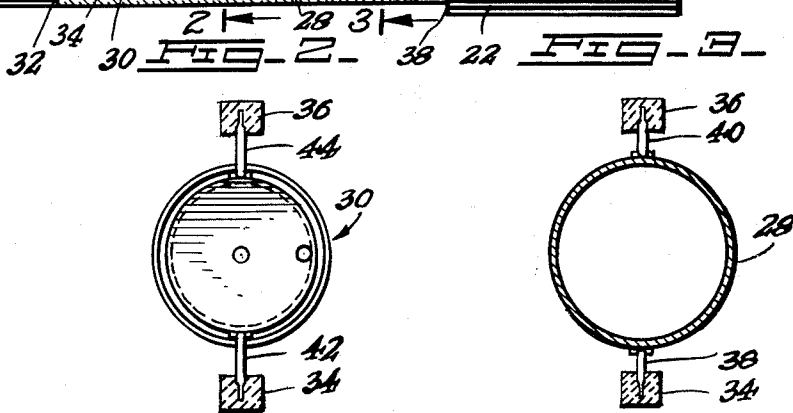
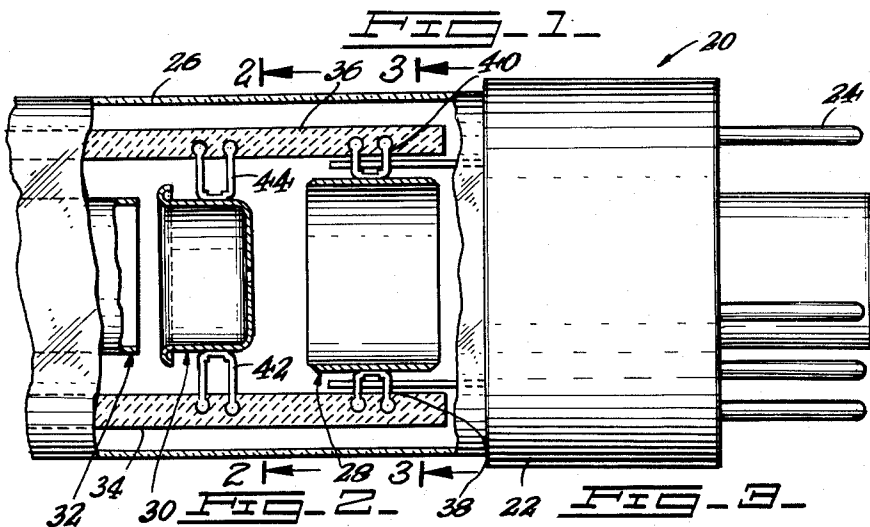
G. B. ERSKINE

3,011,046

MANUFACTURE OF ELECTRODES

Filed May 3, 1956

4 Sheets-Sheet 1



INVENTOR.

GEORGE B. ERSKINE

BY

Morton Amster

ATTORNEY.

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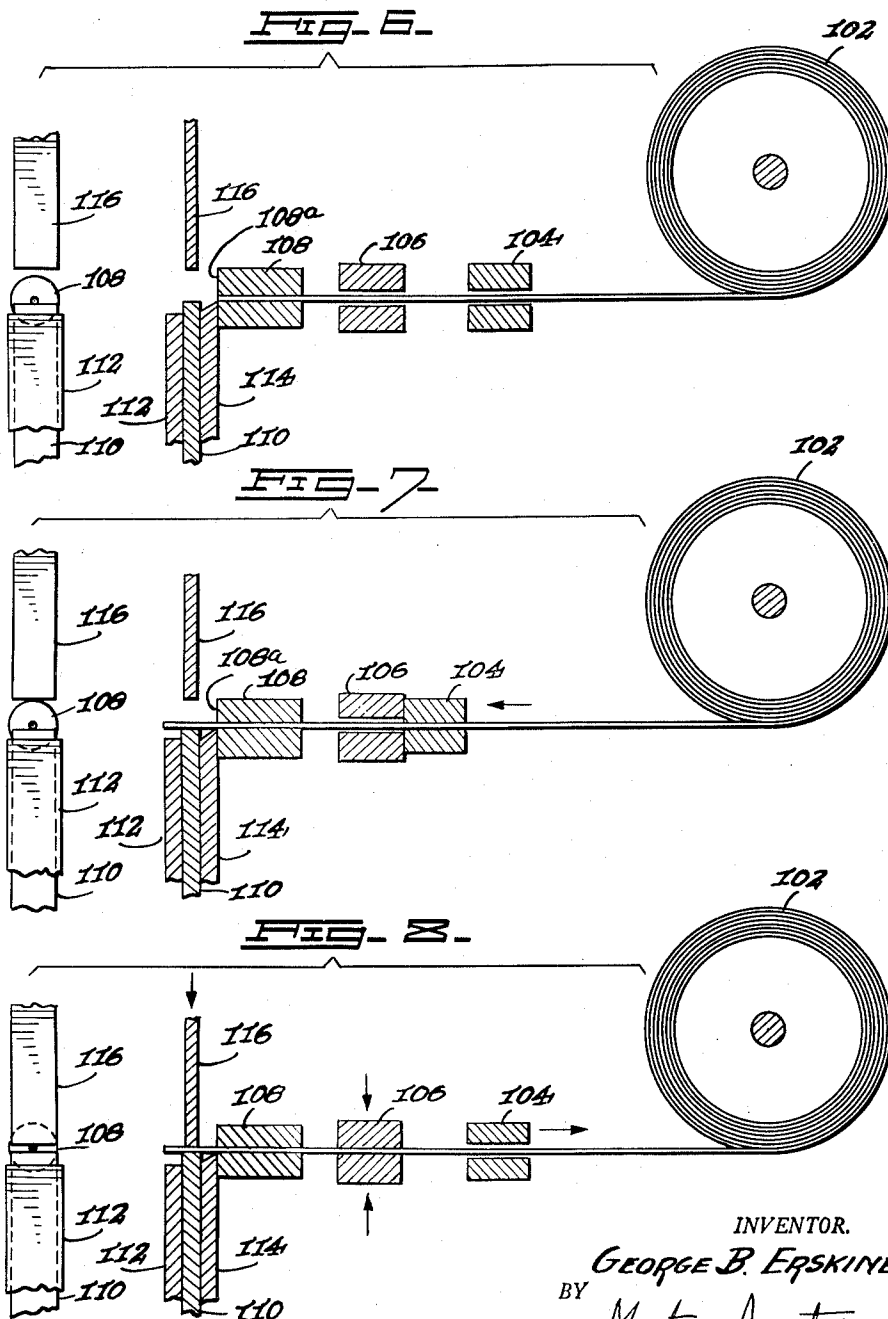
G. B. ERSKINE

