

March 31, 1942.

W. P. HERMAN

2,278,176

APPARATUS FOR ASSEMBLY OF CONNECTOR PLUGS

Filed May 31, 1939

5 Sheets-Sheet 1

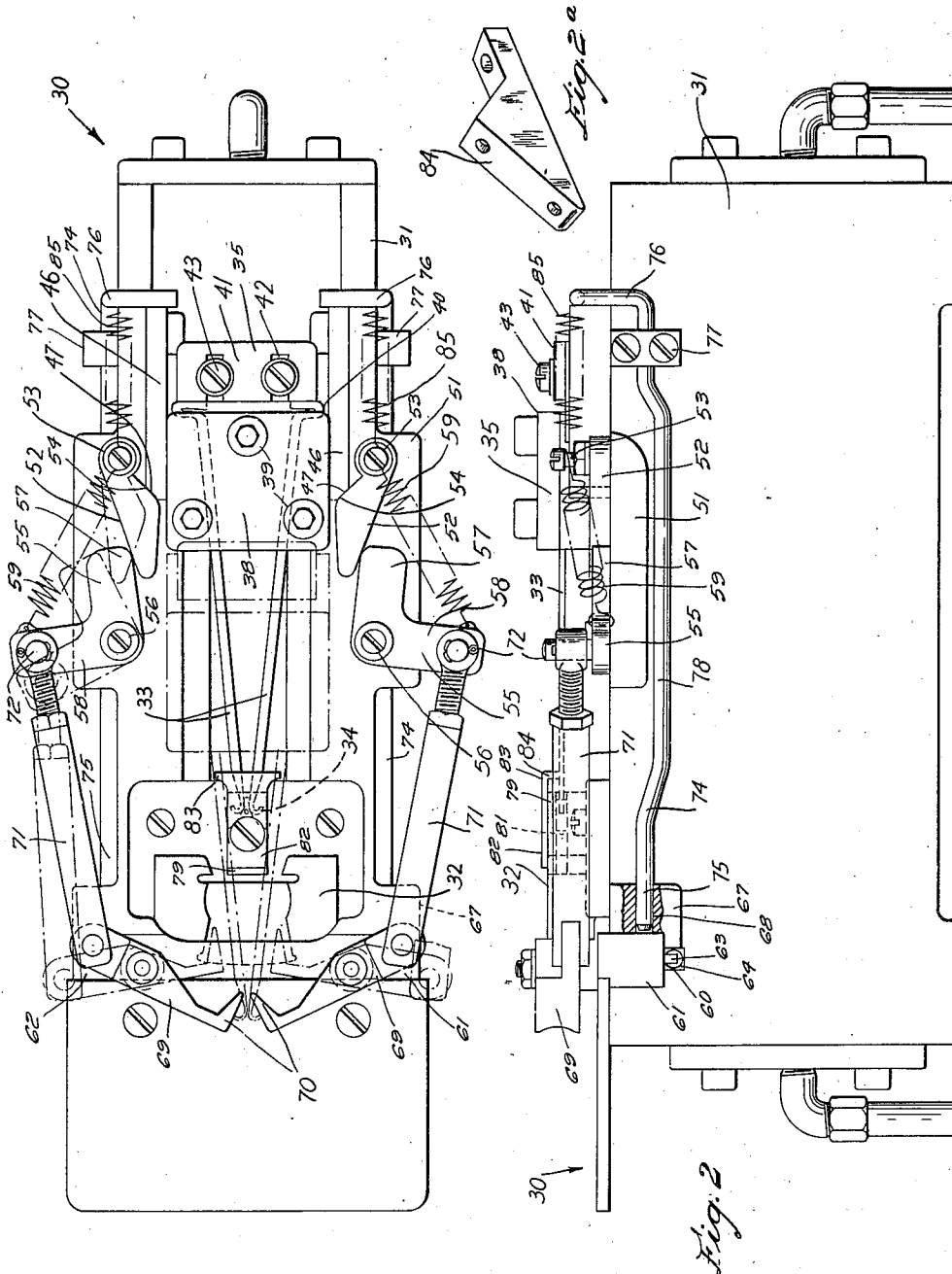


Fig. 1

Fig. 2

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5 Sheets-Sheet 2

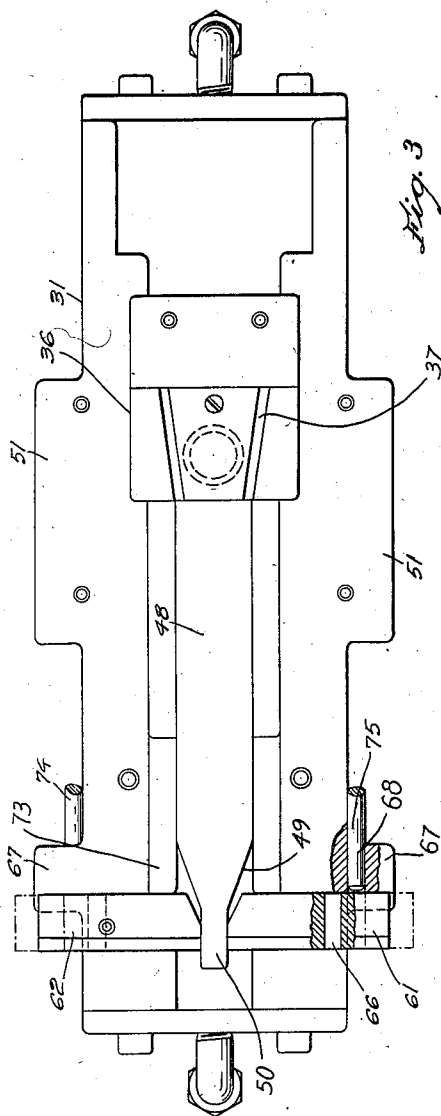


Fig. 3

