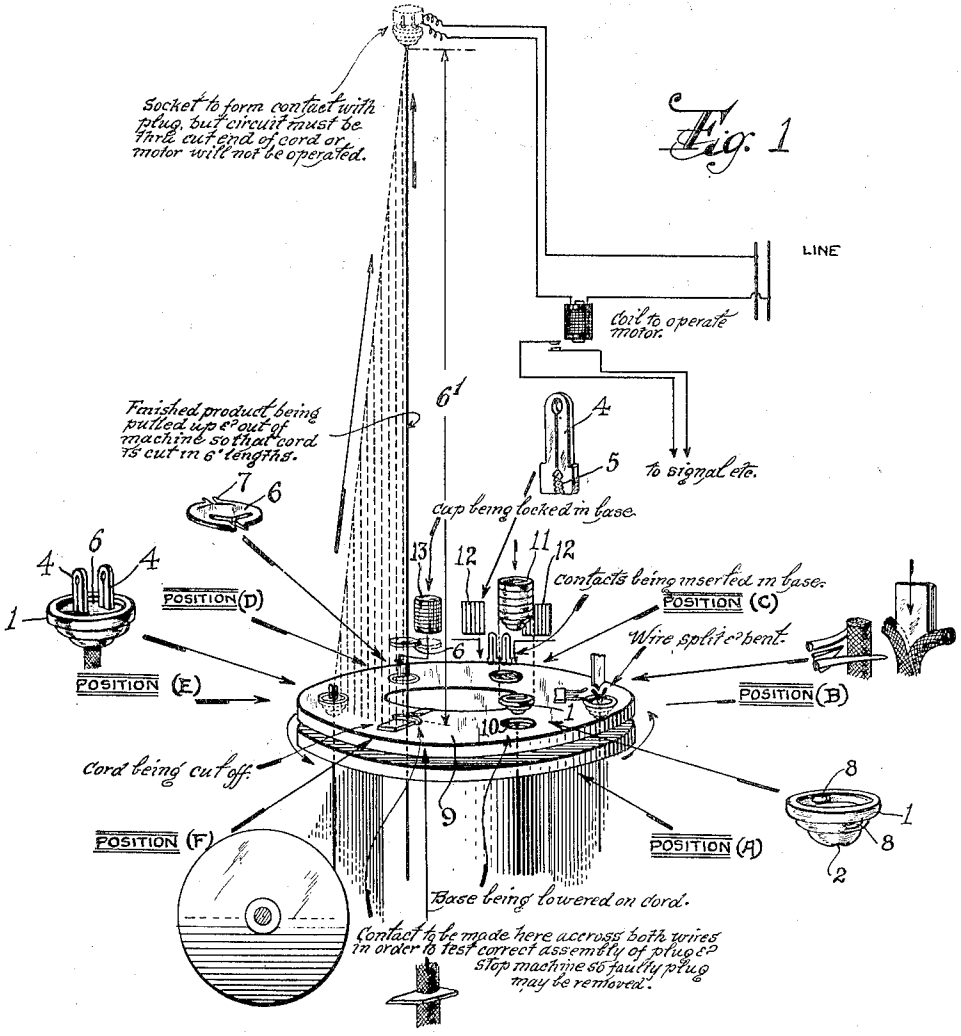
April 3, 1934. C. E. GILBERT 1,953,476

AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

Filed Dec. 23, 1932 8 Sheets-Sheet 1



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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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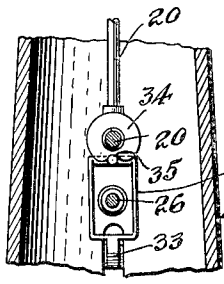


Fig. 5

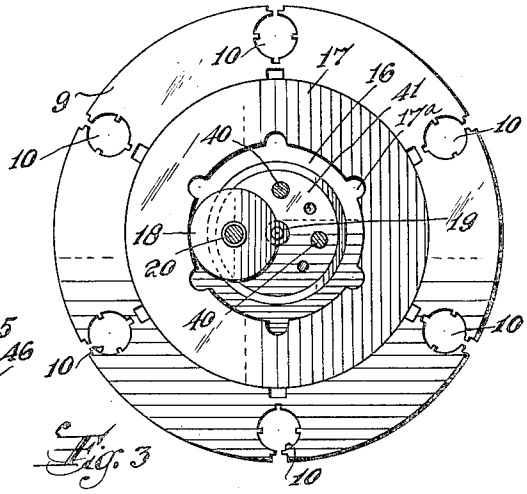


Fig. 3

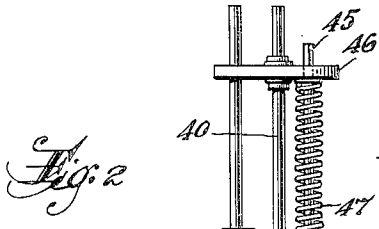
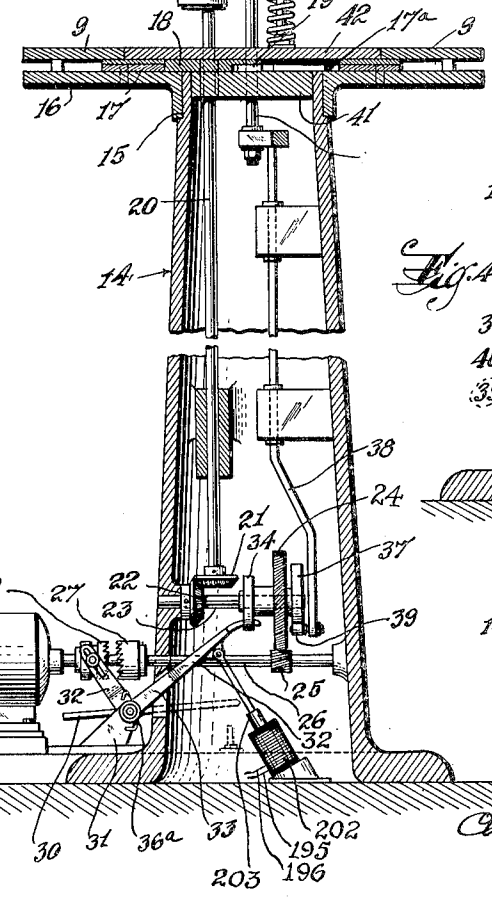


