

Dec. 21, 1954

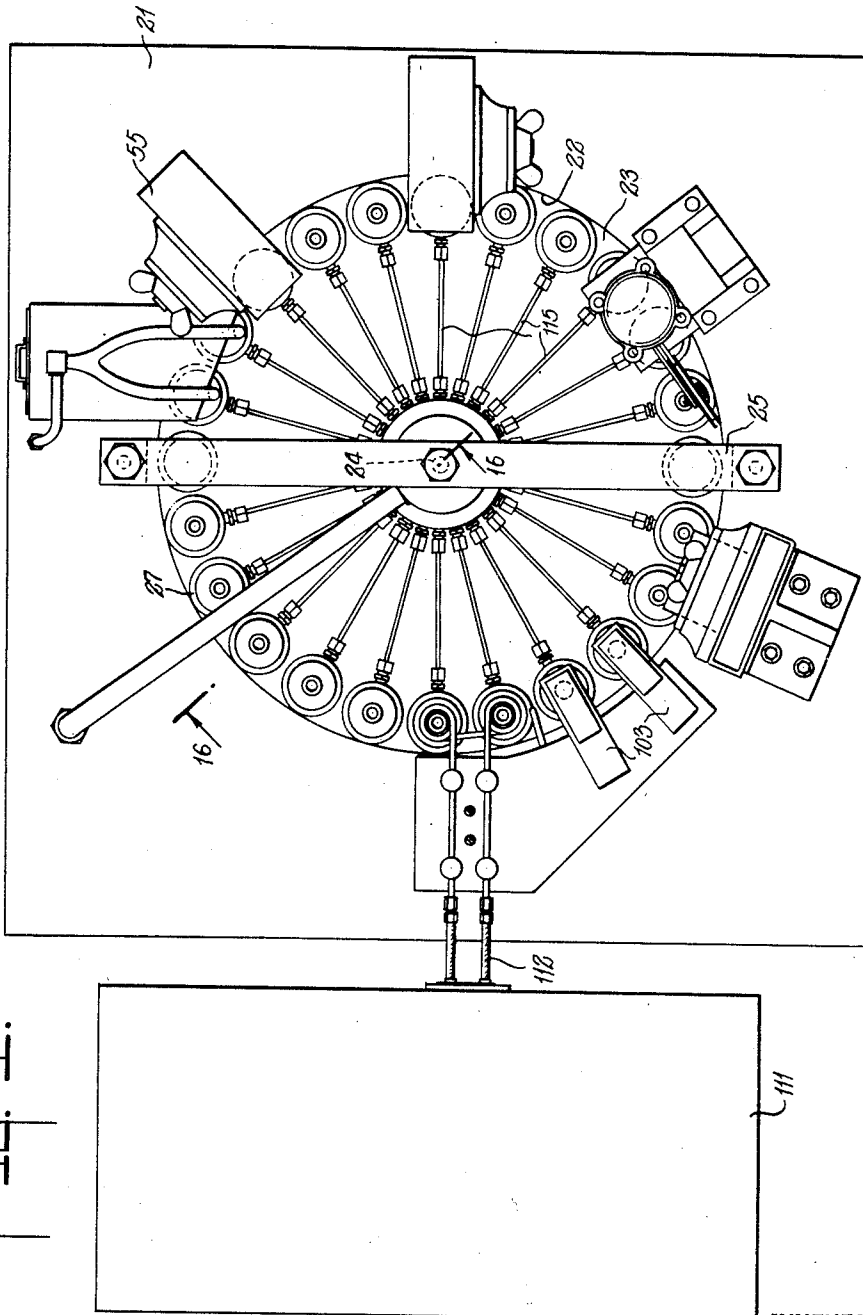
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2,697,774

BRAZING MACHINE AND METHOD

Filed Sept. 25, 1951

9 Sheets-Sheet 1



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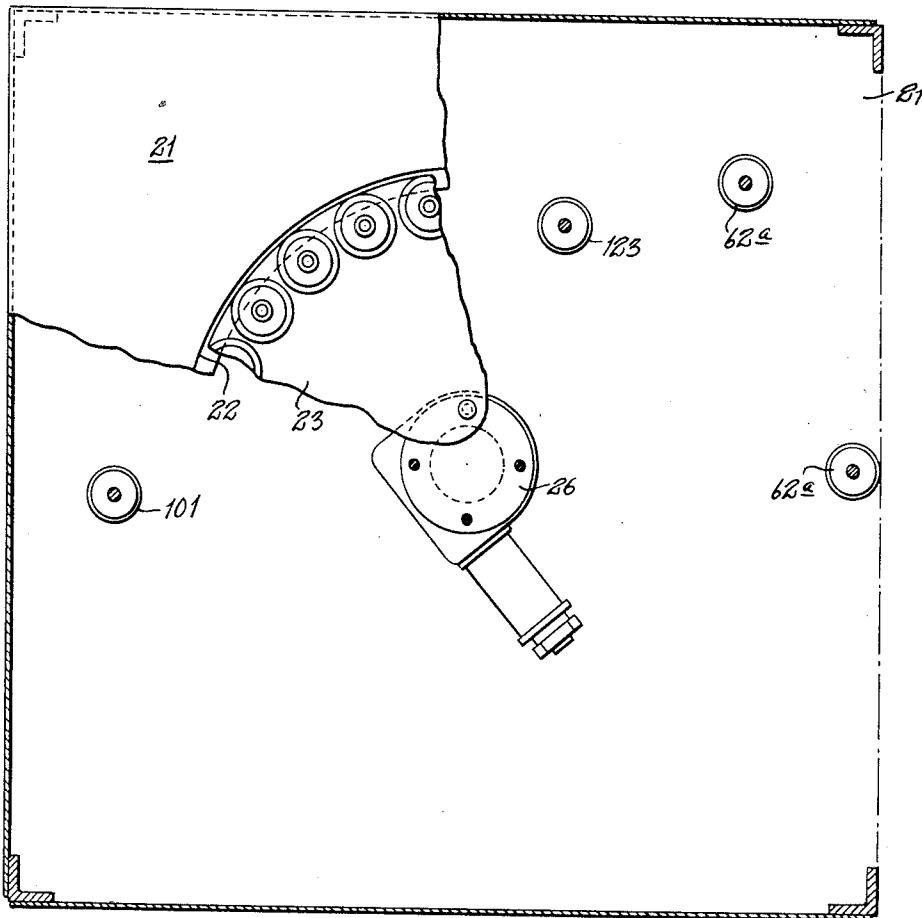


Fig. 2.

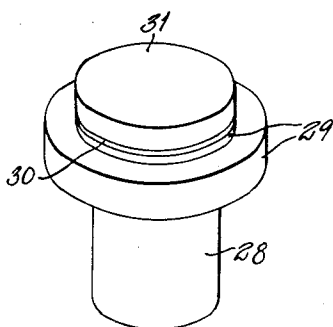


Fig. 3.

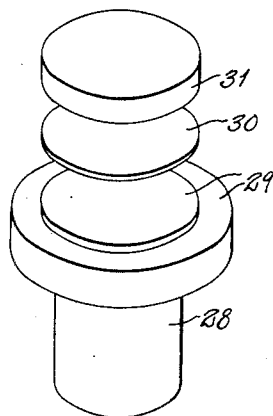


Fig. 4.