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MANUFACTURE OF ELECTRODES

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FIG. 9.

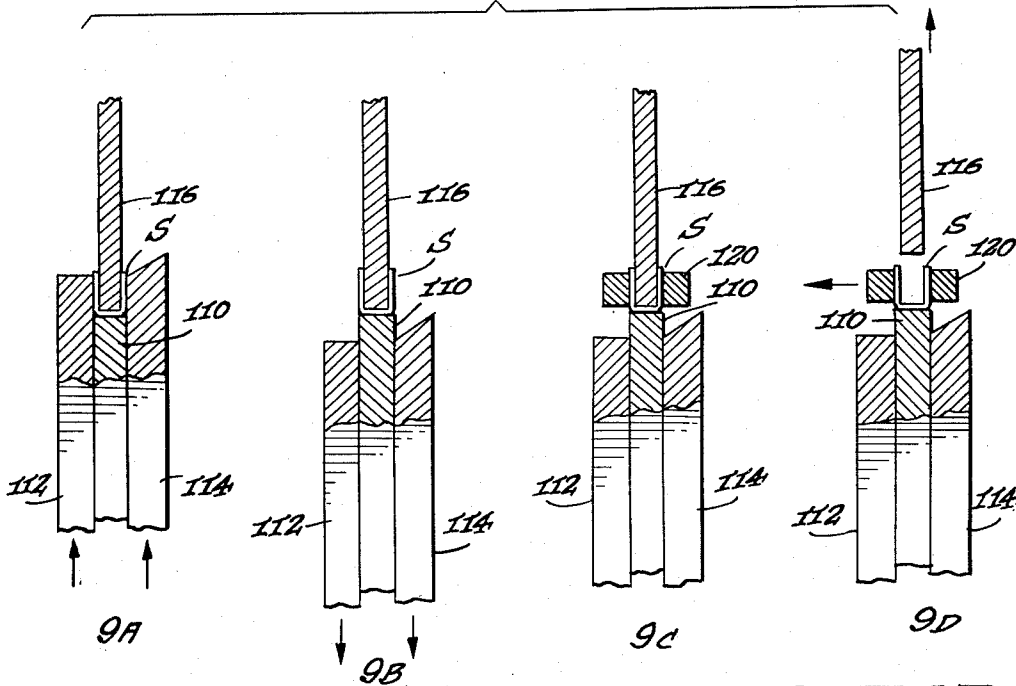


FIG. 10.

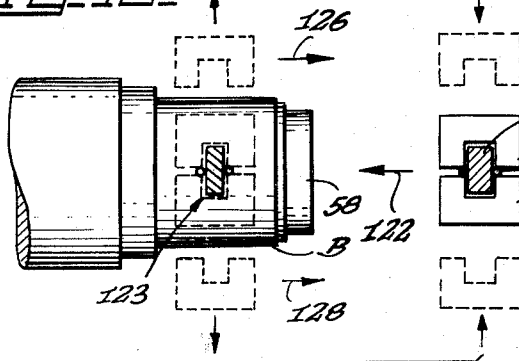


FIG. 11.

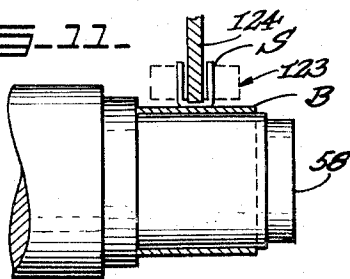
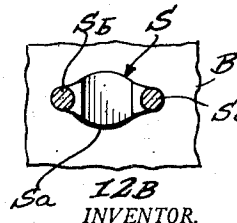
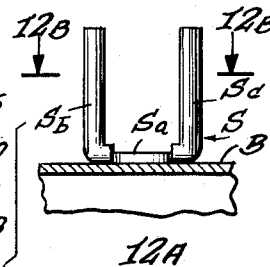


FIG. 12.