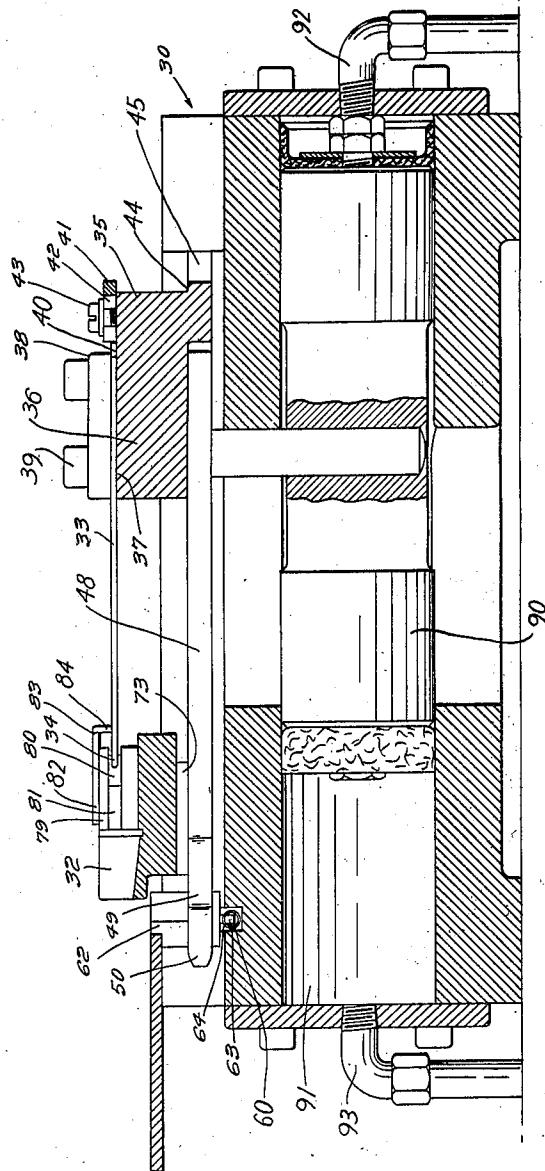


Fig. 4

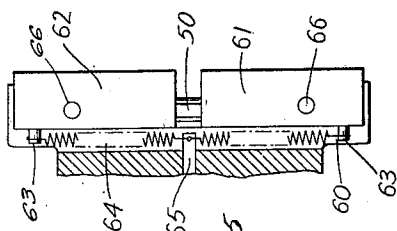


Fig. 5

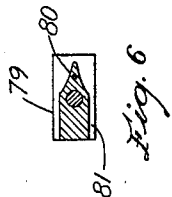


Fig. 6

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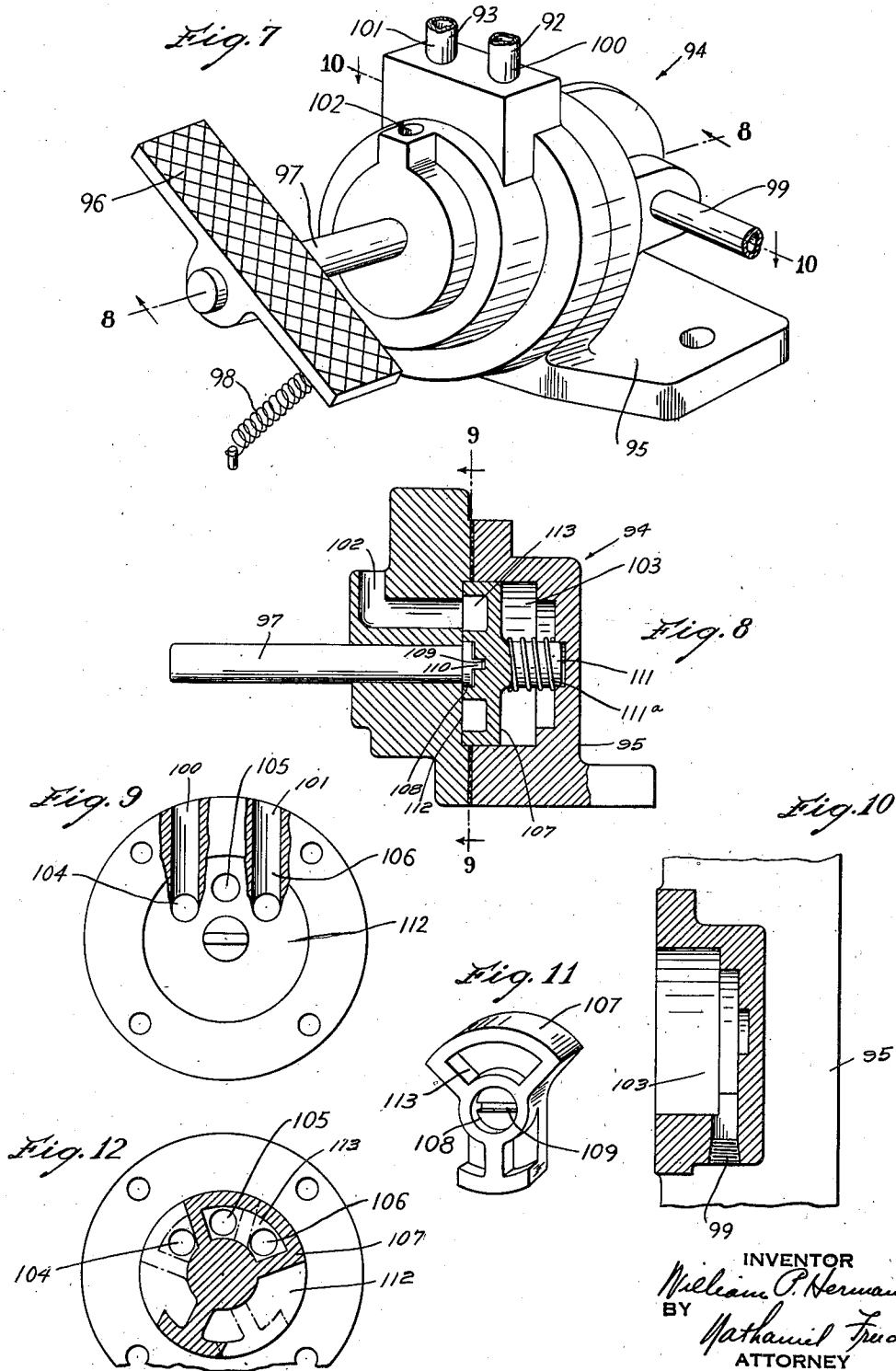
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APPARATUS FOR ASSEMBLY OF CONNECTOR PLUGS