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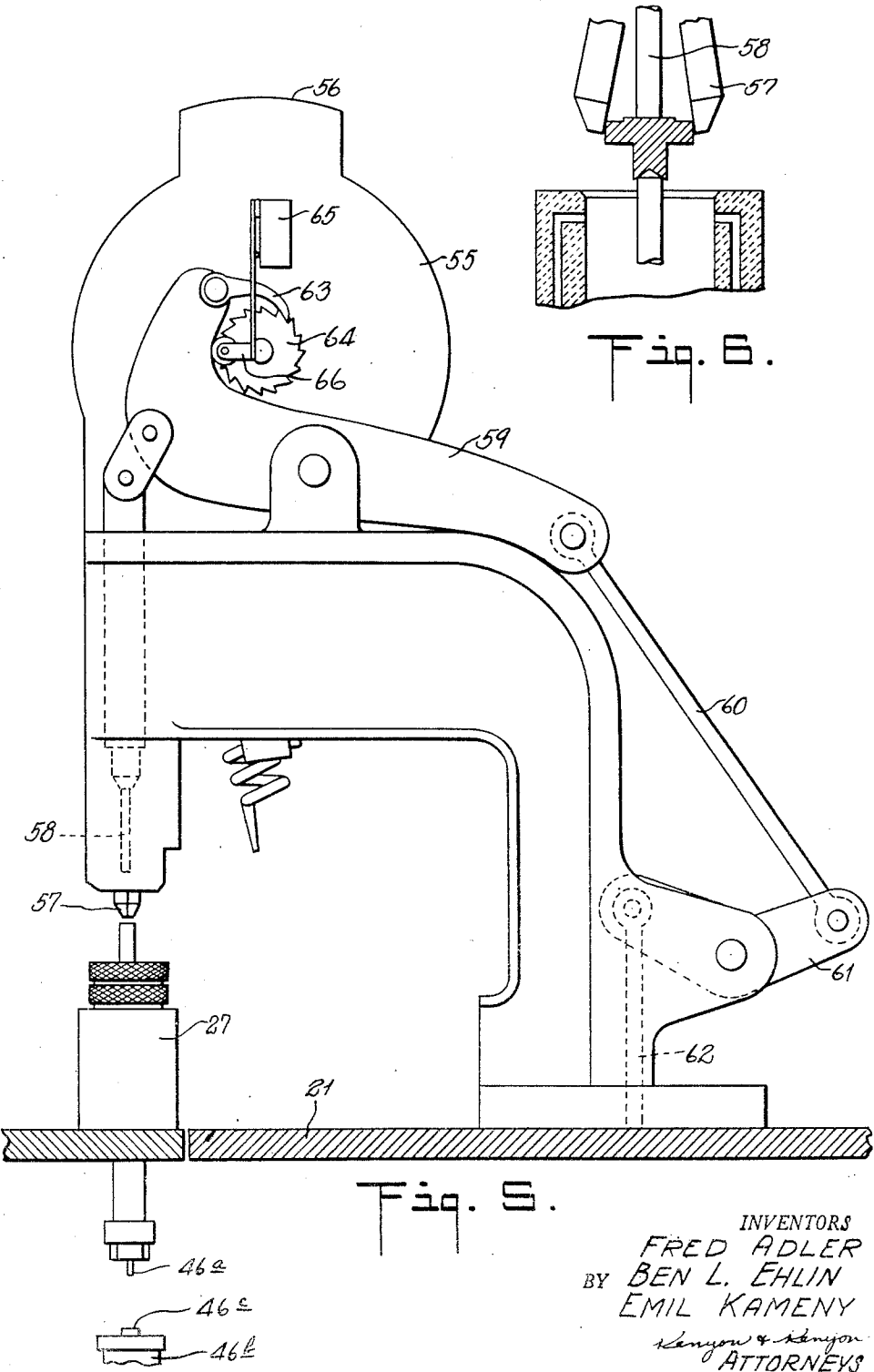
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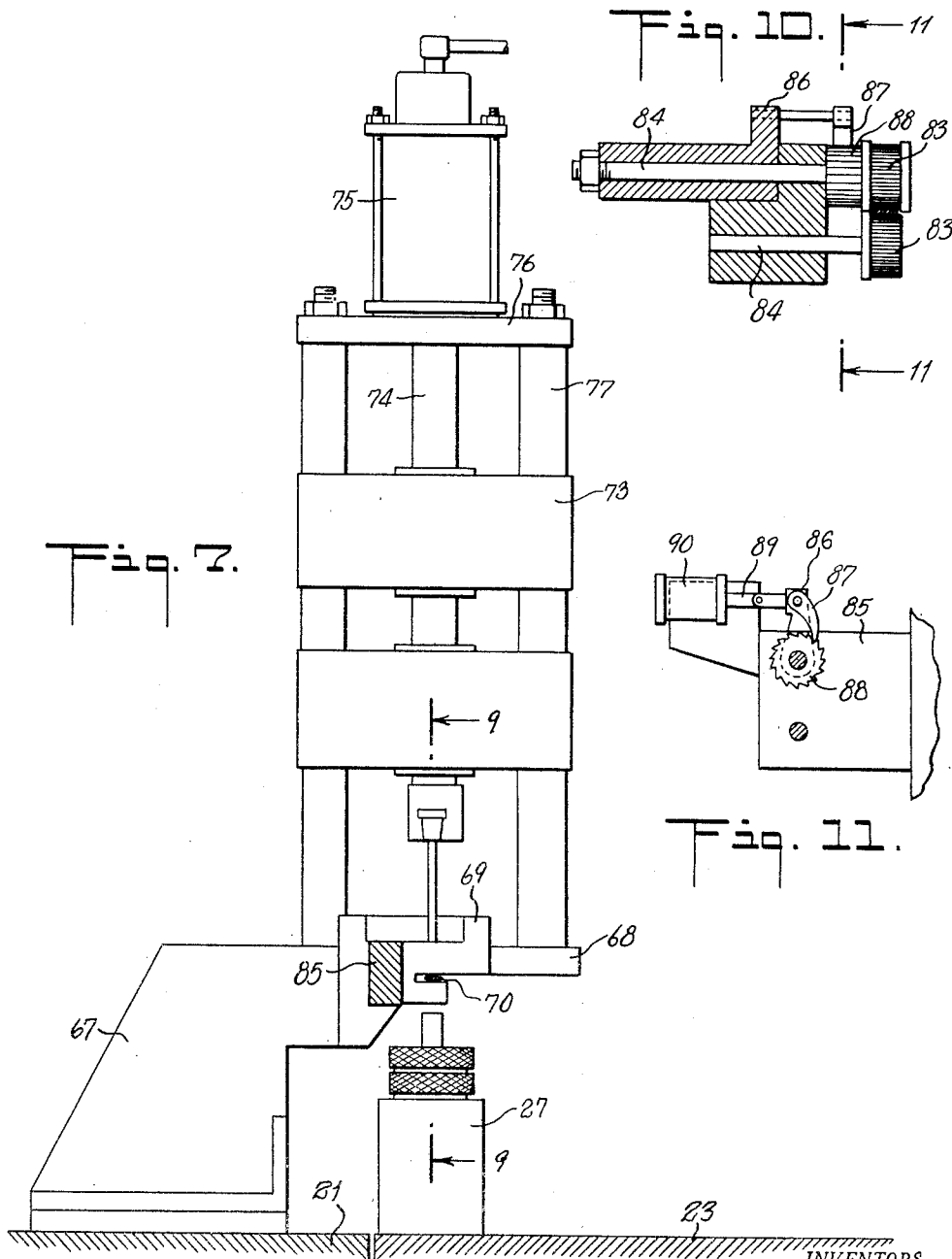
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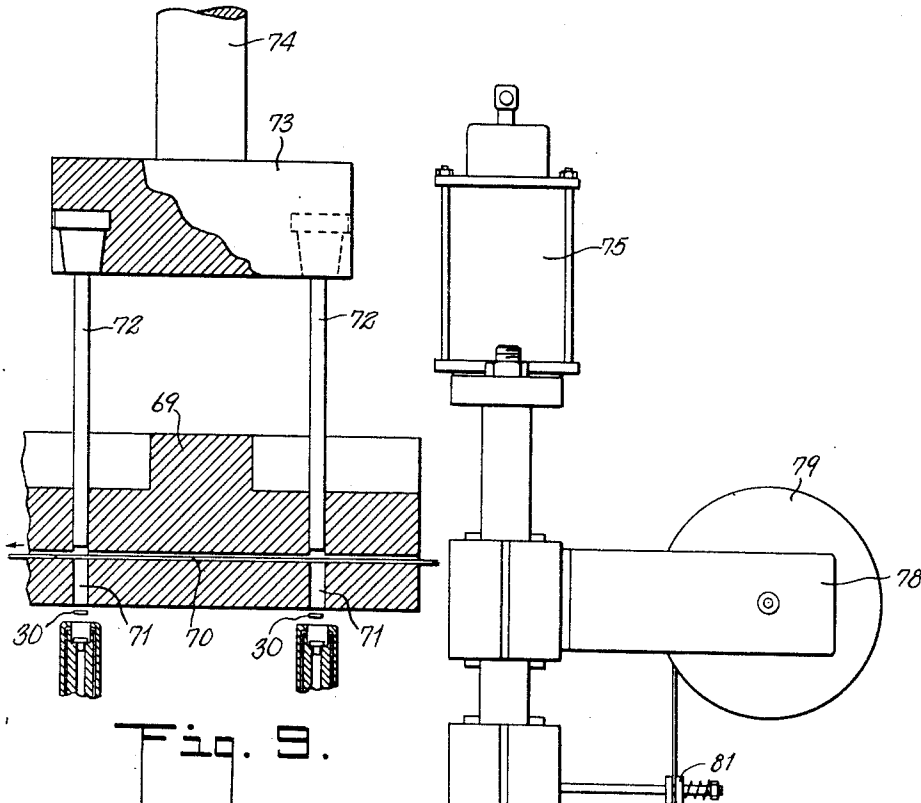
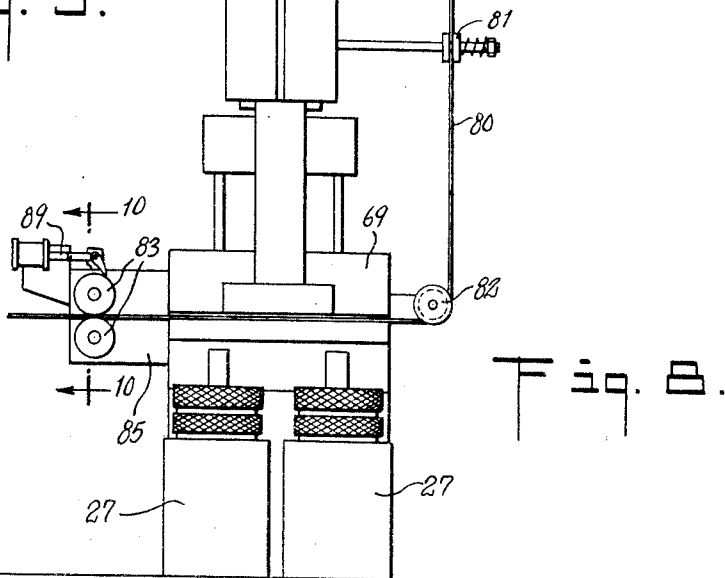