INVENTOR.
GEORGE B. ERSKINE
BY
Morton Amster
ATTORNEY.

Nov. 28, 1961

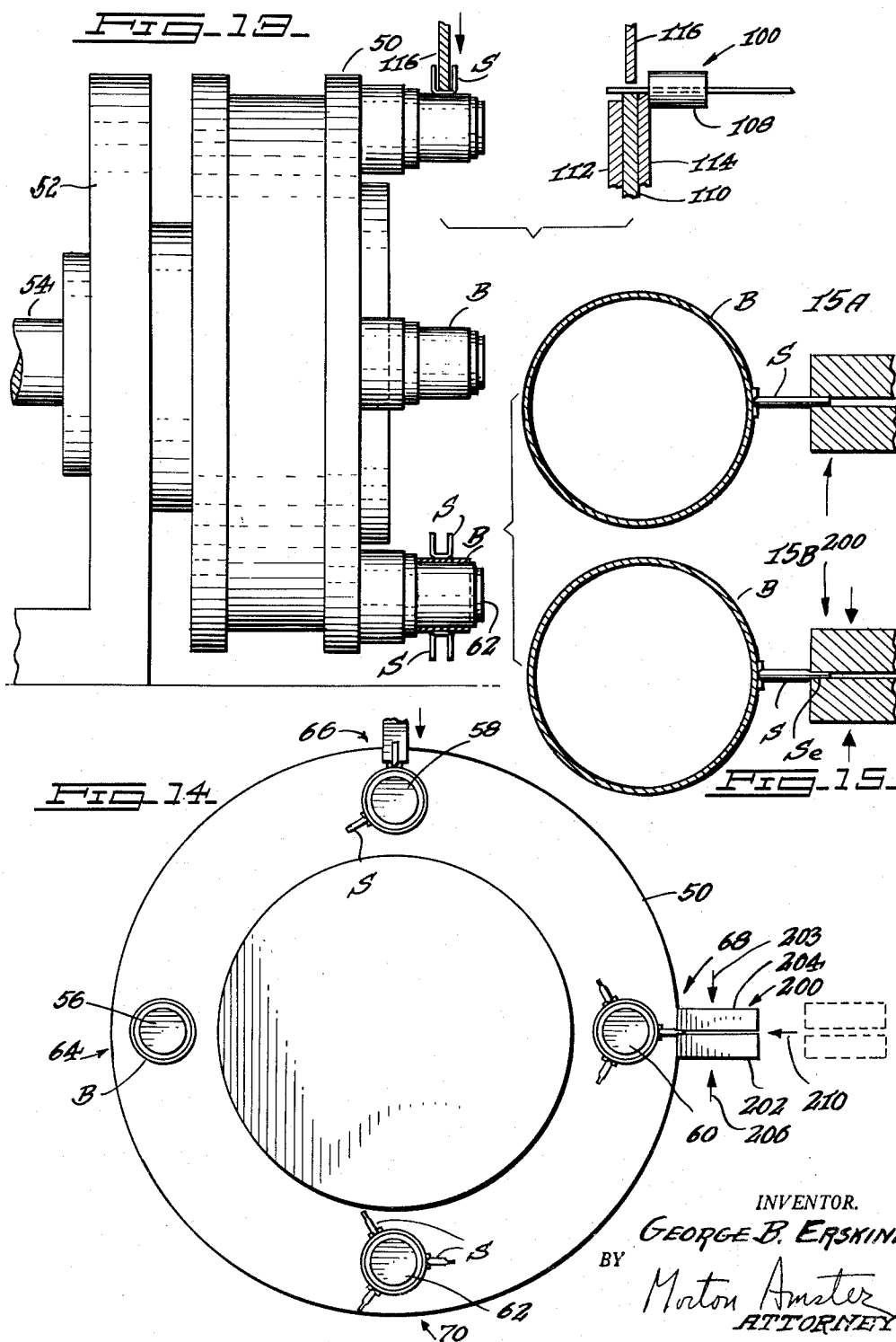
G. B. ERSKINE

3,011,046

MANUFACTURE OF ELECTRODES

Filed May 3, 1956

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3,011,046

MANUFACTURE OF ELECTRODES

George B. Erskine, Emporium, Pa., assignor to Emporium Specialties Co., Inc., Emporium, Pa.

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10 Claims. (Cl. 219-107)

The present invention relates to the manufacture of electrodes, and in particular to an improved method of forming mounting studs for electrodes of the type employed in the electron beam-forming structures of television picture tubes.

In the electron gun assembly of a television picture tube and like cathode ray devices, it is commonplace to employ a number of electrodes which are maintained at prescribed operating potentials to electrostatically and/or electromagnetically focus the electron beam. Usually, these electrodes take the form of cup-like or sleeve-like bodies each having a number of radially-extending mounting studs or pins on its outer periphery. The mounting of the electrodes in the neck section of the tube envelope is achieved by embedding terminal portions of the studs in glass supporting rods which serve to support the several electrodes.