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Fig. 13

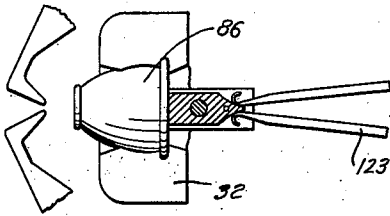


Fig. 14

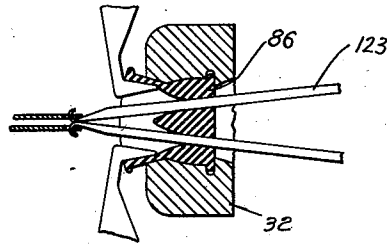


Fig. 15

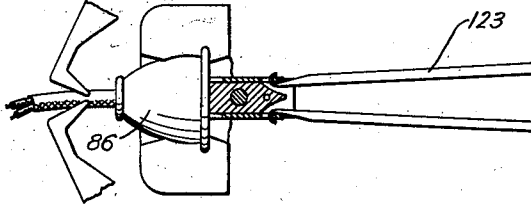


Fig. 16

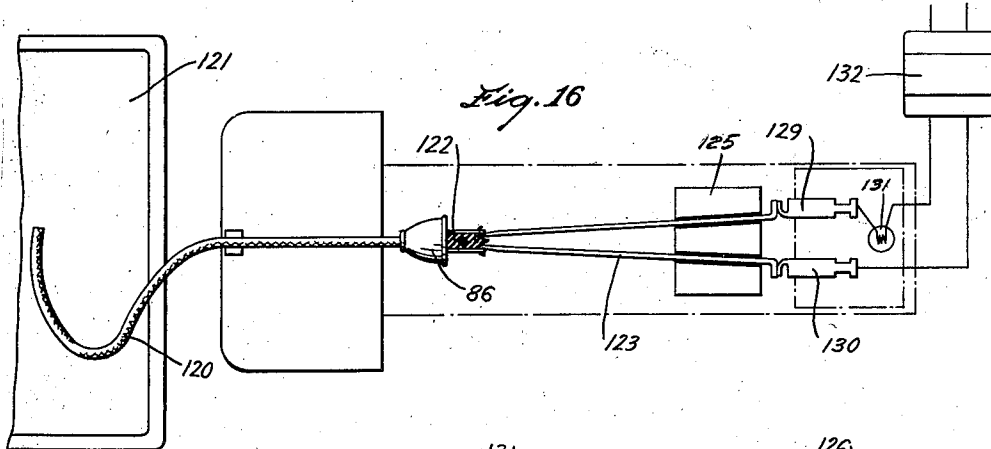


Fig. 17

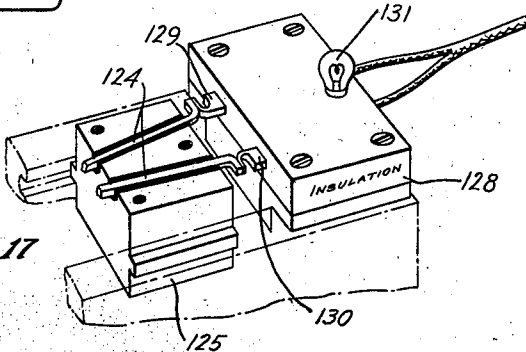
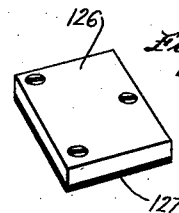