Fig. 9.



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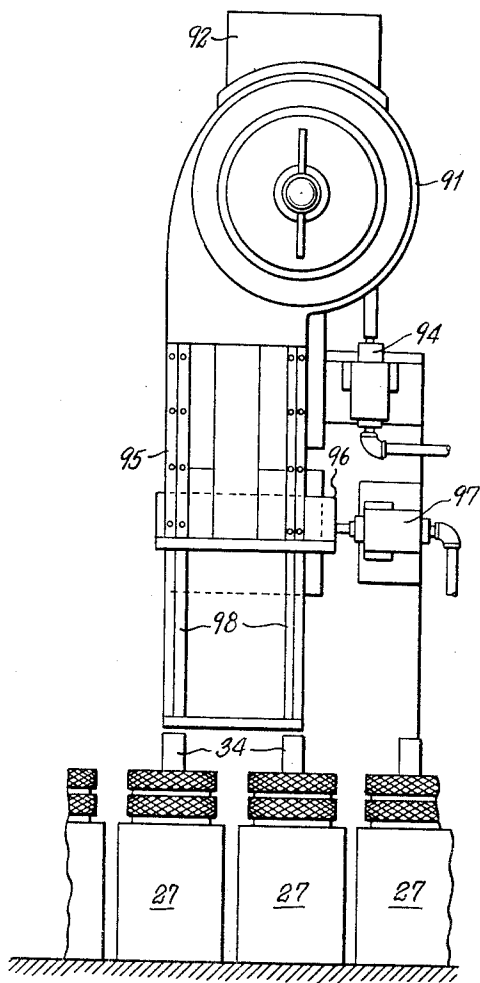


Fig. 12.

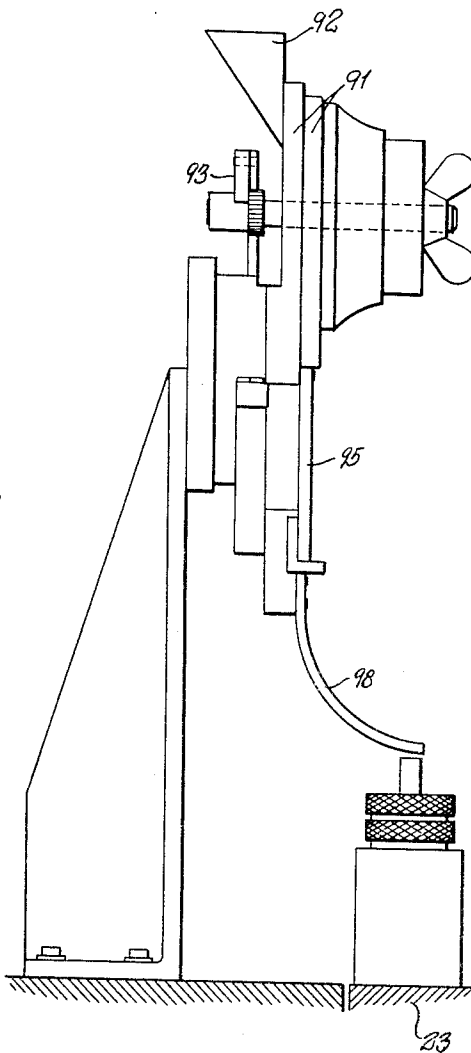


Fig. 13.

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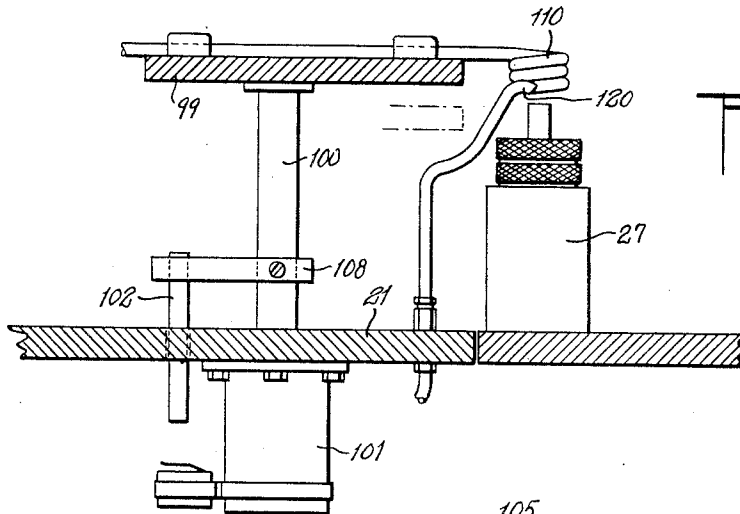


Fig. 15.