Fig. 2



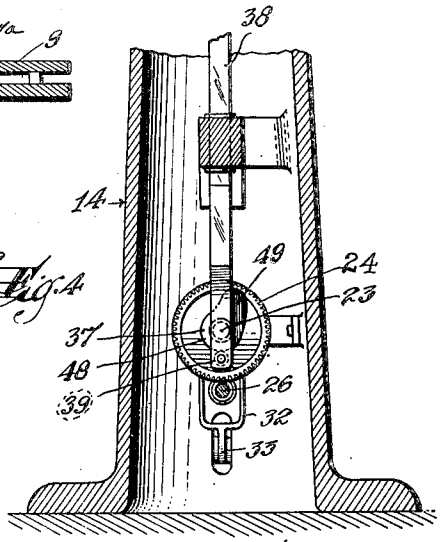


Fig. 4

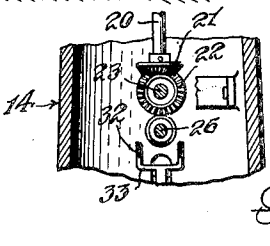


Fig. 4a

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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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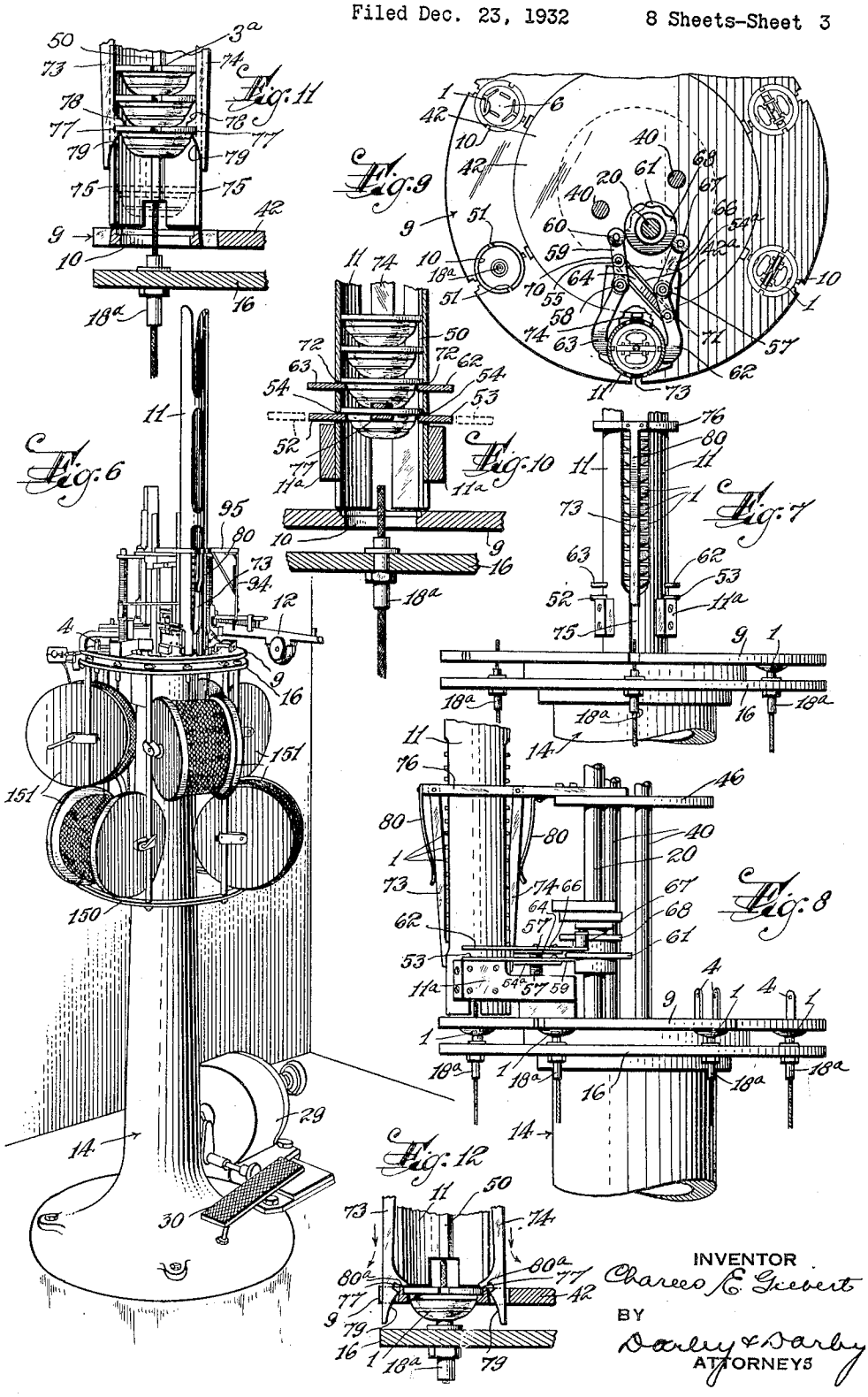