Heretofore, these and other similar types of electrodes, have been constructed by fairly time consuming manual techniques, involving the use of assembly jigs and fixtures. As an illustration of one of the prior art methods, the mounting studs or pins were manually assembled with the sleeve-like electrode body, employing jigs or fixtures wherever possible, and welded to the outer surface of the electrode body. This method, by its very nature, necessitates multiple handlings of the mounting studs, involves tedious and painstaking manual assembly, and requires special jigs and fixtures. Apart from the problems attendant to manufacture, the final electrode assemblies frequently are unsatisfactory, particularly from the standpoint of obtaining a good joint between the mounting studs and the respective electrode bodies. The handling and assembly problems are further complicated by the comparatively small size of the mounting studs, which frequently are of the order of one quarter inch in overall height.

Broadly, it is an object of the present invention to provide an improved method of manufacturing electrodes of the aforesaid type. Specifically, it is within the contemplation of the present invention to provide an improved method of forming, handling and assembling electrodes including a sleeve-like body and outwardly projecting mounting studs, which electrodes are particularly useful in constructing the gun assembly of television picture tubes and like cathode ray devices.

It is a further object of the present invention to provide electrodes for electron gun assemblies which exhibit improved physical properties, particularly mechanical strength at the joint between the electrode body and the one of more mounting studs.

Advantageously, the improved method of the present invention facilitates the mechanization of the manufacture of stud-supported electrodes by semi-automatic and automatic equipment. Accordingly, the necessity of manually handling a large number of parts, which are usually small in size is virtually done away with; and the several forming and assembly operations for the manufacture of this type of electrode may be achieved on a mass production basis, with comparatively low unit cost.

In accordance with an illustrative embodiment demonstrating method aspect of the present invention, electrodes of the type including one or more U-shaped studs projecting from a generally cylindrical electrode body, are manufactured by forming a length of wire stock into

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the configuration of the U-shaped stud with a flat in the bight portion of the stud. The forming tools are used to assemble the stud to project radially of the electrode body, with the flat resting against and extending longitudinally of the body. The stud is then engaged by a welding tool in the region of the flat, and by application of welding pressure in said region, the stud is welded to the electrode body.

The resultant mounting stud is generally of substantially circular cross section, but has a flattened region in contact with and welded to the electrode body. With such mounting studs, it is a comparatively simple operation to mount the several electrodes of an electrostatic and/or electromagnetic focusing system in the neck section of the electron gun assembly, with the assurance of good structural strength, stability, and continued orientation of the several components.

The above brief description, as well as further objects, features and advantages of the present invention will be best appreciated by reference to the following detailed description of a presently preferred method and diagrammatic showing of appropriate apparatus, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an enlarged fragmentary view, with parts broken away and in section, showing part of a typical electron gun assembly;

FIG. 2 is a sectional view taken substantially along the line 2-2 of FIG. 1 and looking in the direction of the arrows;

FIG. 3 is a sectional view taken substantially along the line 3-3 of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a perspective view of a cup-like electrode typical of those employed in the gun assembly of FIG. 1;

FIG. 5 is a perspective view of a sleeve-like electrode, typical of those employed in the gun assembly of FIG. 1;

FIG. 6 is a diagrammatic showing of the mechanisms for forming successive U-shaped studs from wire stock, shown at the start of a stud-forming operation;

FIG. 7 is a diagrammatic showing similar to FIG. 6, but showing the mechanisms upon advance of the leading length or section of the wire stock into operative relation to the forming tools;

FIG. 8 is a diagrammatic showing similar to FIG. 7, but showing the forming tools closed and in position for cutoff of the leading length of stock preliminary to formation of the length of stock;

The several diagrammatic views of FIG. 9 show the relative position of the tools during the formation of successive U-shaped mounting studs and their transfer to the assembly location with the electrode body, to wit;

FIG. 9A is a diagrammatic view showing the forming tools in their advanced limit position after cutoff of the leading length of stock and after the length has been bent into the U-shaped configuration;

FIG. 9B is a view at a time later in the cycle after the forming tools have been withdrawn to their retracted limit position as indicated by the directional arrows;

FIG. 9C is a view at a time later in the cycle after the formed U-shaped mounting stud is engaged by transfer tools;

FIG. 9D is a view at a still later time in the cycle after the upper swaging tool is withdrawn, as indicated by the directional arrow, and just prior to transfer of the formed U-shaped mounting stud;

FIG. 10 is a plan diagrammatic showing, with parts sectioned, illustrating the various positions of movement of the transfer tools between the stud-forming location at the right of the view and the stud-assembly location at the left of the view;

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FIG. 11 is a vertical section taken on FIG. 10 and showing the formed U-shaped mounting stud held in position on the electrode body for the welding operation;

The several views of FIG. 12 are of the structure of the mounting stud after forming, to wit;

FIG. 12A is an enlarged fragmentary elevational view showing the mounting stud in its assembled position on the electrode body;

FIG. 12B is a sectional view taken substantially along the line 12B—12B of FIG. 12A;

FIG. 13 is a side elevational view schematically showing a multiple-station machine for manufacturing electrodes in accordance with the present invention;

FIG. 14 is a front elevational view of the machine shown in FIG. 13, the mechanism at the several work stations being illustrated diagrammatically; and,

FIG. 15 are two views diagrammatically showing the operation of the tools at the swaging station of the machine;

FIG. 15A showing the swaging tools in their engaged but opened position on the terminal portions of the mounting stud; and

FIG. 15B showing the swaging tools in their closed position for forming flats on the terminal portions of the mounting stud.