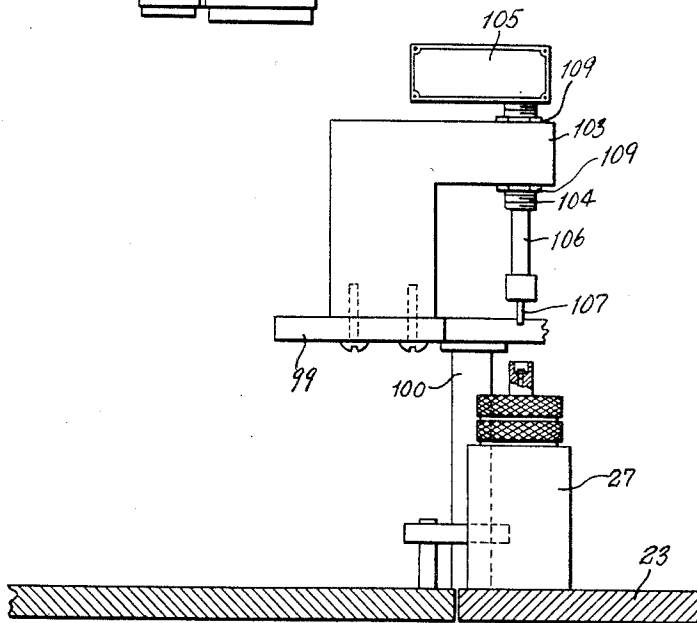


Fig. 14.

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Fig. 16.

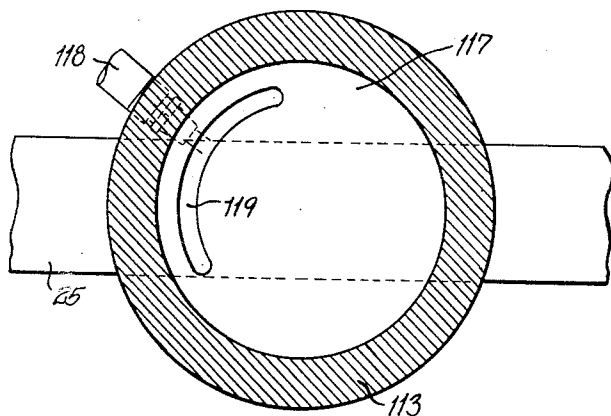
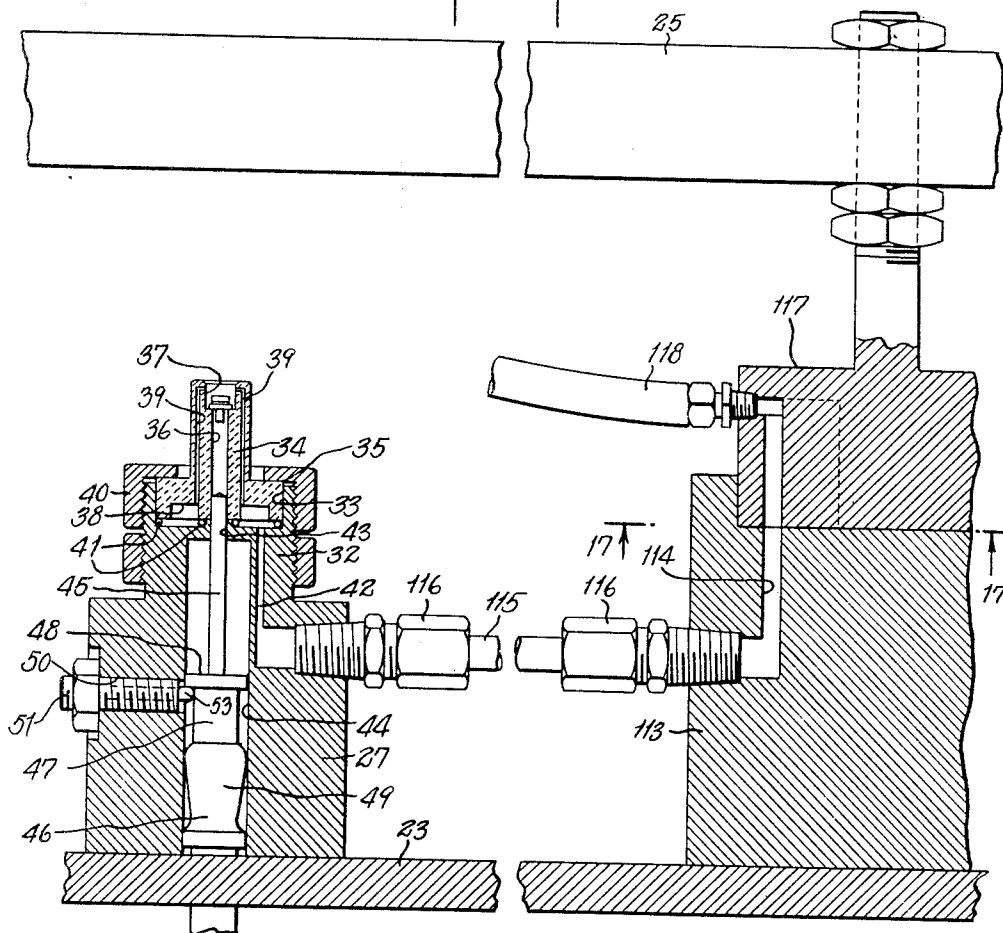


Fig. 17.

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BRAZING MACHINE AND METHOD

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Application September 25, 1951, Serial No. 248,212

10 Claims. (Cl. 219—12)

This invention relates to a brazing machine and method. The invention was developed particularly for the manufacture of small electric contacts of the type comprising a shank having a head on which a tungsten disk is brazed. Such contacts are used in automotive vehicle electrical equipment such as distributors and generator voltage regulators. The principles of the invention may be applied to the manufacture of other assemblies of inter-brazed parts, particularly when the individual parts are relatively small and difficult to handle.

One of the objects in developing the present invention was to provide for the mechanical assembly and thermal interbrazing of the parts without the need for any manual handling of the parts. Another object was to provide for a machine adapted to be placed under fully automatic control so that the finished parts may be produced in a fully automatic manner.

As previously indicated the invention is embodied by a machine especially adapted to manufacture small electric contacts of the type comprising a shank having a head on top of which a tungsten disk is brazed.

This machine includes, in combination, a conveyor having a series of mutually spaced fixtures mounted thereon. Each fixture includes an upstanding non-metallic refractory tube having a bore shaped to receive the rivet shank and an open-topped counterbore in its upper end shaped to receive the rivet head. This refractory tube has one or more gas ducts opening into its counterbore. A metal push rod is provided with a top shaped to engage the bottom end of the shank and this rod is arranged to reciprocate in the refractory tube's bore between extremes at one of which the push rod's top is projected to an up position above the counterbore and at the other of which the rod's top is retracted to a down position spaced substantially below the counterbore. The conveyor is intermittently movable and defines a series of indexing stations with which each fixture successively indexes during halts in the conveyor motion.

A rivet feeder provides, at the first station with which an empty fixture indexes, means for pushing an upright rivet downwardly to the indexed fixture with the rivet shank's lower end engaged by the top of this push rod and guided thereby, as the push rod is thrust downwardly, until the rivet head seats on the bottom of this fixture's counterbore. If the push rod does not move fully down, a safety device prevents further actuation of the machine. Following this station, a brazing disk feeder is arranged with means, located at a following or second one of the stations at which the fixture indexes, which feeds a brazing disk into the counterbore of the fixture on top of the rivet head seated thereon. Next is located a tungsten contact feeder having, at a following or third one of the stations, means for feeding a tungsten contact on top of the brazing disk in the counterbore.

Both the bore and counterbore of each fixture's refractory tube are dimensioned to be loosely fitted by the parts received thereby. The fit is not so loose as to permit the rivet to cant or tumble to an inverted position during the movement to which the fixture is subjected by the starting and stopping of the conveyor. The counterbore fits the brazing disk and contact sufficiently to prevent them from sliding completely off the head of the rivet, the fit being otherwise a loose fit. The loose fit thus provided permit each of the three parts, of the final product, to be placed freely in the counterbore of each fixture's tube and to be loosely located relative to each other but so that the parts are maintained in their properly

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superimposed and mutually flat relationship. Such looseness incidentally permits the parts to be jostled by the table motion. A subsequent operation makes it immaterial that the parts are not held in exact registration with each other.