Fig. 11

Fig. 9

Fig. 10

Fig. 6

Fig. 7

Fig. 8

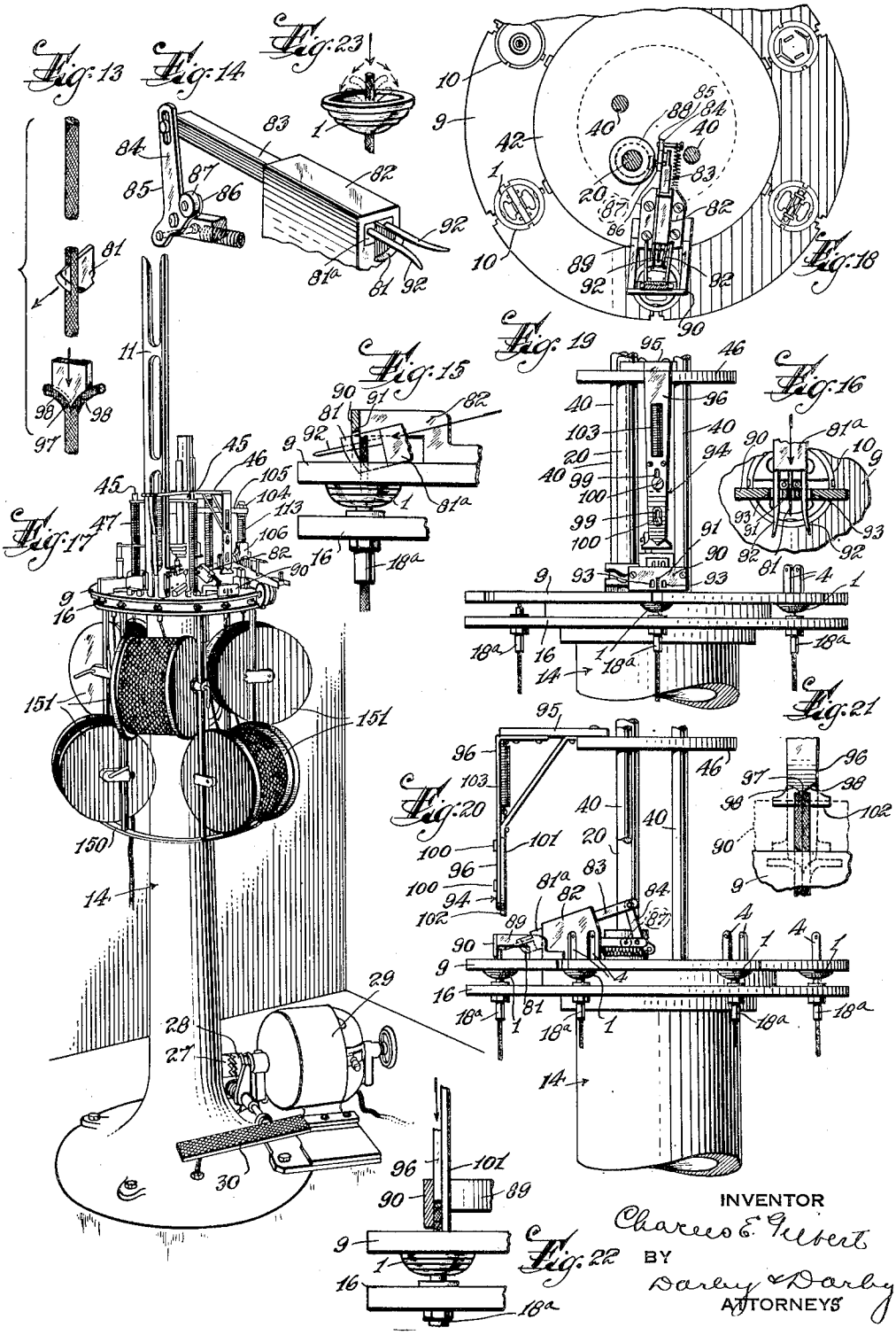
Fig. 12

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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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