Referring now specifically to the drawings, there is shown in FIG. 1 a part of the gun assembly 20 of a typical cathode ray tube which is provided with an electrostatic focusing system. The illustrated gun assembly is conventional apart from the structure of the several beam-forming and focusing electrodes and may take any one of many known forms, including the slashed field gun, the tilted gun, the offset gun, or any combinations thereof which are known to produce an electron beam. For details of typical gun structure, reference may be made to U.S. Patent No. 2,275,029 of March 3, 1942, and 2,719,243 of Sept. 27, 1955. The structure of FIG. 1, which is illustrated only to show a typical environment for the several electrodes, includes a tube base 22 having a number of pins 24 for connection of the several electrodes to appropriate sources of operating potential, the base 22 being joined to the slender neck section 26 of the tube envelope by an appropriate vacuum seal. Within the neck section 26 are electrodes 28, 30, and 32 which are mounted in coaxial relation on supporting rods 34, 36 of glass or similar thermo-plastic material. For the sake of simplicity and clarity, the cathode which is normally mounted within the electrode 28 has not been shown in the drawings. The electrode 28, illustrated as an open-ended sleeve is usually designated as the first grid or control electrode and is seen to be mounted on the vitreous supports 34, 36 by oppositely directed U-shaped mounting studs 38, 40 which are welded to the electrode bodies and have terminal portions which are flattened out and embedded in the vitreous material of the supporting rods 34, 36. The second electrode 30, which is of cup-like configuration and is usually referred to as the second control electrode or grid, is similarly mounted on the supporting rods 34, 36 by studs 42, 44 which are welded to the electrode body and have terminal portions embedded in the supporting rods 34, 36. The electrodes 28, 30 which are shown respectively in FIGS. 5 and 4, are typical of the several electrodes which are mounted by the radially-extending mounting studs within the tube envelope. It will of course be appreciated that the shape of the electrodes, and the number and positioning of the several mounting studs may change depending upon the design of the gun structure.

In FIGS. 4 and 5 the structure of the several mounting studs 38, 40, 42, 44 may be best appreciated. Since each of the studs is of exactly the same construction, the description of one will suffice. The stud 40 is seen to include a flattened bight 40a which connects legs 40b, 40c which have flattened out terminal portions 40d, 40e. The mounting stud is fabricated of generally circular

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wire stock; accordingly, the flattened bight section serves to provide a substantial region of contact with the body of the electrode to provide an adequate joint upon welding. The flattened end portions or terminals 40d, 40e are arranged in a common plane lengthwise of the electrodes and provide substantial area contacts with the supporting rod and anchor the electrodes on the rods in a very stable and permanent fashion.

Before dealing in detail with the assembly method, reference will be made to the showing in FIGS. 13 and 14 for a general description of preferred apparatus which will serve as a general introduction to the details of the present process. The stud-forming and electrode-assembly apparatus, shown in FIGS. 13 and 14, includes a turret 50 which is journaled for intermittent indexing on a frame 52 by horizontal shaft 54. The turret 50 carries a number of circumferentially-spaced mandrels 56, 58, 60 and 62, each of which is mounted for independent indexing about its own axis. Making specific reference to FIG. 14, and considering the respective mandrels 56, 58, 60 and 62 being located at the 9, 12, 3 and 6 o'clock positions of a clock face, it will be appreciated that upon indexing of the turret and rotation thereof through an angular travel of approximately 90° in the clockwise direction, each mandrel will be passed to the next successive position about the machine. The 9 o'clock position, which has been generally designated by the reference numeral 64, is a loading position at which the electrode body B is manually loaded onto the mandrel 56; the 12 o'clock position, which is generally designated by the reference numeral 66, is the position at which one or more U-shaped mounting studs S are formed by mechanisms 100 and welded to the electrode body B; the 3 o'clock position, which is generally designated by the reference numeral 68, is the position at which swaging mechanisms 200 are operative to provide the flattened terminal portions on the terminal ends of the respective U-shaped mounting studs; and the 6 o'clock position, generally designated by the reference numeral 70, is the position at which the completed electrodes are manually removed.

A typical sequence of operations for applying three U-shaped mounting studs S on the electrode body B will now be generally described.

The illustrative sequence shown diagrammatically in FIG. 14 is for welding mounting studs at circumferentially spaced locations 120° apart about the electrode body B. The electrode body is manually loaded on to the mandrel at the loading station 64, and upon advance through an arcuate travel of 90° in the clockwise direction, arrives at the electrode forming and welding station 66 at which the mounting studs are welded at the prescribed circumferentially spaced locations. At the station 66, the mounting operation consists of the welding of a first stud onto the electrode body followed by indexing of the mandrel in the clockwise direction through an angle of approximately 120° to bring the electrode body into position for mounting of the second stud. The mounting operation is completed with the second stud, and after final indexing through 120°, the mounting of the third stud completes the assembly. The details of the mechanisms for forming and mounting the studs will be described in conjunction with FIGS. 6 to 12. Upon welding of the appropriate number of studs S to the electrode body B, the turret indexes through a clockwise traverse of 90°, whereupon the body with the three studs arrives at the swaging station 68, at which the mechanisms 200 are effective to provide flats on the terminal portions of the mounting studs. At the station 68, the mandrel itself indexes an appropriate number of times to position the several studs in operative relation to the swaging mechanism 200, as will be appreciated from the description which follows. Thereupon, the turret 50 is indexed through a further 90° clockwise traverse to bring the completed electrode into the unloading station 70. It will of course be appreciated that the mechanisms at

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the several stations are simultaneously effective so that for each index of the turret 50, an electrode body B is loaded at the station 64 and a completed assembly is available for unloading at the station 70.