A feeler or detector apparatus follows the elements described so far. This apparatus has a feeler at a fourth one of the stations with which the fixtures index. This feeler is arranged to enter the counterbore of each indexed fixture until stopped by the parts placed therein, this apparatus including a control mechanism actuated by the extent to which the feeler can enter each counterbore. If all three parts are not in each counterbore which the feeler enters, the control mechanism is actuated. This control mechanism is useful for operating an indicator or for stopping the operation of the machine when the latter is provided with a fully automatic control system.

Following this feeler apparatus an electric induction heater device is provided with a movable heating coil, at a fifth one of the indexing stations. This device is arranged to move from an up position clearing each fixture to a down position encircling the refractory tube of each fixture indexed therewith. With this coil powered by induction heating current of adequate power and with a frequency properly related to the size of the parts involved, the brazing disk of each assembly is rapidly fused so that the contact is brazed to the rivet head.

The machine includes means for flowing a gas through the previously mentioned duct or ducts, and this gas may be of a non-oxidizing or of a reducing nature as represented by hydrogen or the like. Thus the parts may be continuously bathed in a flow of moving gas which protects the parts against oxidation.

During the heating period the molten brazing metal floats the tungsten contact accurately into substantial concentric registration with the rivet head. This relationship is maintained until the brazing metal freezes and the parts are permanently united. Due to this action any lack of registration between the parts before brazing, does not affect the production of electric contacts having accurately concentric parts.

As a last or sixth position the machine has a thruster for moving the push rod of each fixture to its up position to eject the finished electric contact. When the push rod moves towards its up position its top end contacts the bottom end of the rivet shank and pushes up the finished product. At this station the machine has a pneumatic discharger and collector for the ejected products.

The conveyor is arranged so that each fixture is used over and over again or, in other words, so that the series of fixtures works as an endless series. The various elements of the machine may be arranged to operate in a fully automatic and properly timed manner by anyone accustomed to arranging for this kind of working by automatic machines in general.

The foregoing description incidentally outlines a new method of assembling and brazing small parts. The loose positioning of the parts in the refractory tube permits their ready assembly in the tube and their carriage from one point to another. The use of induction heating makes it necessary to hold the tube stationary only very momentarily to effect the brazing of the parts. Therefore, it is possible to move the fixture promptly to another station. The gas flow may be continued after the actual termination of the induction heating power for as long as it is necessary to protect the parts against oxidation.

As previously suggested the invention is useful not only for making the described contacts but also possibly in connection with the brazing or heat treatment of many other kinds of work.

A specific example of the machine embodying the foregoing and other features is illustrated by the accompanying drawings in which:

Fig. 1 is a top view or plan of the machine;

Fig. 2 is a bottom view to show the manner in which the conveyor is moved;

Fig. 3 is an isometric view showing on a greatly enlarged scale one of the previously mentioned electric contacts;

Fig. 4 is similar to Fig. 3 but is an exploded view showing the organization of the various parts of the contact;

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Fig. 5 is a side view of the rivet feeder;
 Fig. 6 is a vertically sectioned view showing the manner in which the rivet is fitted onto and pushed down on the guiding and ejecting push rod;
 Fig. 7 is a side view of the brazing disk feeder;
 Fig. 8 is a front view of this feeder;
 Fig. 9 is a vertical section view taken on the line 9—9 in Fig. 7;
 Fig. 10 is a cross section taken on the line 10—10 in Fig. 8;
 Fig. 11 is a cross section taken on the line 11—11 in Fig. 10;
 Fig. 12 is a front view of the tungsten contact feeder;
 Fig. 13 is a side view of this contact feeder;
 Fig. 14 is a side view of the feeler gauge apparatus;
 Fig. 15 is a side view of the electric induction heating coil arrangement;
 Fig. 16 is a sectional view taken on the line 16—16 in Fig. 1 and showing the manner in which the gas is fed during and after the heating;
 Fig. 17 is a cross section taken on the line 17—17 in Fig. 16;
 Fig. 18 is a side view of the pneumatic discharger and collector;
 Fig. 19 is a vertical cross section of one of the fixtures showing the contact ejected and ready to be pneumatically removed and collected.

In a machine of the type under disclosure the effective teaching value might be diminished by the inclusion of parts which may be made in accordance with the prior art. Therefore, such parts are eliminated from the described drawings insofar as is considered possible.

With the above understanding, Fig. 1 shows a horizontal stationary table 21 which may be suitably supported at a convenient height above the floor. This table 21 has formed through it a relatively large circular hole 22 in which a horizontal rotary turntable 23 turns on a suitably journaled vertical shaft 24. The lower end of this shaft 24 projects beneath the table where it connects with an intermittently rotating power feed device 26. The device shown is of a pneumatically actuated type which is commercially available today. Such a device may be controlled so that for each power actuation it provides a limited rotative action. The angle of the intermittent rotative action is controllable.

A circular series of mutually spaced fixtures 27 is concentrically mounted on the top of the turntable 23, the latter functioning as the conveyor for the fixtures. As shown by Fig. 1 a relatively large number of these fixtures 27 is provided. The intermittent rotating action provided by the device 26 may be such as to move each fixture progressively from one single-unit indexing station to another, or to move a plurality of the fixtures at a time to each station in which case multiple-unit stations are provided. In the illustrated machine the arrangement is such that the fixtures are moved two at a time to each indexing station since this provides more time for the actuation of the mechanisms at the various stations without slowing down the output of the machine. Therefore dual units are used at each station.

Figures 3 and 4 show, greatly enlarged, the electric contact processed by the illustrated machine. This contact includes a rivet having a shank 28 and a head 29 in the form of a flange on top of which is a somewhat reduced flat-topped pedestal. The brazing disk 30, which may be a disk of any suitable brazing metal, is placed on top of the head of the pedestal 29, and the tungsten disk 31 is placed on top of the brazing disk 30. This tungsten disk is thicker than the brazing disk. Fig. 4 shows the assembly of these parts, and Fig. 3 shows how the parts look after brazing, the disk 30 having been used to braze the rivet head 29 and the contact 31 together. All of the parts are superimposed flatly together and are mutually concentric when finished in the form of the final contact.

The various fixtures 27 are all constructed similarly to each other. The internal construction of one of them is shown by Figures 16 and 19 particularly well.

Each fixture includes a cylindrical metal mount which is fastened on the turntable 23, this mount being the member to which the numeral 27 is applied in the drawings. This mount 27 has a reduced upper stub 32 which is externally threaded and which internally has a recess 33. The non-metallic refractory tube 34 may be made

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of any suitable refractory dielectric material and it has a base flange 35 which rests in this recess 33 on the latter's bottom surface. The tube 34 extends upwardly and has a bore 36 fitted by the rivet shank 28 and an open-topped counterbore 37 in its upper end and which receives the rivet head 29. The base flange 35 has an annular recess 38 in its bottom face and two fluid ducts 39 extend longitudinally through the tube's wall and interconnect the counterbore 37 and this recess 38. All of these parts are made of non-metallic or dielectric material. The bore 36 and counterbore 37 are designed to provide the loose fit for the contact's parts, as previously described. The open top of the counterbore 37 provides a mouth for receiving the parts and this counterbore's bottom provides a support for positioning the parts part way in or through the tube 34.

An inwardly flanged union nut 40 is screwed onto the top of the stub 32 with its flange engaging the top of the base flange 35 of the non-metallic refractory tube part of the fixture. This serves to press the base flange 35 tightly down on the bottom of the recess 33, gasket or packing rings 41 provide a gas-tight fit. The stub 32 of the mount 27 and a part of the latter are provided with a fluid duct 42 connecting with the annular space defined by the bottom of the base 35, whereby to provide for the connection of the gas with the ducts 39.

The upper end of the stub 32 of the mount 27 has a hole 43 which registers with the bore 36 of the tube 34. This hole 43 connects with a larger bore 44 extending longitudinally through the mount 27.