Fig. 18



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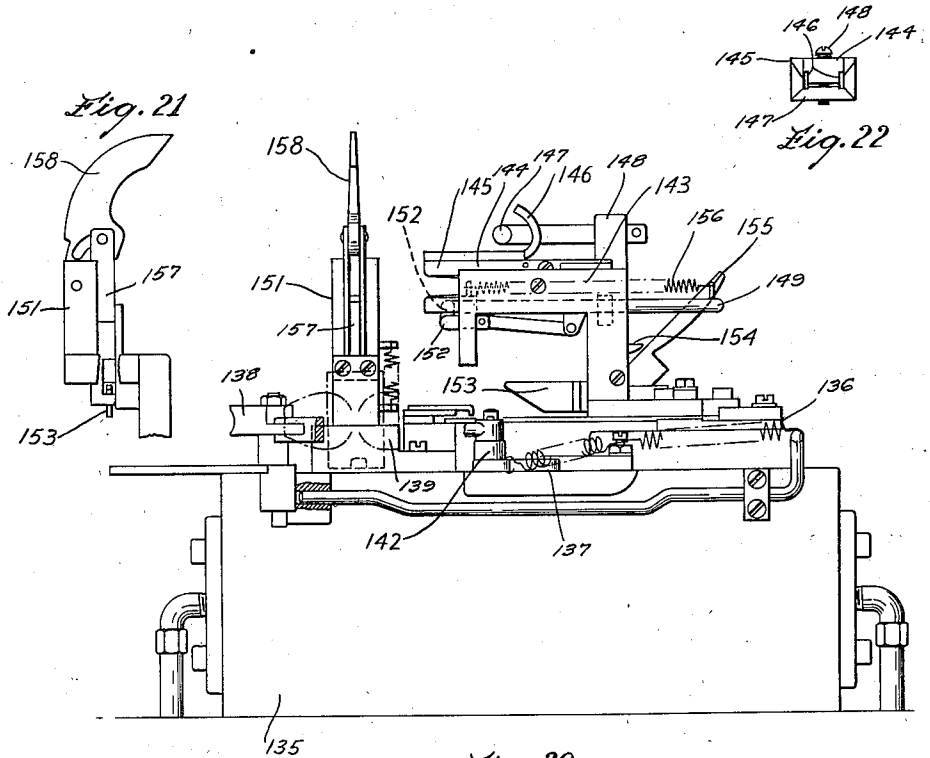
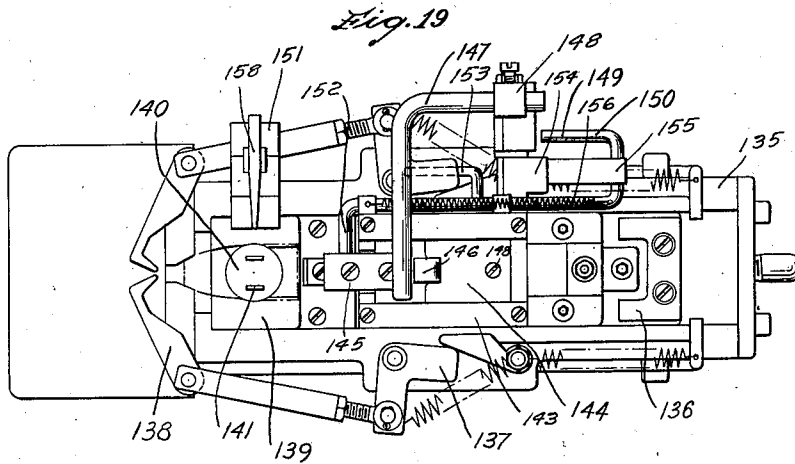


Fig. 20

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UNITED STATES PATENT OFFICE

2,278,176

APPARATUS FOR ASSEMBLY OF
CONNECTOR PLUGS

William P. Herman, Providence, R. I.

Application May 31, 1939, Serial No. 276,625

4 Claims. (Cl. 29—84)

My present invention relates to the manufacture of electrical connector plugs, and has particular reference to an apparatus for assembling contact prongs in the plug body.

The present application constitutes a continuation in part of my copending application Serial No. 99,848, entitled Connector plug assembly apparatus, filed September 8, 1936, now Patent No. 2,198,966, dated April 30, 1940.

It is the principal object of the present invention to provide a simple and readily operated apparatus for assembling contact prongs and plug bodies made of resilient material.

It is a further object of my invention to provide structures for holding a plug body and for drawing the prongs therethrough into locking engagement therewith.

It is an additional object of my invention to provide an apparatus for inserting prongs having laterally displaced portions and resilient plug bodies having correspondingly shaped recesses whereby the prongs are securely locked in the body.

A further object of my invention is to provide improved means for distending the plug body during the passage of the contact prong and for disengaging the plug body from the machine after assembly.

Another object of my invention is to provide means for testing the contact plug while it is being assembled.

A further object of my invention is to provide a simple apparatus which can be readily adjusted for assembling either ordinary contact plugs or multiple current taps.

Another object of my invention is to provide an improved valve mechanism for operating the machine of the present invention.

With the above and other objects and advantageous features in view, my invention consists of a novel arrangement of parts more fully disclosed in the detailed description following, in conjunction with the accompanying drawings, and more specifically defined in the claims appended thereto.