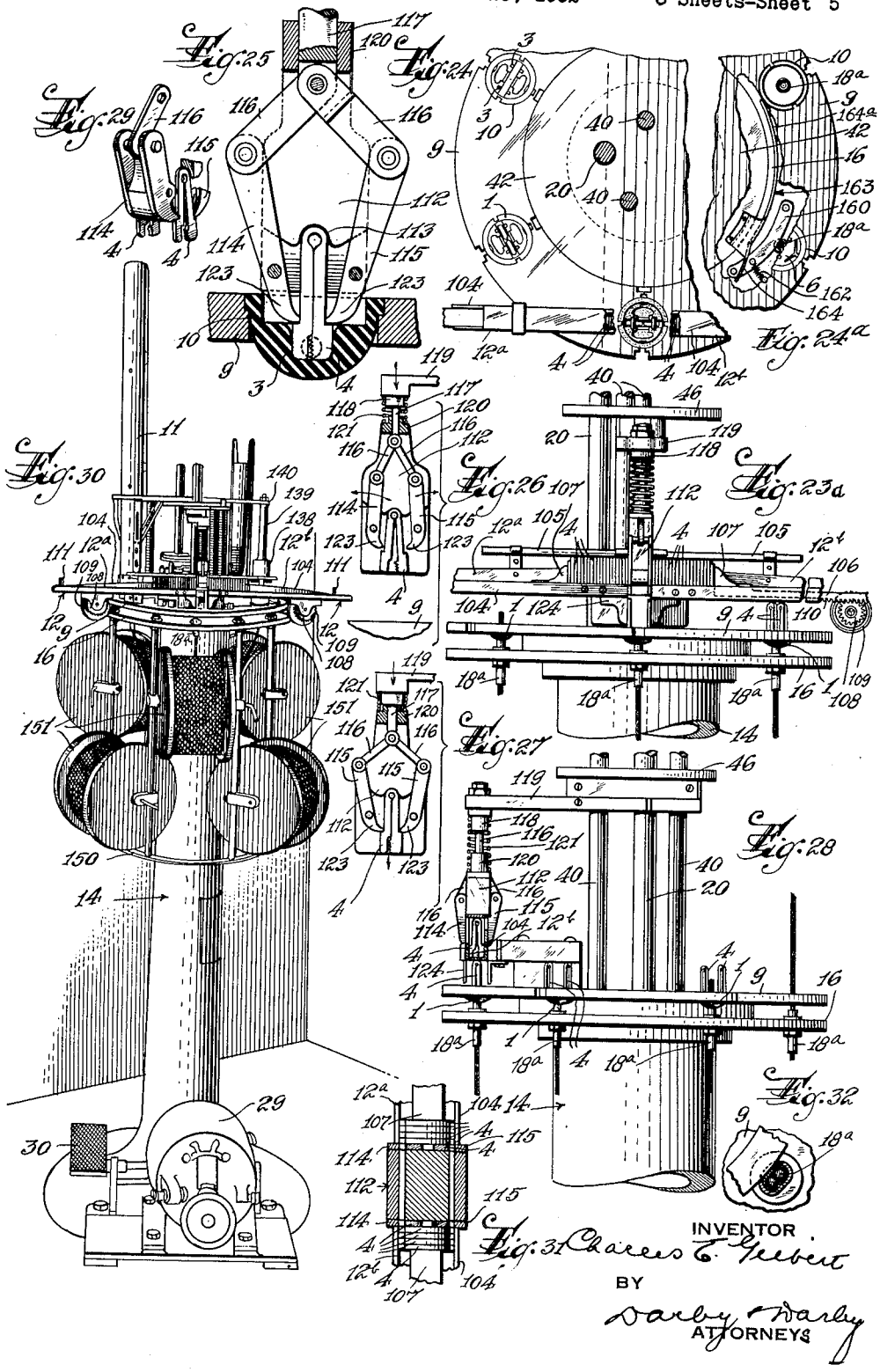


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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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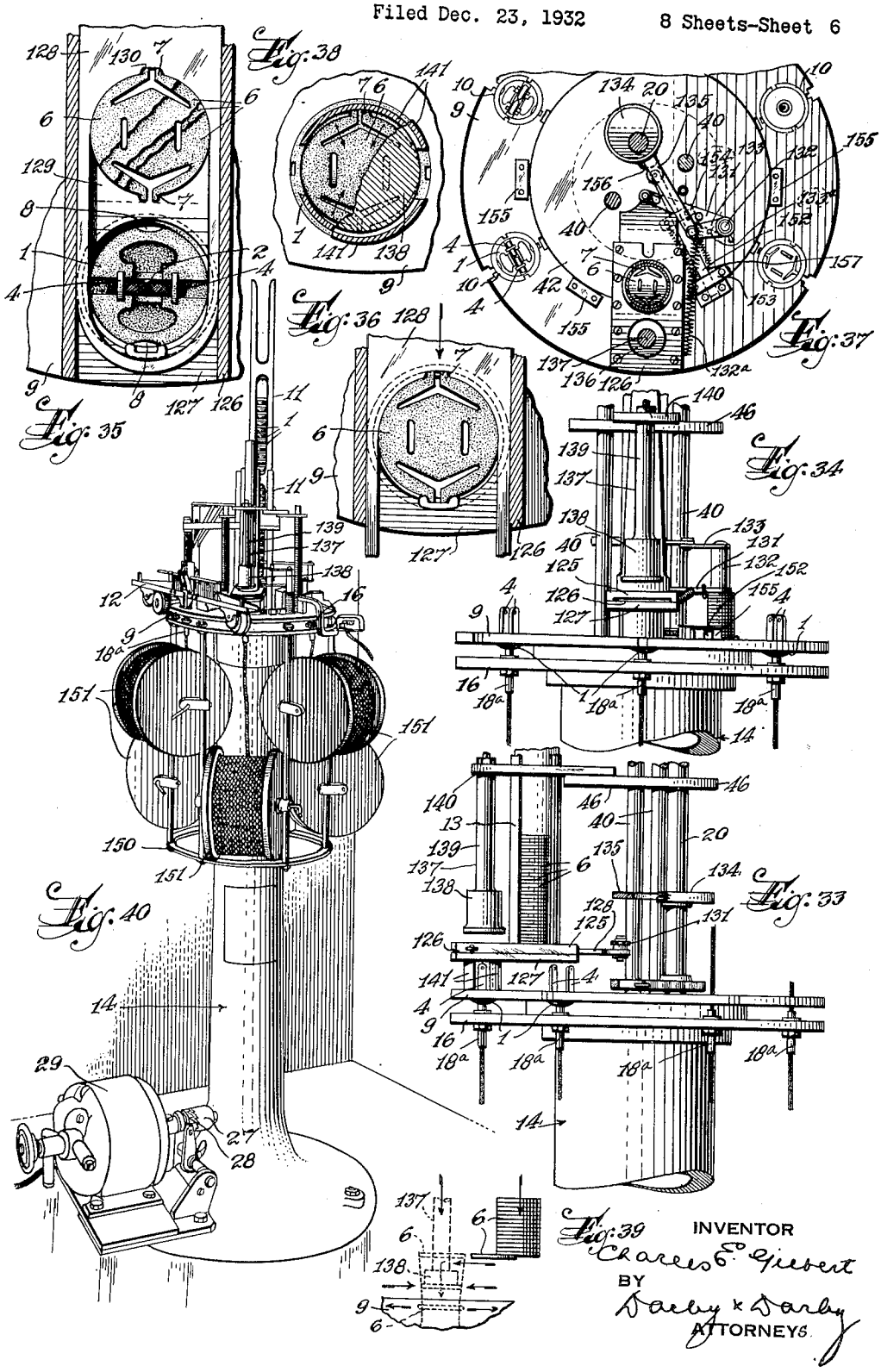