The push rod 45 extends through this hole 43 and its bottom end connects with a reciprocating plunger 46 slidably fitting the bore 44. This plunger 46 projects downwardly through the turntable 23 and is adapted to be pushed upwardly from below the turntable by way of its lower end. The upper end of this plunger 46 has a reduced cylindrical neck 47 terminating at its top with a flange 48 and at its lower end with a smoothly rounded shouldered portion 49 which tapers downwardly. The side wall of the mount 27 has a transverse threaded hole 50 in which a longitudinally bored screw 51 is threaded, the bore 52 of this screw containing a reciprocative pin 53 biased by a spring 54 to press against the plunger 46 mounting the push rod 45. When the plunger 46 is pushed upwardly with force the pin 53 retracts and frictionally holds up the plunger 46, by engaging the shouldered portion 49, so that the push rod 45 is projected to its up position where its upper end is above the top of the tube 34, as shown by Fig. 19. When the push rod 45 is pushed fully downwardly the friction of the pin 53 is overcome, the pin 53 moving out into the space defined by the neck 47 when the push rod is at its down position. The flange 48 then engages the pin 53 and holds the plunger 46 against further downward motion, while the portion 49 prevents the plunger 46 from inadvertently rising without being given a deliberate and forcible upward thrust.

The bottom end of the plunger 46 has a downwardly projecting and downwardly spring biased reciprocating pin 46a. At the rivet feeding station an electric micro-limit switch 46b is positioned with an actuator 46c located so it is actuated by the pin 46a only when the plunger 46 is thrust to its fully down position, which occurs only upon proper actuation of the rivet feeder.

This switch may be placed in circuit with any suitable electrical system to stop the machine or to actuate an indicator. Thus, the just described arrangement provides a safety arrangement guarding against the possibility that the rivet feeder might not feed a rivet. The portion 49 may be shaped so that it is disengaged from the pin 53 only when the plunger is thrust downwardly by the full stroke of the rivet feeder plus the length of a rivet. This provides positive assurance against actuation of the machine when a rivet is absent from a fixture which should contain a rivet.

As the turntable 23 is intermittently turned, by the rotating power feed device 26, two of the fixtures 27 simultaneously index with dual rivet feeders. Each rivet feeder is constructed in the same manner. Figures 5 and 6 show the details of one of the feeders in a general manner because the type of feeder used follows the prior art. Two of the switches 46b may be used with this dual arrangement, using one for each fixture.

This type of feeder includes a hopper 55 having a

mouth 56 through which a large supply of the rivets may be fed. The rivets are then fed singly in an upright position, with their shanks downwardly, to a chuck 57 down through which they are pushed by a finger pin 58, the chucks spreading to permit this feed as is indicated by Fig. 6. This finger pin is powered by a walking beam 59 which is worked through a connecting rod 60 by a two-armed lever 61 which is rocked by a depending rod 62 which extends down through the table 21 to a suitable thruster unit 62a located below this table 21. The walking beam 59 also works a pawl 63 which turns a ratchet wheel 64 which powers a stirring device inside of the hopper 55. The limit switch 65 and its operating crank arm 66, shown in Fig. 5, are provided for use in conjunction with automatic electrical control of the rivet feeder.

This type of rivet feeder is adapted to push a rivet into a hole and thrust it home in this hole, and with the present machine it is used to thrust the rivet part of the contact, with its shank 28 downwardly, into the counterbore 37 of the tube 34 of the fixture indexed with the rivet feeder. The top of each of the push rods 45 is pointed somewhat, the bottom end of the rivet part normally being recessed so that the pointed end of the push rod can engage it without lateral slippage. Therefore, as the rivet is pushed downwardly by the finger pin 58 the push rod 45 guides the rivet so that its shank enters the bore 36 of the refractory tube 34. The finger pin 58 then returns upwardly, leaving the rivet fitting the bore 36 and counterbore 37 as previously described.

In the case of the illustrated machine the two rivet feeders may be operated simultaneously to supply each of the tubes of two fixtures simultaneously with a rivet. Since the rivet feeders are somewhat bulky they are spaced apart a distance equal to the spacing between four of the fixtures 27. This arrangement, however, results in loading of all the fixtures with rivets when the fixtures are intermittently fed in pairs.

Operation of the feed device 26 again moves the turntable 23 so as to index a pair of the fixtures with the next or second station. Here a dual brazing disk feeder of special design is located.

This brazing disk feeder is shown in detail by Figures 7 through 11. It comprises an upstanding bracket 67 secured to the stationary table 21 and mounting a cantilever 68 which overhangs the rotary turntable 23 over the fixtures carried by the latter. This cantilever supports a horizontal block 69 providing a horizontal passage 70 extending over and aligned with the counterbores of the refractory tubes of the pair of fixtures indexed at this station. The block 69 also has vertical holes 71 axially aligned with the two tubes and having diameters equalling the diameters of the brazing disks to be supplied on top of the rivets with which the pair of fixtures was previously supplied. Vertical punches 72 reciprocate in these holes 71 and are powered by a cross head 73 which is manipulated up and down by a vertical punch rod 74 powered by a thruster 75. This thruster is mounted on a superstructure 76 supported above the cantilever 68 by pedestals 77. Thus it can be seen that the brazing disk feeder is in the form of a dual punch press.

The super structure 77 supports a horizontal arm 78 which rotatively positions a coil 79 of suitable brazing metal strip 80. This strip 80 feeds downwardly from the coil 79 through a back tensioning device 81 and down and around a roller 82 where it then deflects to a horizontal position and extends through the horizontal passage 70 in the horizontal block 69.

Upon leaving the passage 70 the strip 80 is engaged by a pair of feed rolls 83 which pull on the strip to effect its feed. The feed rolls 83 are mounted by horizontal shafts 84 supported by a stub 85 projecting from the block 69. One of these shafts 84 journals a crank arm 86 which mounts a pawl 87 engaging a ratchet wheel 88 non-rotatively fixed to the adjacent one of the feed rolls 83. This crank arm 86 is powered through a connecting rod 89 by a small thruster 90. Each time the thruster 90 is energized it pushes the connecting rod 89 forwardly so as to partially rotate the ratchet 88 and the one of the feed rolls 83 associated therewith, thus effecting an intermittent feed of the grazing metal strip 80.

When the punch operating thruster 75 is energized it

pushes down the two punches 72 so as to simultaneously punch out two of the brazing disks 30, which then individually fall into the counterbores 37 of the refractory tubes 34 of the two indexed fixtures. Due to the looseness of the fit of these disks with the counterbores, the disks fall freely into position flatly on top of the heads 29 of the rivets already in the fixtures. Thus each of the fixtures is supplied with the second part of the desired ultimate assembly.

Upon the next operation of the rotating power feed device 26 the turntable moves the pair of fixtures, now each supplied with two of the parts, to the next or second indexed station. The turntable motion may be made rapidly because, as presently explained, the loss of exact registration between the brazing disks and rivet heads ultimately becomes immaterial. The fit of the parts is sufficient to prevent the brazing disks from completely falling off of the rivet heads but, in the interest of a rapid and positive feed of the parts to the fixtures, the fit is loose enough to permit the parts to jostle or jiggle about as the turntable is rapidly started and stopped. The illustrated type of feed device 26 is capable of intermittently feeding the turntable rotatively with high accelerating and decelerating effects.

At this next or third station the tungsten disk feeder is located. This feeder is a modification of a prior art type and, therefore, does not require explanation of all of its details.

This tungsten disk feeder includes a hopper 91 provided with a feeding mouth 92 through which a large supply of the contacts may be fed. The hopper has a stirring device inside of it powered by an arrangement generally indicated at 93 and which is made along the lines of the corresponding arrangement of the rivet feeder. In this instance the arrangement is powered by a small thruster 94. The contacts feed from the hopper 91 flatly down two chutes 95 with a gate arrangement 96 controlling their exit. This gate arrangement is operated by another small thruster 97. Each time the thruster 97 is operated a single contact is permitted to fall from each of the chutes 95. Chute extensions 98 curve downwardly and inwardly respecting the turntable 23 so as to terminate over the mouths of the tubes 34 of the two fixtures indexed at this station. Each time a pair of fixtures halts, at this station, operation of the thruster 97 drops a contact disk into the mouth of each tube on top of the brazing disk therein, thus completing the assembly of the small parts which are to constitute the finished electric contact. Operation of the device 26 then indexes the pair of fixtures with the next station.