Reference will now be made to FIGURES 6 to 9 inclusive, wherein the method of forming the U-shaped mounting studs S in accordance with the present invention is shown, with diagrammatic representations of typical apparatus for the semi-automatic or automatic forming operation. The studs S are formed from wire stock 102 of circular cross section which is fed through a stock feed 104 and stock check 106 to a cut-off bushing 108. Associated with the cut-off bushing 108 are a stationary forming anvil or backup tool 110, a pair of movable forming tools 112, 114 and a top swaging tool 116. The function of the several parts of the stock feeding, cutting end forming tools will be best appreciated by progressive consideration of FIGS. 6 to 9 inclusive. In the response to movement of the stock feed 104 to the left through its feed stroke into contact with the stock check 106, a length 1 of wire is fed from the coil supply 102 into straddling relation to the stationary forming anvil 110. The length of the feed is determined by the position of the stock feed 104 and the stock check 106 in relation to each other and may be changed in accordance with the type of mounting studs being manufactured. After the forward feed is completed (FIG. 7), the stock check 106 close on the wire and the stock feed 104 opens and returns to its feeding position shown in FIG. 8 (FIG. 6) in which position the stock feed 104 is ready to advance the next length of stock to the forming tools. During the return stroke of the stock feed 104 and while the stock check 106 is closed on the wire, the top swaging tool 116 moves down through a predetermined stroke to swage the wire length 1 intermediate its ends and in the region which is to ultimately be the flattened out bight section of the mounting stud. With the top swaging tool in the down position (illustrated in FIG. 8) the length of stock 1 is clamped onto the stationary forming anvil 110 and is ready for cutoff and forming into the general U-shaped configuration. Cut-off is achieved by the forming tool 114 at the right of the stationary anvil 110, which forming tool cooperates with the leading surface 108a of the cut-off bushing 108 as the forming tools 112, 114 move through their predetermined upward thrust. The forming tools cooperate with the top swaging tool 116 to bend the length 1 into the general U-shape, the action of the forming tools 112, 114 being best appreciated by progressive inspection of the several views of FIG. 9.

The action of the forming tools 112, 114 in conjunction with the top swaging tool 116 is to form the generally U-shaped stud about the top swaging tool 116. As seen in FIG. 9B the formed stud S is wrapped about the the adjacent end of the swaging tool and remains supported between the swaging tool 116 and the stationary anvil 110 as the tools 112, 114 retract. The forming operation occurs at a location spaced from the turret 50, as seen in FIG. 13, thereby necessitating provision for transfer of successive mounting studs into a position for assembly with the electrode body B. To simplify the transfer operation the mounting stud S is initially formed in the plane in which the stud is to be ultimately supported for assembly with the electrode body; accordingly, it is merely necessary to change the position of the stud in said plane to bring the stud into position for assembly.

The mechanisms for achieving this transfer may be best appreciated by reference to FIGS. 10 and 11 in association with the showing of FIGS. 9C and 9D. A pair of transfer tools 118, 120 are arranged at opposite sides of the plane in which the stud S is to be displaced, which tools are movable into and out of gripping relation with the stud S and are movable as a unit between a pick-up location relative to the top swaging tool 116 to a drop-off location in which the stud S is properly positioned relative to the electrode body B. As seen in FIG. 10, the tools 118, 120 are closed down on the stud S which is still

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supported by the top-swaging tool 116, the tools 118, 120 initially having been positioned in the spread apart or open position shown by the dot-dash line. When the tools are closed as illustrated in FIG. 10 (see also FIG. 9C) the swaging tool 116 is retracted through its return stroke as shown in FIG. 9D which frees the stud S, supported solely on the tools 118, 120, for movement in the transfer plane, as indicated by the directional arrow 122 in FIG. 10. The stroke of the transfer tools 118, 120 is selected so that the stud S is brought into an assembled position, designated by the numeral 123, wherein the bight is adjacent the outer periphery of the electrode body B and extends longitudinally or axially of the body.

With the stud supported in the assembled position 123 (FIGS. 10 and 11) by the transfer tools or jaws 118, 120, a welding electrode 124 advances through a predetermined forward or downward thrust to urge the stud S against the electrode body B. During the transfer of the formed stud S from the forming location to the assembly location, the bight section is somewhat spaced from the periphery of the electrode body B so that the stud does not foul on the electrode body B. However, as the welding electrode 124 moves down it forces the bight section of the stud S against the electrode body B, in which position the stud is welded to the electrode body. Prior to the welding operation the transfer tools or jaws 118, 120 spread apart, as shown by the directional arrows, and in said spread-apart position return to their starting position, as indicated by the directional arrows 126, 128. When the next stud is formed and held on the top-swaging tool 116, the transfer tools 118, 120 are in position to close toward each other, as indicated by the arrows, to once again assume the full line position at the right of FIG. 10. After the transfer tools 118, 120 release the stud S, the same is solely supported by the welding electrode 124 which bears with the requisite welding pressure against the flattened bight section. The machine proper serves as a ground for the welding unit, the welding electrode 124 being connected to a conventional welding supply and control which is not illustrated in the drawings.