Fig. 35

Fig. 36

Fig. 37

Fig. 38

Fig. 34

Fig. 33

Fig. 40

Fig. 39

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AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

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Fig. 42

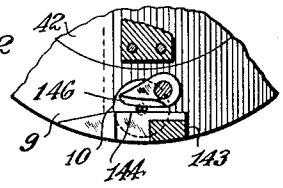


Fig. 41

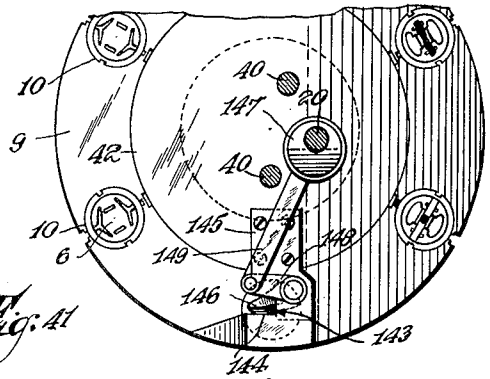


Fig. 46

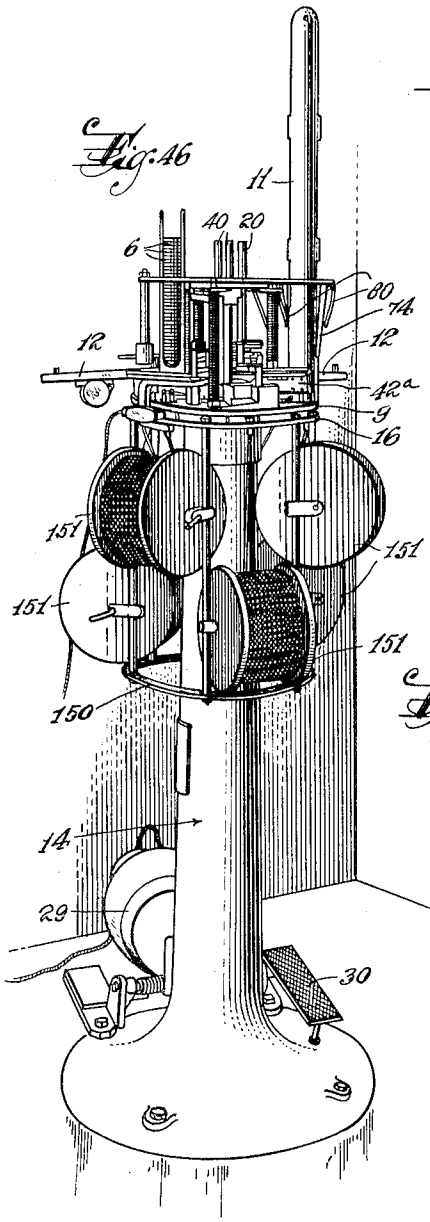


Fig. 43

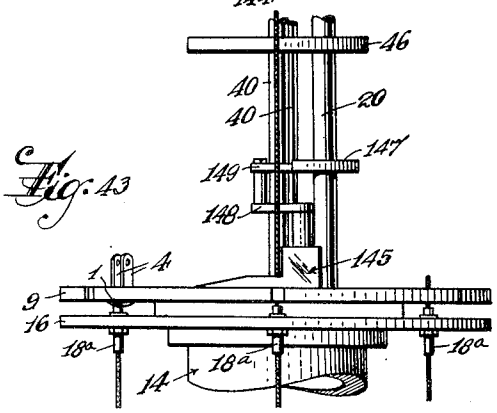


Fig. 44

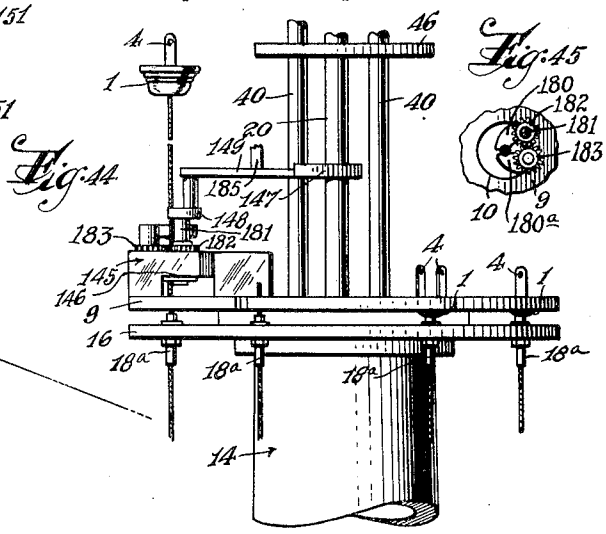


Fig. 45

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Fig. 49

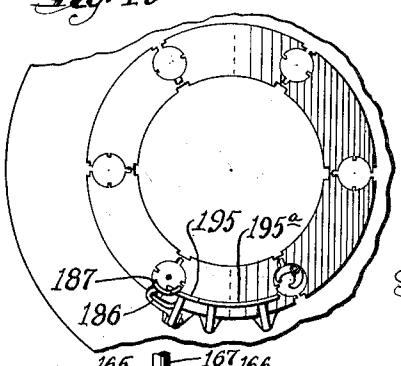


Fig. 50

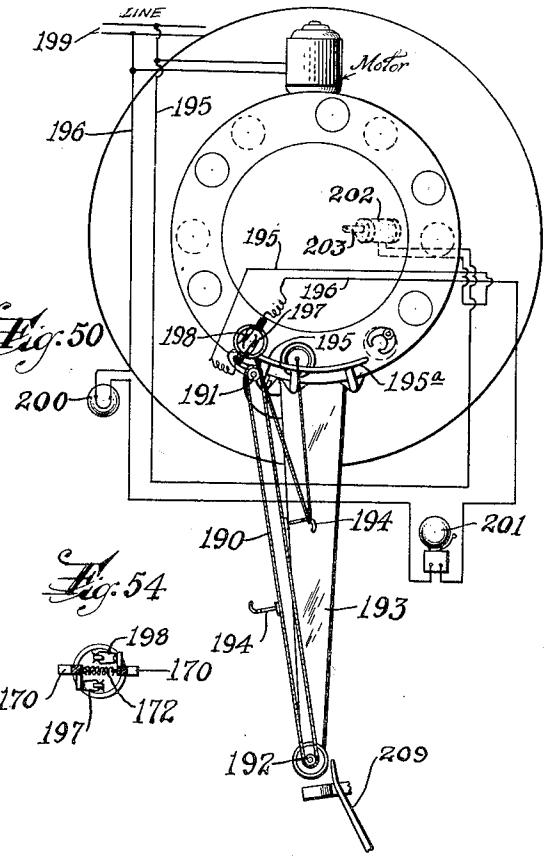


Fig. 47

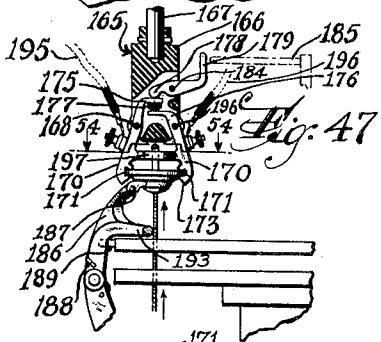


Fig. 54

Fig. 48

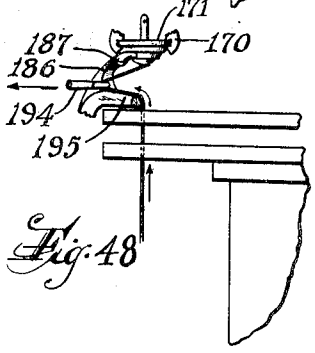


Fig. 52

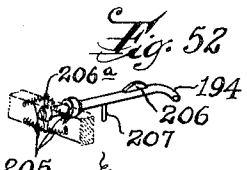


Fig. 53

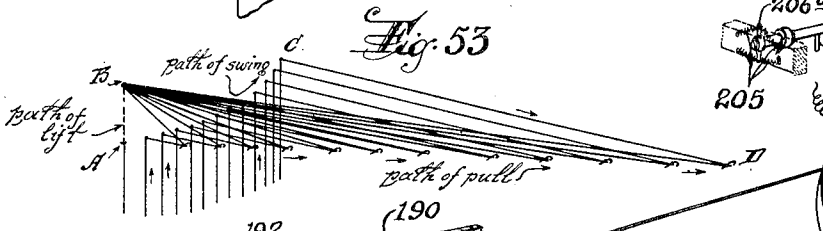
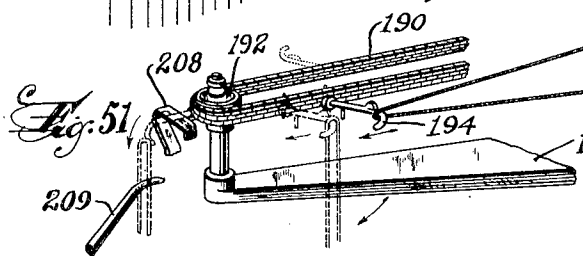


Fig. 51



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Patented Apr. 3, 1934

1,953,476

UNITED STATES PATENT OFFICE

1,953,476

AUTOMATIC MACHINE FOR ASSEMBLING ELECTRIC PLUGS

Charles E. Gilbert, New York, N. Y.

Application December 23, 1932, Serial No. 648,618

13 Claims. (Cl. 29—84)

Practically all electrical appliances are sold with a flexible cord and plug attached, by means of which they may be connected to an electric circuit. One of the most costly operations in connection with the use of electric plugs and cords by manufacturers is that of attaching the electric cord to the plug, since it has not been possible to do this mechanically. Considerable manual labor, particularly from the point of view of time, is required to remove the insulation from the wires and to insert them properly in the plug beneath the binding screws.

Furthermore, the cost of the plug itself is considerably increased by the manual operations involved in the assembly of its parts. This is done by the manufacturer of the plug, but, naturally, its costs is reflected in the cost of the appliance to which the plug is ultimately attached.

The object of my invention is to eliminate all manual labor in connection with the assembly of certain types of plugs and in the attachment of the electrical cord thereto and to speed up production many times by performing the operations mechanically and automatically.