At this following or fourth station a feeler apparatus is located, the details of which are shown by Fig. 14. This apparatus includes a vertical moving shelf 99 supported by a vertically reciprocative column 100 which can be moved up and down by a thruster 101. The column extends up through the stationary table 21 while the thruster 101 is arranged beneath this table, a rotative lock arrangement 102 preventing rotation of the column 101. This shelf 99 mounts brackets 103 which overhangs the fixtures carried by the turntable 23 and each of these brackets mounts a feeler gauge arrangement. Each of these arrangements comprises a tube 104 which is externally threaded through and passes its bracket 103 and mounts a microlimit switch 105 on its top and projecting above its bracket. This microlimit switch is worked by a feeler 106 having a reduced end 107 sized to enter the counterbore 37 of the tube 34 of the fixture indexed therewith. It is to be understood that the general arrangement of the elements is such that the two feeler gauge devices are positioned so that the two ends 107 enter the two tubes indexed at this station.

The microlimit switch 105 may be arranged to either open or close its contacts whenever the feeler 106 is not stopped at a predetermined position by its end 107 contacting a pile formed by all three of the parts that should be positioned in the fixture tube. When the end goes to a lower position, due to the absence of one or more of the three contact parts, the microlimit switch 105 is actuated and its actuation may be used to establish an alarm or stop the operation of the entire machine if the latter is supplied with an automatic control and timing system.

Although not previously explained, it is to be understood that the feelers 106 go into operation when the column 100 is either pulled downwardly or permitted to

drop by actuation of the thruster 101. The column 100 may be biased upwardly with the thruster serving to pull the column down. The lock arrangement 102 includes an arm 108 which also functions as a stop definitely fixing the down position of the column 100, or a suitable stop may be included as part of the thruster 101. Therefore, screw adjustment of the feeler gauge tube 104 may be effected to produce the described effect. This tube 104 is shown with nuts 109 screwed on it above and below the bracket 103. These may function either to lock the position of the tube 104 if it is screwed through the bracket 103, or the necessary hole through the latter may be unthreaded and the nuts 109 used to locate the vertical position of the tube 104 as required to produce the described effect. Whenever only one of the feeler devices is discussed it is to be understood that the discussion is applicable to both these devices.

With three contact parts loosely piled in each of the tubes of the pair of fixtures, these fixtures next are indexed by another operation of the feed device 26, at the next or fifth station. The vertically moving shelf 99 is made long enough to extend to this fifth station and it mounts a pair of high frequency current induction heating coils 110. These coils are positioned so that when the shelf 99 goes to its down position, as previously described, the two coils 110 are simultaneously lowered over the tubes 34 of the two fixtures indexed at this brazing station. A commercially available electric power unit 111 is positioned beside the table 21 and supplies the two coils 110 with current through flexible leads 112. The frequency and power of the current should be appropriate for the size of the parts involved and so as to very rapidly braise the parts together by fusing the brazing disks. At this time the plunger 46 of each of the fixtures is at its down position where it is holding its push rod 45 at its down position where it is substantially free from the flux of the coil 110 encircling its tube 34. The necks 47 and pins 53 assure positive maintenance of the down positions. Therefore, the push rods are not heated during the brazing operation.

As the brazing disks fuse the contacts are floated into concentricity with the rivet heads, and the turntable is not moved until after the coils 110 are raised and the current through them is discontinued. As soon as the induction heating is removed, from the contact assemblies, freezing of the molten brazing metal occurs almost instantaneously so that the concentricity of the parts becomes permanent.

The center of the turntable 23 has an upstanding hub 113 provided with a gas passage 114 for each of the fixtures. Each gas passage 114 has an outlet facing a radially opposite one of the fixtures, and the fluid duct 42 of this fixture connects with this outlet by way of a pipe 115 through the medium of suitable unions 116. A rotary gas valve 117 depends from the bridge 25 and presses against the top of the hub 113, this gas valve being provided with gas through a tube 118 connected with a suitable source of gas under pressure. This gas valve 117 connects the gas flow with an arcuate recess 119 in its bottom face which presses against the top of the hub 113, and the various gas passages 114 extend upwardly so as to successively register with this arcuate recess 119 as the turntable turns from one indexing station to another. The arcuate passage is positioned so that registration by the gas passages 114 occurs shortly prior to indexing of the associated fixture with the fifth or brazing station. When a combustible gas such as hydrogen is used a constantly burning pilot flame ignites the gas flow as soon as it starts to leave the tops of the tubes 34 of the various fixtures. As shown by Fig. 15 this pilot flame may be produced by a burner 120 in the form of a pipe which extends up through the table 21 and bends over so that, when supplied with burning gas, it projects a flame across the tops of the various fixtures' tubes as they register therewith. In the case of hydrogen this prevents the atmosphere around the machine from possibly becoming explosive.

All of the other devices work rapidly and permit a rapid intermittent feeding of the turntable. It is important to note that the brazing station does not represent a bottleneck which reduces materially the productivity of the machine. When the induction heating coils are lowered over the tubes the brazing heat is created almost instantaneously in the contact parts, thus making it unnecessary to keep the tubes surrounded by the coils

very long. Almost immediately after the termination of the induction heating the fused metal freezes so that the turntable can again be fed without affecting the concentricity of the parts of the contacts just brazed.

The gas functions to keep the contact parts bathed in a flow of non-oxidizing gas during the induction heating, required to effect the brazing, and for as long thereafter as the parts, though frozen, remain at a sufficiently elevated temperature to be oxidized by the atmosphere. The length of time the parts are kept bathed in the moving flow of hydrogen or the like is determined by the length of the arcuate recess 119 and the rotary valve 117.

With the next rotary motion of the feed device 26 the pair of fixtures containing the finished contacts arrive at the last or sixth station.

At this final station the tops of the tubes 34, of the two fixtures, index or register with a pair of blowpipes 120 pointing transversely across the tops of the tubes and into a housing 121 in which a drawer 122 slides. The back of this drawer is low enough so that when compressed air is blown through the blowpipes 120 the jets of air are directed over the drawer's back and over the length of the drawer above its top. A thruster 123 is positioned beneath the table top 21 and thrusts upwardly across head 124 positioned to engage the bottom ends of the plungers 46 of the two indexed fixtures. When energized the thruster 123 pushes up the two plungers 46 and, therefore, pushes up the two associated push rods 45. The push rods, in turn, push up and eject, from the counterbores 37, the two finished contacts. The top ends of the push rods bear upon the bottoms of the rivet shanks and this, combined with a rapid motion, lifts the two finished rivets into the jets of air blowing from the two blowpipes 120. These jets of air blow the contacts over and into the drawer 122 which slides in the housing 121 on top of the table 21.

The thrusters that have been described hereinabove may be of any suitable type. They may be fluid actuated and in the form of a cylinder and piston arrangement, or they may be electrically actuated and in the form of an electric solenoid provided with an appropriate armature. Thrusters of suitable types for the various applications are known to the prior art. The blowpipes 120 may be supplied with compressed air in any suitable fashion. They may continuously eject compressed air or the air may be controlled by a valve which is actuated intermittently as required to collect the contacts ejected from the fixtures.