The stud S welded onto the electrode body B is shown in FIGS. 12A and 12B. As seen in these figures, the stud is of generally circular cross section and includes the flattened bight section S_a and opposed leg sections S_b , S_c .

As will be appreciated from a consideration of the typical assembly operation described in conjunction with FIGS. 13 and 14, the forming and welding steps will be repeated for each stud which is to be formed and welded onto the electrode body B.

Reference will now be made to FIGS. 14 and 15 for a description of the mechanisms 200 by which the flattened terminal portions are formed on the respective studs S. As shown generally in FIG. 14, the swaging mechanisms include swaging tools 202, 204 which are adapted to close toward each other as indicated by the directional arrows 206, 206 when in an operative position at the swaging station 68. As the tools 202, 204 close down on each other, the terminal portions of the studs are provided with the flattened ears or lugs S_a , S_c . These lugs serve to anchor the studs in the vitreous supporting rods of the conventional gun assembly. The swaging tools 202, 204 are normally disposed in spread apart condition in a location retracted from the turret, as seen by the broken line showing at the right in FIG. 14. When the swages are to be formed, the tools 202, 204 move forwardly, as indicated by the directional arrow 210, to the operative, but open position, shown at the top of FIG. 15. Thereupon, by appropriate mechanisms (not shown), the tools 202, 204 move toward each other as indicated by the directional arrows 206, 208 to flatten the terminal portions in a common plane, which plane coincided with the plane in which the stud lies. When the swaging of a single stud is completed, the tools open and retract to the dotted line position of FIG. 14, allowing the mandrel supporting the electrode to index to bring the next stud into position for swaging; or allowing the entire turret to index to bring

the next electrode into position for the swaging operation.

From the foregoing it will be appreciated that the present method involves the cutting a length of wire stock from a stock supply, the shaping of the stud into a U-shaped configuration with a flat in the bight portion of the stud, the transfer of the formed stud to an assembly position relative to an electrode body, and the welding of the stud to the electrode body by the application of welding pressure in the region of the flat. Any number of studs may be secured to the electrode body at circumferentially spaced locations as determined by the design of the gun assembly. In particular, the forming and assembly operations for each of the studs is such as to facilitate ready mechanization without structural complexity. Once the stud is formed, it is properly oriented for assembly to the electrode body, except for the slight displacement to attain final orientation brought about by the welding electrode. The number of studs secured to any given electrode body and the radial disposition of the several studs is readily controllable by properly correlating the degree the number of times that the respective mandrels are indexed at the several stations. From the viewpoint of obtaining semi-automatic or automatic operation, the several assembly operations which have been described may be unified in a single machine, with proper timing of the several forming, transfer and welding tools.

Although the invention has been described in conjunction with electrodes having three mounting studs symmetrically disposed, it will be appreciated that the present invention finds application for the mounting of studs in other angular arrays. Depending upon the design of the electrode, two, three or four studs may be disposed at equally spaced or varying angles with respect to each other.

It must be again emphasized that the welding of the studs to the electrode body with the ends unflattened assures the provision of a strong weld. The subsequent flattening of the ends can be carried out with comparative ease and on an automatic basis in that the electrode body provides a convenient fixture for bringing successive mounting studs into position for flattening of the ends.

A latitude of modification and substitution is intended in the foregoing disclosure, and in some instances some features of the invention will be used without a corresponding use of other features.

What I claim is:

1. A method for manufacturing electrodes each having a sleeve-like body and at least one U-shaped stud projecting therefrom including the steps of feeding a length of wire so that its end portion is adjacent to and spaced from said sleeve-like body, forming said length of wire stock into a U-shaped stud with a flat in the bight portion of said stud, assembling said stud with said sleeve-like body to project radially thereof with said flat resting against and extending longitudinally of said sleeve-like body, and welding said stud to said sleeve-like body by the application of welding pressure in the region of said flat.

2. A method of manufacturing electrodes each having a sleeve-like body and at least one U-shaped stud projecting therefrom adapted for use in electron gun assemblies including the steps of feeding wire stock from a wire supply such that said wire stock is adjacent to and spaced from said sleeve-like body, cutting a length of wire from said wire stock, forming said length of stock into a substantially U-shaped stud having leg sections interconnected by a bight section, assembling said U-shaped stud with a sleeve-like electrode body with said stud having its bight section abutting against the outer periphery of said body and having its leg sections extending outwardly from said body, and welding said stud to said body by contacting said stud in said bight section.

3. A method for manufacturing electrodes each having a sleeve-like body and at least one U-shaped stud projecting therefrom including the steps of feeding a length of wire adjacent to and spaced from said sleeve-like body, forming said length of wire stock into a U-shaped stud, assembling said stud with said sleeve-like body to project radially thereof with its bight portion resting against and extending longitudinally of said sleeve-like body, and welding said stud to said sleeve-like body by the application of welding pressure to said bight portion of said stud.