In my application for Letters Patent Serial No. 585,464, filed January 8, 1932, I have disclosed a plug which need be assembled only when the electrical cord is attached, the two operations being performed simultaneously and constituting, in fact, a single operation. Of course, this may be done manually, but the nature of my plug permits of automatic assembly at high speed. This invention is directed to a machine for such automatic assembly of the plug elements and simultaneous attachment of the plug to the cord, the automatic measuring of the cord into lengths of six feet or any other length desired and the automatic testing of the connections to determine whether proper electrical contact has been secured within the plug. The machine may also be employed for the simple assembly of the plug elements without the cord when it is desired to produce the plug in such assembled state for general sale, etc.

The plug of my copending application and the machine of the present invention, by means of which it may be assembled, are illustrated in the following drawings of which

Figure 1 is a purely pictorial view from which the succession of steps involved in the assembly of a plug by the machine can be ascertained with ease, and which will greatly assist in the understanding of the remaining figures and the general operation of the machine;

Fig. 2 is a vertical section through the machine primarily illustrative of the operating parts within the base and associated with the source of power;

Fig. 3 is a plan view of the rotatable head in which the plug bodies are transported from one position to another and also disclosing the mechanism by means of which the head is rotated;

Figs. 4, 4a and 5 are vertical cross-sections of the base illustrating in greater detail some of the operating parts contained therein;

Figs. 6 to 12 are views illustrating the first step of assembly in which the plug bodies are transferred from a mechanism to the rotating head of Fig. 3;

Figs. 13 to 23 are to illustrate the mechanisms and operations involved in the second assembly step, that of slitting the outer covering of the insulated cord and bending the insulated wires therein into proper position above the plug body;

Figs. 23a to 32 illustrate the mechanisms and operations involved in making connection between the insulated wires and the contact elements and in inserting the contact elements within the recesses provided therefor in the plug body;

Figs. 33 to 40 illustrate the mechanisms and operations concerned with the inserting of the retaining disk in the plug body, and also (Fig. 37) illustrating the means whereby the rotating head of Fig. 3 is locked against rotation while at rest;

Figs. 41 to 46 show the mechanisms and steps connected with the testing of the assembled plug and cord for perfect electrical contact and to the severing of the cord;

Figs. 47 and 48 show the means whereby the plug is removed from the rotatable head of Fig. 3 before testing and before severance of the cord;

Figs. 49 to 53 are illustrative of the means whereby the cord is measured to its desired length before severance; also of the electrical circuit for testing the electrical connections and also the means whereby the cord with plug attached is ultimately disposed of; and

Fig. 54 is a detail view of a part of the device of Fig. 47.

The plug as will be observed from my co-pending application and from Figs. 1, 24 and 25 hereof, consists of a molded body 1 provided with the usual central aperture 2 for the cord and with recesses 3 for the reception of wire gripping and prong elements 4. The remaining element is a retaining disk 6. After the cord is brought in through the central aperture, the outside in-

sulation enveloping both insulated wires is removed and a wire with its own individual insulation intact is inserted between the jaws 5 of the contact element. Then the jaw end of each contact element is pushed into a recess 3 which is so proportioned and shaped that it will force the jaws together to pierce the insulation and make electrical contact with the wire within. It also holds the contact elements firmly upright and in correct alignment in this condition. Then retaining disk 6 is slipped over the projecting prongs and snapped into place in the body to close it and to retain the contact elements in position. The disk is so held by lugs 7 which engage with suitable recesses 8 in the plug body.

In referring to this plug of my copending application, I do not wish to be understood as limiting my invention to a machine for the assembly of that particular plug only. The machine which I will describe is of necessity of some particular construction, and I have selected the form which I have devised for assembling the plug of my invention for this purpose, without thereby intending to impose any limitations upon my invention.

As generally stated, the machine consists essentially of a suitable pedestal or base upon which is mounted a head horizontally and intermittently rotatable into six different positions, at which six different steps of assembly are performed by devices positioned at those six points.

The six steps involved are pictorially shown in Fig. 1. A rotatable head 9 is provided with six cavities or openings 10 for the reception of six plug bodies openside up. "Position A" of Fig. 1 shows a plug body 1 about to drop into a recess 10 from a magazine 11 directly above it. In a previous position of head 9, an electric cord with all of its insulation intact has been fed up from below into recess 10, so that when the plug body 1 drops into the recess the cord will project through its central aperture and a short distance above it.

The head now rotates to the second position, "Position B" of Fig. 1, where the insulation which envelopes both insulated wires is slit lengthwise to expose the insulated wires within, and the ends of the wires with the insulation intact are bent in diametrically opposite directions so that they lie directly across and above recesses 3 into which the contact elements fit. Then the head rotates again to "Position C", which is the third step at which the recess carrying the plug body registers with a magazine 12 holding contact elements from which two are automatically removed and transported downwardly, so that the wire gripping jaws first receive the insulated wires and are then pushed into the recesses 3, carrying the wires with them. As already stated, this last operation also makes the contact with the wires within the insulation.

The head 9 then rotates again to fourth position, "Position D" of Fig. 1, at which point a retaining disk 6 is removed from a magazine 13, slipped over the contact prongs and snapped into position in the open end of the plug body. The plug is then completely assembled with the cord attached.

The next step is performed in "Position E" by again rotating the head to that extent. At this point, the plug is removed from socket 10 a few inches either manually or automatically, after which the head again rotates to the final position, "Position F", where the cord is cut. While the head is rotating from "Position E" to "Position F", the plug with the cord attached is removed either manually or automatically to the distance equal to the desired length of the cord, so that when the cord is severed at "Position F" the desired length of cord will be attached to the plug.