In the drawings:

Fig. 1 is a plan view of an apparatus embodying my invention;

Fig. 2 is a side elevation thereof;

Fig. 2a is a perspective view of the angle plate;

Fig. 3 is a plan view of the novel apparatus, parts being removed;

Fig. 4 is a vertical section along line 4—4 on Fig. 1;

Fig. 5 is a section taken along line 5—5 on Fig. 3;

Fig. 6 is a section taken along line 6—6 on Fig. 4;

Fig. 7 is a perspective view of the operating valve mechanism;

Fig. 8 is a section taken along line 8—8 on Fig. 7;

Fig. 9 is a section taken along line 9—9 on Fig. 8;

Fig. 10 is a section taken along line 10—10 on Fig. 7;

Fig. 11 is a perspective view of the air baffle;

Fig. 12 is a section taken along line 12—12 on Fig. 8;

Figs. 13, 14 and 15 are diagrammatic views showing the assembly steps;

Fig. 16 is a diagrammatic view showing the electrical testing hookup;

Fig. 17 is a detailed perspective view showing the construction of the testing mechanism;

Fig. 18 is a perspective view of the cover for the finder carriage;

Fig. 19 is a plan view of a modified form of my novel apparatus for assembling multiple current tap plugs;

Fig. 20 is a side elevation thereof;

Fig. 21 is an end view of a vertical slot contact holder; and

Fig. 22 is an elevation of the trigger ram.

It has been found desirable to provide an apparatus for facilitating the assembly of contact plug bases with the prongs and electrical cord connections by pulling the prongs into the base; the prongs having laterally displaced portions forming locking shoulders, and the bases having corresponding recesses whereby the displaced portions securely lock the prongs in the bases against removal. In addition to the conventional two-prong connector plug, the modified form of my invention is designed to assemble a multiple current tap plug having four contacts intersecting at right angles to each other. The present apparatus is designed to be highly adjustable for precision work and is further designed to eliminate unnecessary parts and reduce the number of parts on the operative structure.

As described in my copending application, Serial No. 99,848, a plug base is set into the apparatus, two pull arms are then passed through the base recesses while the base neck is distended, the prong assembly is then secured to the pull arms, and the pull arms are then withdrawn through the plug base to insert the prongs into

the base recesses, thus completing the assembly.

Referring to the drawings, my improved apparatus 30 includes a lower casing 31 which houses the actuating mechanism, and on which the assembly parts are mounted. A plug base is seated in a retaining nest 32 mounted on the casing and shaped to receive the base; two resilient pull arms 33 having hooked ends 34 are mounted in a carriage 35. The carriage 35 comprises a block 36 having laterally disposed grooves 37 in which the pull arms are recessed. The pull arms are held in the grooves 37 by an upper plate 38 which is bolted to the block 36, as by bolts 39. To adjust the extension of the pull arms, their inner ends are turned at right angles, at 40, and the inner ends abut the adjustment plate 41 which is adjustable through the slots 42 and bolts 43 extending into the blocks 36. The carriage 35 is provided with side rails 44 to slide in aligned grooves 45 in the casing top. The carriage also carries, on either side, cam bars 46 having their forward outer corners cut off, as at 47, for actuating the cam. As can be seen in Figs. 3 and 4, the block 36 carries a cam tongue 48 beneath it which is tapered, as at 49, adjacent its forward end and terminates in a narrow bar portion 50.

Now referring to Figs. 1 and 2, the lower casing 31 is provided adjacent its central portion with extension block 51 disposed on either upper side edge of the lower plate and preferably integral therewith. The upper rear surface of the extension portions 51 carry a cam plate 52 on which is loosely pivoted, as at 53, and is provided with an inner angular cam edge 54 which is adapted to extend in the path of the cam bars 46 on the side of the carriage. An L-shaped cam element 55 is loosely pivoted at 56 on the forward portion of the extension block 51, with one arm, 57, bearing against the outer edge of the cam plate 52, and the other arm, 58, being connected at its other end by a coil spring 59 to the pivot 53. The coil spring 59 therefore continually urges the L-shaped cam element 55 backward, the arm 57 urging the cam plate 52 into the path of the cam bars 46 on the carriage.

Referring now to forward portion of the machine, and more particularly to Figs. 1 to 6 inclusive, the upper surface of the base 31 is provided with a transverse groove 60. Rectangular blocks 61 and 62 are positioned to slide above the groove with integral depending portions 63 extending into the groove at their outer end. The blocks 61 and 62 are urged toward each other by a spring 64 positioned in the groove 60 and having each end attached to an extension portion 63. Each block 61 and 62 is also provided with a transverse opening 66, and the base 31 is provided with integral laterally extending portions 67 having openings 68 adapted to register with the openings 66 when the blocks 61 and 62 are pushed apart. Spreaders 69 are pivotally mounted on blocks 61 and 62, the inner ends of the spreaders being formed as hooks 70 and the outer ends being pivotally engaged with adjustable rods 71 which have their other ends pivoted, as at 72, to the arm 58 of the cam 55. The tongue 48 is guided in its forward movement between guide block 73 set in the base and integral therewith.

Each side of the base is equipped with a rod 74 having its front ends 75 slidable in the openings 68 of the block 67 and having its rear end bent upwardly and over the base, as at 76, into the path of the cam bars 46. The rods 74 are held

slidably in position by the journal block 77 and the central portion of the rod, 78, is bent downwardly to just clear the depending portion 51 of the side extension.

A pull arm guide 79, see Figs. 1, 2 and 6, is positioned in front of the retaining block, and has a tapered front portion 80 which extends between the pull arms in their forward movement and gradually pushes them apart, and has side transverse grooves 81 in which the pull arms ride in their forward motion. The top of the guide 79 is surmounted by a guide plate 82 which widens at its front end 83 and is provided with a depending flange 84 under which the pull arms slide and which retain the pull arms in the grooves 81 during the pulling movement and while the plug base is being disconnected from the pull arms.