4. A method of manufacturing electrodes adapted for use in television picture tube guns including the steps of feeding a stock of wire of substantially circular cross-section such that its end portion is adjacent and spaced from the location of the sleeve-like body of the electrode to be manufactured, cutting a length of wire from said stock of wire, forming said length of stock into a stud having a flat section intermediate its ends, assembling said studs with said sleeve-like electrode body with said stud having its intermediate section abutting against the outer periphery of said sleeve, and welding said stud to said sleeve-like electrode by contacting said stud in said intermediate section.

5. A multiple-station machine for manufacturing electrodes of the type including at least one U-shaped stud projecting from a sleeve-like body comprising a turret, a plurality of mandrels arranged at circumferentially spaced locations about said turret, each of said mandrels being adapted to support a sleeve-like body which is to be brought into successive stations of said machine, mechanisms at one station of said machine for forming U-shaped studs from wire stock, means arranged in operative relation to the forming mechanisms for bringing successive studs into an assembled position with the successive sleeve-like bodies arriving at said one station of said machine, and welding mechanisms at said one station of said machine for joining at least one stud to said sleeve-like body including a welding electrode arranged to maintain said stud in assembly with said sleeve-like body preliminary to welding.

6. A multiple-station machine for manufacturing electrodes of the type including at least one U-shaped stud projecting from a sleeve-like body comprising a turret, a plurality of mandrels arranged at circumferentially spaced locations about said turret, each of said mandrels being adapted to support a sleeve-like body which is to be brought into successive stations of said machine, mechanisms at one station of said machine for forming a U-shaped stud from wire stock, means arranged in operative relation to the forming mechanisms for bringing successive studs into an assembled position with the successive sleeve-like bodies arriving at said one station of said machine, welding mechanisms at said one station of said machine for joining at least one U-shaped stud to said sleeve-like body including a welding electrode arranged to maintain said U-shaped stud in assembly with said sleeve-like body preliminary to welding, and swaging mechanisms at a further station of said machine for flattening out terminal portions of said U-shaped stud.

7. A multiple-station machine for manufacturing electrodes of the type including at least one stud projecting from a sleeve-like body comprising a turret, a plurality of mandrels arranged at circumferentially spaced locations about said turret, each of said mandrels being adapted to support a sleeve-like body which is to be brought into successive stations of said machine, mechanisms at one station of said machine for forming a stud from wire stock, means arranged in operative relation to the forming mechanisms for bringing said stud into an assembled position with a sleeve-like body arriving at said one station, and welding mechanisms at said one station of said machine for joining said stud to said sleeve-like body.

8. A multiple-station machine for manufacturing electrodes of the type including at least one U-shaped stud projecting from a sleeve-like body comprising a turret, a plurality of mandrels arranged at circumferentially spaced locations about said turret, each of said mandrels being adapted to support a sleeve-like body which is to be brought into successive stations of said machine, mechanisms at one station of said machine for forming U-shaped studs from wire stock, the forming mechanisms including cooperating male and female forming tools disposed at a location remote from successive mandrels arriving at said one station, means arranged in operative relation to said forming mechanisms for bringing successive studs into an assembled position with the successive sleeve-like bodies supported on said mandrels and arriving at said one station of said machine, and welding mechanisms at said one station of said machine for joining at least one stud to said sleeve-like body.

9. A method for manufacturing electrodes each having a sleeve-like body and a plurality of U-shaped studs projecting radially of said body comprising the steps of supporting said body, feeding a first length of wire adjacent to and spaced from said body, forming a first U-shaped stud from said first length of wire having a bight section and projecting legs and welding said stud to a first circumferential portion of said body with said bight in contact with said body and with the legs extending radially of said body, turning said body on its longitudinal axis, feeding a further length of wire adjacent to and spaced from said body, forming at least a second U-shaped stud from said further length of wire having a bight section and projecting legs and welding said second stud to a second circumferential portion of said body

with said bight in contact with said body and with said legs extending radially of said body, swaging terminal portions of said first stud, turning said body on its longitudinal axis, and swaging terminal portions of said second stud.

10. A method of forming a wire element and welding the same to a metal sleeve, comprising supporting the metal sleeve in a selected position, feeding a wire so that its end portion is brought adjacent to and spaced from said sleeve, forming the end portion of the wire into a radial element having a transverse part, moving the radial element toward the sleeve, pressing the transverse part against said sleeve, and electrically welding the transverse part to the sleeve.

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2,456,474	Wainwright	Dec. 14, 1948
2,473,543	Randolph	June 21, 1949
2,525,737	Tolson	Oct. 10, 1950
2,564,737	Szegho	Aug. 21, 1951
2,565,533	Szegho	Aug. 28, 1951
2,606,268	Pityo	Aug. 5, 1952
2,646,523	Gugelberg	July 21, 1953
2,668,219	Sandberg et al.	Feb. 2, 1954
2,701,320	Kovach	Feb. 1, 1955
2,734,119	Pityo	Feb. 7, 1956
2,846,561	Pityo	Aug. 5, 1958