A description of the operation of the machine has been so interwoven with the description of the parts of the machine as to eliminate the need for a detailed discussion of the machine's operation. Any skillful mechanic familiar with automatic machines can interconnect and time the various components so as to make the machine fully automatic. When operated in this fashion it is only necessary for the operator to maintain the rivet and contact hoppers supplied with the necessary parts, to make certain that the brazing disk feeder is supplied with adequate brazing metal strip, and to occasionally remove the finished contacts from the collecting drawer of the machine. The safety device prevents operation if a rivet fails to feed. If the contact parts are not supplied, and the machine continues to operate, no harm can result because the microlimit switch feelers 106 will detect any failure of the various feeders to supply the various fixtures each with the required three component parts of the contacts. Actuation of either of the microlimit switches 46b or 105 may be used to stop the operation of the machine and to give an alarm, thus indicating to the operator that the machine requires attention.

The manner in which the machine may be made is considered apparent to any skilled designer of automatic machines after he becomes acquainted with the foregoing disclosure.

We claim:

1. A machine adapted to manufacture small electric contacts of the type comprising a rivet shank having a head on top of which a contact disk is brazed, said machine comprising, in combination, a conveyor, a series of mutually spaced fixtures mounted on said conveyor, each of said fixtures including an upstanding non-metallic

refractory tube having a bore receiving said rivet shank and an open-topped counterbore in its upper end receiving said rivet head and at least one gas duct opening into said counterbore and a metal push rod having a top shaped for engagement with the bottom end of said shank, said rod being arranged to reciprocate in said bore between extremes where its said top is projected to an up position above said counterbore and is retracted to a down position spaced substantially below said counterbore and said rod having means for releasably retaining it at its said up position, said table being intermittently movable and defining a series of indexing stations with which said fixtures index when said table halts, a rivet feeder having at one of said stations means pushing an upright rivet downwardly to an index one of said fixtures with the rivet shank end engaged by the top of this fixture's push rod and guided thereby as the push rod is thrust downwardly until the rivet head seats on the bottom of this fixture's counterbore, means for detecting failure of said rivet feeder to feed a rivet, a brazing disk feeder having means at a second one of said stations with which said fixture indexes and which feeds a brazing disk into the counterbore of said fixture on top of the rivet head seated therein, a contact disk feeder having means at a third one of said stations with which said fixture indexes and which feeds a contact disk on top of the brazing disk in said counterbore, a feeler apparatus having a feeler at a fourth one of said stations with which said fixture indexes and which feeler enters said counterbore until stopped by the elements therein and said apparatus including control mechanism actuated by the extent to which said feeler can enter said counterbore, an electric induction heater device having a movable heating coil at a fifth one of said stations which moves from an up position clearing said fixture to a down position encircling said refractory tube, a rivet discharging assembly at a sixth of said stations and including means thrusting said push rod to its said up position to eject the finished electric contact, and means pneumatically blowing off and collecting said contact from the top of said push rod, and means feeding a protecting gas to said fixture's gas duct at least while said coil encircles its said refractory tube.

2. A machine adapted to manufacture small electric contacts of the type comprising a rivet shank having a head on top of which a contact disk is brazed, said machine comprising, in combination, a conveyer, a series of mutually spaced fixtures mounted on said conveyer, each of said fixtures including an upstanding non-metallic refractory tube having a bore receiving said rivet shank and an open-topped counterbore in its upper end receiving said rivet head and at least one gas duct opening into said counterbore and a metal push rod having a top shaped for engagement with the bottom end of said shank, said rod being arranged to reciprocate in said bore between extremes where its said top is projected to an up position above said counterbore and is retracted to a down position spaced substantially below said counterbore and said rod having means for releasably retaining it at its said up position, said table being intermittently movable and defining a series of indexing stations with which said fixtures index when said table halts, and said machine including means for feeding the component parts of said contacts to the counterbores of each of said fixtures as they index with various ones of said stations and so that said parts are assembled upright, means for heating said brazing disks in said fixtures after all said parts are assembled therein, and means for feeding a protecting gas through said fixtures' gas ducts during said heating.

3. A fixture adapted for use in assembling and brazing small electric contacts of the type comprising a rivet shank having a head on top of which a contact is brazed, said fixture including, in combination, an upstanding non-metallic refractory tube having a bore receiving said rivet shank and an open-topped counterbore in its upper end receiving said rivet head and at least one gas duct opening into said counterbore and a metal push rod having a top shaped for engagement with the bottom end of said shank, said rod being arranged to reciprocate in said bore between extremes where its said top is projected to an up position above said counterbore and is retracted to a down position spaced substantially be-

low said counterbore and said rod having means for releasably retaining it at its said up position.

4. A fixture adapted for use in assembling and brazing small electric contacts of the type comprising a rivet shank having a head on top of which a contact is brazed, said fixture including an upstanding refractory tube having an open-topped counterbore in its upper end, said tube having a bore receiving said rivet shank and said counterbore being sized to receive said rivet head and a brazing disk and said contact assembled thereon, said tube having at least one gas duct extending through it and opening into said counterbore.

5. A fixture adapted for use in assembling and brazing small electric contacts of the type comprising a rivet shank having a head on top of which a contact is brazed, said fixture including an upstanding refractory tube having an open-topped counterbore in its upper end, said tube having a bore receiving said rivet shank and said counterbore being sized to receive said rivet head and a brazing disk and said contact assembled thereon, a push rod reciprocating in said bore and having an upper end shaped to engage the bottom end of said rivet and reciprocating between an up position accessible from the top of said tube and a down position permitting said rivet head to rest in said counterbore.

6. A fixture adapted for use in assembling and brazing small electric contacts of the type comprising a rivet shank having a head on top of which a contact is brazed, said fixture including an upstanding refractory tube having an open-topped counterbore in its upper end, said tube having a bore receiving said rivet shank and said counterbore being sized to receive said rivet head and a brazing disk and said contact assembled thereon, a push rod reciprocating in said bore and having an upper end shaped to engage the bottom end of said rivet and reciprocating between an up position accessible from the top of said tube and a down position permitting said rivet head to rest in said counterbore, said tube having at least one gas duct extending through it and opening into said counterbore.

7. Apparatus for induction-heating small parts and including, in combination, a non-metallic refractory tube having a mouth receiving the parts and internally having a support holding the received parts positioned part way through the tube, an induction-heating coil arranged to encircle said tube adjacent to said support, and a metal rod in said tube with an end movable to the latter's mouth and retractable to a position substantially free from the field of said coil.

8. Apparatus for brazing small parts, including, in combination, feeders feeding the parts and brazing metal and a heater effecting the brazing, and at least one movable fixture provided with means guiding it past said feeders and a heater cooperating therewith, constructed and arranged so that the parts and brazing metal are fed into the fixture and the brazing heat is applied, said fixture being constructed to hold the parts and said metal against excessive displacement and including means moving with the fixture and flooding the parts and the brazing metal with flowing gas during the application of the brazing heat at said heater.

9. A device adapted for use in brazing small parts and the like, said fixture comprising, in combination, an upstanding non-metallic refractory tube having an open-topped counterbore in its upper end portion and a base flange having an annular recess in its bottom face and at least one duct extending longitudinally through the tube's wall and interconnecting said counterbore and said recess, a mount having a top surface on which said flange bottom face rests and said surface having a hole registering with the bore of said tube and a fluid duct opening into said recess, said recess and said mount's top surface defining an annular space, and a push rod reciprocating in said mount through said hole and in the bore of said tube.

10. A device adapted for use in brazing small parts and the like, said fixture comprising, in combination, an upstanding non-metallic refractory tube having an open-topped counterbore in its upper end portion and a base flange having an annular recess in its bottom face and at least one duct extending longitudinally through the tube's wall and interconnecting said counterbore and said recess, a mount having a top surface on which said flange bottom face rests and said surface having a hole

registering with the bore of said tube and a fluid duct opening into said recess, said recess and said mount's top surface defining an annular space, and a push rod reciprocating in said mount through said hole and in the bore of said tube, said push rod having a part providing an abutment and below the latter providing an engaging surface, and said mount having a finger biased against said part and engaged by said abutment to limit the down motion of said push rod and engaged by said engaging surface to hold said push rod against falling 10 when said push rod is moved to an up position.

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