To facilitate operation the machine is preferably tilted forwardly towards the operator at an angle of approximately 30° by mounting it on a pair of angle supports 84, see Fig. 2a, which may be clamped to the bottom of the base.

The operation of the assembling parts may now be explained. Referring to Figs. 1 to 6 inclusive and the diagrammatic views 13, 14 and 15, a plug husk 86 is seated in the retaining nest 32, where it is held against displacement, and the carriage 36 is moved to the left, the pull arms 33 entering into the groove 81 in the pull arm guide 79 and being guided thereby through the husk slots. As the carriage moves to the left, the ends 76 of the rods 74 are released and pulled forwardly by springs 85 until the front ends 75 bear against the blocks 61 and 62. The tongue 48, guided between the guide blocks 73, moves forwardly until the front end 50 passes between the blocks 61 and 62 and the tapered edges 49 engage the cam edges on the blocks 61 and 62 and force them apart against the action of the spring 64. The blocks 61 and 62 continue to move outwardly until the openings 66 are aligned with openings 68 in the extension block 67 and they are then locked in this position by the end 75 of the rod 74 which is pushed forwardly by the spring 85. At the same time, the cam bars 46 on the carriage engage the angular cams 52 and push them against the arms 57 of the L-shaped cams 55 and turn them against the action of the spring 59. This action is transmitted through the arms 58, adjustable bars 71 to the pivoted spreaders 69 which are then swung to the dotted line position shown in Fig. 1, and thus enter the cable neck opening of the husk and spread it. The initial position of the parts is shown in Fig. 13, and the second position is shown in Fig. 14. The prong assembly is now attached to the hooked ends 34 of the pull arm and the carriage is moved to the right, thus retracting the pull arm and drawing the prongs through the plug husk slots. As the retraction continues, the parts are held in distended position, as shown in Fig. 14, by the locking action of the rods 74. When the carriage has reached its extreme right position, it has released pressure of the cam bars 46 against the angle cams 52 and L-cams 55, and bump against the ends 76 on the rods 74 withdrawing them from the aligned openings 66. Immediately, all tension springs are brought into play, and the blocks 61 and 62 pull towards each other while the L-shaped cam 55 swings about its pivot causing the spreaders 69 to return to normal position as shown in Fig. 15. Inasmuch as the pull arms 33 are adjusted at an angle they will tend to spring toward each other after clearing the end 80 on

the pull arm guide 79 and to disengage the hooked ends 34 from the contact blades. However, they may not completely disengage and this can be completed by the pulling of the electrical cord upwardly and forwardly, thus also pulling the husk 86 from the retaining nest 32. The plate 82, having the flange 84 bearing down upon the end of the pull arms 33, prevents their being forced from their position in the grooves 81.

The above-described operation is independent of any specific operating force; electric power, hydraulic pressure, mechanical or any other type of operating means may be used. It is preferred, however, to utilize compressed air as the operating medium, and the structure shown is therefore so illustrated. As described in my copending application Serial No. 99,848, the carriage is operated by a piston 90 in a bore 91 having pipe connections 92 and 93 at each end for alternately transmitting compressed air under pressure.

While any type of control mechanism may be used, I prefer to use the foot pedal type shown in Figs. 7 to 12 inclusive, which leaves the operator's hands free. The control valve 94, comprising a suitable casing 95 which may be bolted to the floor and is operated by a pedal 96 journaled to the control shaft 97 and held in inoperative position by the coil spring 98. The compressed air enters the casing 95 through the inlet 99 and is directed through outlets 100 and 101 to pipes 92 and 93 connecting with the assembly machine base. The forward end of the casing 95 is provided with an outlet 102 for the exhaust. The casing 95 is provided with a pressure chamber 103 to which the inlet 99 communicates. Referring to Fig. 9, the upper portion of one wall of the chamber 103 is provided with three openings 104, 105 and 106 respectively, the central opening 105 communicating with the exhaust port 102 and the openings 104 and 106 communicating with ports 100 and 101 respectively. The air baffle 107 is constructed as shown in Fig. 11 with a central journal opening 108 having a key slot 109 into which the operating shaft 97 is keyed, as at 110. Integrally formed with the air baffle 107 is a rearwardly extending shaft 111 which is slidably journaled in the rear of the casing to permit slight lateral movement of the air baffle. The air baffle 107 is adapted to fit tightly within the pressure chamber 103 so that the pressure of the fluid entering the inlet 99 will force it against the wall 112. This action is supplemented by the spring 111a. The upper portion of the air baffle 107 is provided with an enclosed chamber portion 113 having the front end open and which is large enough to just cover two of the openings 104, 105 or 106.

The operation of the valve is as follows: As can be seen in Fig. 12, when the pedal is in the position shown in Fig. 7, the air baffle 107 is angularly disposed so that the chamber 113 covers openings 105 and 106 and uncovers opening 104. The pressure of the compressed air entering the port 99 into the pressure chamber 103 goes through the opening 104, outlet 101, into the pipe 93 and keeps the carriage of the machine to the right, the cylinder to the right of the piston 90 communicating through the pipe 92, opening 100 and port 106 through the chamber 113 and port 105 with the outlet port 102. When it is desired to move the carriage of the machine to the left, the pedal 96 is pushed so that the shaft 97 will force the air baffle to turn into the

position shown in dotted lines in Fig. 12, covering ports 104 and 105 and exposing port 106. The pressure from the pressure chamber 103 will then enter the port 106, outlet 100, pipe 92, and into the base of the assembly machine and force the carriage to the left. At the same time, the air in the cylinder to the left of the piston 90 will be pushed outwardly through the pipe 93, port 101, port 104, through the chamber 113, out of port 105, and out of the exhaust 102.

It is obvious, that where hydraulic pressure is used, it may be necessary to attach the exhaust port 102 through pipes back to the oil sump.

As can be readily understood from the machine heretofore described, the assembly of the cord, plug and blade is done at a rapid rate of speed, and since each plug requires two cord connections and two blades, it is apparent that the blade and cord, which are preassembled, must be turned out at a rapid rate. Various methods of assembly are used, such as soldering, spot welding, and clamping. Whatever the method, it must be fast and accurate and the connection must be strong. However, occasionally the connection may be so weakened that when the pull arms in the machine pull the blade into the plug husk one of the electrical cord connections may be disconnected from the blade. If this happens within the plug husk, the finished plug is obviously defective, and there is no way of checking this without actual test. To avoid the necessity of separate testing, I have devised the testing mechanism shown in Figs. 16, 17 and 18 which may be readily applied to the heretofore described machine.

The electrical cord connections usually come in bundles with the bare ends hanging downwardly. It is therefore merely necessary, as in Fig. 16, to place the ends 120 into a box of steel wool 121 to insure electrical contact. A brine tank or other conducting means may also be used for this purpose. The pull arm guide 122 is preferably made of tough fibre or other dielectric materials and the pull arms 123 are encased in dielectric coverings 124 at the point where they are imbedded in the grooves in the block 125. The pull arms are held in the block by means of the plate 126 which is separated from the block 125 and the pull arms by a sheet of fibre or other insulating material 127. To the extreme right of the machine, at the point where the carriage completes its return stroke, an insulated block 128 is fixed, having pins 129 and 130, which may be spring pressed, disposed in the path of the rear of the pull arms on their return stroke. The contact pins 129 and 130 are connected by suitable wiring means to an electric bulb 131 and 6 to 12 volt transformer 132. When the machine is assembling a plug and the carriage moves rearwardly so that it reaches the point where the plug is completely assembled, the back ends of the pull arms contact the pins 129 and 130. This completes an electrical circuit through the cord lead wire, contact pin 130, the pull arm, through the plug husk, through the cord end 120, into the steel wool 121, back through the other pull arm, through the contact pin 129, and lights the bulb 131. This tells the operator that the connection between the cord lead wire and the contact blade in the plug husk is complete. Other signalling means such as a bell may also be used instead of the bulb 131. If the light fails to light, the operator can immediately discard the husk which is being removed from the machine as inoperative.

This gives a positive, accurate and rapid check of each plug husk as it is being completed in the machine and saves the time of additional checking later on.

When it is desired to assemble cube taps or multiple current tap plugs, the augmented machine, shown in Figs. 19, 20, 21 and 22, may be used. This machine may be made by attaching certain additional parts to the machine heretofore described, or by constructing a new machine.

The multiple current tap plug requires the insertion of two pairs of contact blades in the plug husk. One of the pairs may be pulled through by the method heretofore described and the other pair, disposed at right angles to the first pair, may be pushed into the husk.

Referring to Figs. 19 and 20, the machine base 135 is similar to the one heretofore described and is operable in the identical manner. It is provided with a carriage 136, the same cam movements 137, and the spreaders 138. In assembling a multiple current tap plug to which there is no electrical cord connection, the spreaders 138 may be eliminated. The retaining nest 139 is provided with an annular seat 140 adapted to hold the plug husk and two upturned retaining prongs 141 which partially enter the vertical slots in the plug husk to hold the husk in place and to act as a stop when the vertical contacts are pushed into the husk. The horizontal blade and cord connection are assembled in the conventional manner heretofore described, the pivot studs 142 raising the operating mechanism to the level of the transverse openings. Mounted on the carriage 136 is a frame 143 in which is slidable an auxiliary carriage 144. Pivoted on the auxiliary carriage 144 is a vertical slot contact holder 145 having a hook 146 which is adapted to engage the bar 147 in its path, the bar 147 being held in place by the plate 148 fixed to the side of the base 135. The holder 145 is provided at one end with slots 146, one wall of the slots 146 being formed by a plate 147 which is held in place by a screw 148 with a spring action. Journalled on the outside of the frame 147 is an S-shaped bar 149 having one end 150 adapted to abut against a frame 151 attached to the base 135 adjacent the nest. The other end, 152, is attached to the vertical slot contact holder 145 to limit movement of the auxiliary carriage. The frame 143 is provided with a forwardly extending cam bar 153 and a rearwardly extending cam plate 154 adapted to engage a rocker arm 155 which is pivoted to the base 135 and is long enough to engage the end 150 of the S-shaped bar 149. The bar 149 is held in position to the left by a spring 156.

Pivoted on the frame 151 is an operating trigger 157 which is pivotally connected with a cam 158 which is adapted to swing in a vertical line over the nest.

In operation, a multiple current tap husk is placed into the nest 139 with the pins 141 entering into the vertical slots. Two contacts are placed into the vertical slot contact holder 145 and held therein by the spring action of the plate 147. The machine is now moved to the left and the pull arms and spreaders operate as heretofore described. The frame 143 moves to the left with the carriage and carries the auxiliary carriage with it. As the vertical slot contact holder 145 passes beneath the bar 147, the hook 146 engages the bar 147 and swings the holder 145 to a vertical position. When the carriage has moved sufficiently so that the holder

145 is in alignment with the vertical slots of the husk, the S-bar 149 abuts against the frame 151 and its other end 152 prevents further movement of the holder 145 and auxiliary carriage 144. Further movement of the carriage 136 causes the auxiliary carriage 144 to remain in place and slide in its grooves. Simultaneously with this further movement, the cam bar 153 engages the trigger 157 and the cam 158 swings downwardly and engages a ram 159 in the holder 145 forming the contacts out of the slots 146 and into the vertical slots in the husk until the pins 141 are reached.

As the carriage is returned to the right, the cam bar 153 releases the trigger 157 and returns the cam 158 to its original position. The spring 156 pulls the S-bar 149 and auxiliary carriage 144 to the left of the frame 143. Further movement, however, causes the bar 147 to hit the holder 145 and return it to its horizontal position. At the same time, the cam plate 154 engages the rocker arm 155, which in turn engages the end 150 of the S-bar 149 and pulls the S-bar and auxiliary carriage to the right of the frame 143 against the action of the spring 156, so that the end of the holder 145 is exposed in position for landing.

The machine of my present invention is therefore an improved construction which provides the spreading of the spreaders with a cam bar which relieves the upper structure of parts and relieves the stress of unnatural cam action. Furthermore, by the use of the present machine, a more precise movement of the pull arm is possible and a more direct action is obtained, giving longer life to the machine. The springs are direct and operate directly upon the cam instead of indirectly as in the previous machine of the present type.

Another great advantage of the present machine is the fact that the husk of the plug is held open during the entire assembly movement and the spreaders do not release the husk until the assembly is entirely completed and at the end of the backstroke of the assembly carriage. This prevents tearing of the husk.

By the use of the valve mechanism hereinabove described, it is possible for the operator to have both hands free and the electrical hook-up provides a positive check of each plug while it is being assembled without loss of time and without the requirement of further testing.

The augmented machine permits the assembly of multiple current taps with the same ease and speed as the conventional contact plugs without radical changes in the original machine.

While I have disclosed certain specific constructional embodiments of my invention, it is obvious that desired changes in the shape and location of the parts and of the movement and sequence of the cam action may be made to suit different requirements, and that the principles of my invention may be applied to other articles and other types of similar machines, without departing from the spirit and the scope of the invention as defined in the appended claims.

I claim:

1. In an apparatus of the type described, a base, a nest on said base for holding a resilient plug husk having a passageway arrangement, a carriage reciprocable on said base, a pair of spaced pull arms mounted on said carriage and reciprocable through said husk passageways, a pair of aligned blocks slidably mounted in said base, a spring connecting said blocks and adapt-

ed to resiliently urge said blocks in alignment towards each other, a cam tongue mounted in said carriage and adapted to separate said blocks during the movement of said carriage, pivotally mounted fingers on said blocks for distending the husk passageway during the initial movement of said carriage, and lock pins slidably mounted on said base and adapted to enter openings in said blocks when said blocks are in separated position for locking said fingers in distending position during the movement of said carriage.

2. In an apparatus of the type described, a base, a nest on said base for holding a resilient plug husk having a passageway arrangement, a carriage reciprocable on said base, a pair of spaced pull arms mounted on said carriage and reciprocable through said husk passageways, a guide block mounted on said base for guiding the pull arms during reciprocation, said block having means for retaining said pull arms in operative engagement therewith, a pair of aligned blocks slidably mounted in said base, a spring connecting said blocks and adapted to resiliently urge said blocks in alignment towards each other, a cam tongue mounted in said carriage and adapted to separate said blocks during the movement of said carriage, pivotally mounted fingers on said blocks for distending the husk passageway during the initial movement of said carriage, and lock pins slidably mounted on said base and adapted to enter openings in said blocks when said blocks are in separated position for locking said fingers in distending position during the movement of said carriage.

3. In an apparatus of the type described, a base, a nest on said base for holding a resilient plug husk having a passageway arrangement, a carriage reciprocable on said base, a pair of spaced pull arms mounted on said carriage and reciprocable through said husk passageways, a pair of aligned blocks slidably mounted in said

base, a spring connecting said blocks and adapted to resiliently urge said blocks in alignment towards each other, a cam tongue mounted in said carriage and adapted to separate said blocks during the movement of said carriage, pivotally mounted fingers on said blocks for distending the husk passageway during the initial movement of said carriage, and lock pins slidably mounted on said base and adapted to enter openings in said blocks when said blocks are in separated position for locking said fingers in distending position during the movement of said carriage, said lock pins having portions thereof in the path of return movement of said carriage whereby said pins are withdrawn from said openings to release said blocks on completion of the reciprocating movement of said carriage.

4. An apparatus comprising a base, a nest on said base adapted to receive a resilient contact plug husk having an opening, a carriage mounted for reciprocating movement on said base, pull arms carried by said carriage and movable through a husk positioned in said nest, said pull arms being dielectrically insulated from said carriage and having their free ends extending rearwardly from said carriage, means for distending the husk opening, means for reciprocating said carriage to cause said pull arms to pull a cord and blade assembly into said husk, a block mounted on said carriage and having spaced electrical contact terminals in the path of movement of said carriage adapted to contact the free ends of said pull arms on the completion of the pulling action, and means for registering an electrical current through said contacting terminals, pull arms and the cord and blade assembly when said carriage has completed its reciprocating movement and said pull arms have pulled the cord and blade assembly into said husk.

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