Substantially coincidently with the severing of the cord the wires are short-circuited adjacent the point of severance and a current is transmitted through the plug and cord to test the electrical connections within the plug. A faulty connection may be indicated by a light or an audible signal. At the same time, the machine may be automatically stopped until the defective plug is removed and the cause of the difficulty ascertained. In fact, means may be provided which will stop the machine at any point when anything goes wrong during assembly.

Each plug goes through the above operations, six being in course of assembly at one time, one in each recess at the head, so that the machine delivers an assembled plug and begins the assembly of a new one at each fractional rotation of the head.

Obviously, plugs may be assembled without the electric cord in the same manner, although, of course, the operations relating to the cord will have no effect. Hence, if desired for plug assembly only, these may be eliminated from the machine which will reduce the number of operations to four—those represented by Positions A, C and D of Fig. 1—plus an additional step taking the place of the final step F, involving simply the removal of the plug from its recess in the head by a kick-out device of any suitable kind.

The general mode of operation will now be understood and I will proceed with the detailed description of the machine.

Referring to Fig. 2, it consists of base 14 upon the top of which is mounted by a suitable bearing 15, a flanged disk-like rotatable table 16. Concentrically attached to this table is an annular plate 17 forming the outer element of a Geneva movement. Above plate 17 and attached to table 16 is the annular head 9 already mentioned, provided with cavities 10 for the reception of the plug bodies, equally spaced near its outer periphery (Fig. 3) and each of a suitable size to receive the body of the plug open side up so that its edge lies substantially flush with the surface of the head. Affixed in table 16 and projecting into the bottom of each cavity 10 a short distance and centrally positioned therein is a tube 18^a of suitable size to permit passage of an electric cord. This tube is, preferably, somewhat oval in cross-section to correspond with the usual shape of an electric cord and is so positioned that the cord will emerge therefrom with its two wires lying in a plane which will bisect the two recesses 3 of the plug body in their cross-wise or shortest dimension.

As already stated the annular plate 17 forms the outer element of a Geneva movement (see Fig. 3). That is to say its inner periphery is generally circular in form but is provided with six equally spaced depressions 17^a separated by the usual arcuate lands. Within the center opening of plate 17 is positioned the other element of the Geneva movement, consisting of a disk 18 provided with a projection 19 of suitable character to engage with one of the depressions 17 upon each rotation of disk 18. This completes the Geneva movement by means of which table 16 and head 9 will be rotated ⅙th of a revolution for each revolution of disk 18 in the well known manner.

Disk 18 is fixed to a shaft 20 (Fig. 2) which runs downwardly within the base of the machine and terminates in a bevel gear 21, which meshes with a complementary bevel gear 22 fixed to the horizontal shaft 23. Horizontal shaft 23 is also provided with a gear 24 which meshes with a gear 25 on another shaft 26, the outer end of which is provided with one element 27 of a clutch (Fig. 2), the other element 28 of which is slidably splined to the shaft of a motor 29 or other suitable source of power. When the motor 29 is running and the clutch elements are engaged, the Geneva movement will operate to rotate the head 9 intermittently to bring each of cavities 10 into the six different positions and to permit them to remain there a certain length of time.

Clutch element 28 may be operated by a foot pedal 30 pivotally mounted in a suitable bracket 31 through an attached lever 32 suitably connected to clutch element 28 to slide it upon the motor shaft into engagement with the other element 27, or the clutch may be automatically operated throught a lever 33 also rigidly connected to pedal 30 and consequently to lever 32, the other end of which engages with a cam 34 also mounted on shaft 23.

Cam 34, as shown in Fig. 5, is of circular shape with the exception of a single depression 35 into which lever 33 can retreat. Cam 34 is so proportioned that while lever 33 rides upon the circular part of its surface, it will be depressed sufficiently to bring clutch elements 27 and 28 into engagement, whereas while lever 33 rests in depression 35 in the cam, the clutch elements will be maintained out of engagement through the upward rocking of lever 33 and the consequent backward sliding of clutch element 28 upon the motor shaft—a movement which is insured by means of a coil spring 36^a which maintains tension in the proper direction upon lever 32 and the associated clutch operating mechanism. Cam 34 is so positioned upon its shaft that lever 33 will pass into depression 35 when projection 19 upon the Geneva movement element 18 is about to enter one of the depressions 17^a in the outer element 17 of the Geneva movement. That is to say, the machine comes to rest after head 9 has turned through one of the 1/6th revolutions and just before the Geneva movement would effect another similar turning movement, so that the first thing which happens when the clutch is again engaged is the partial rotation of the head followed by the continued rotation of the inner element 18 of the Geneva movement until it has made a complete revolution, whereupon it again stops with projection 18 in position to properly engage with a depression 17^a to repeat the operation.

Although the Geneva movement provides a reliable means for accurately positioning head 9 in its various positions of rest, the required accuracy of position is such that it is desirable to lock head 9 in each position by positive and additional means. This is shown in Fig. 37 and consists of a bolt 152 radially slidable in suitable guide brackets 153 and 154 attached to center-plate 42. Head 9 is provided with sockets 155 into which the end of bolt 152 projects when head 9 is at rest and so positioned that head 9 will then be locked against rotation with its recess in the six positions heretofore indicated. Just before head 9 is rotated, bolt 152 is drawn back out of socket 155 to unlock head 9 so that it may be rotated. The operation of bolt 152 is effected from a suitable cam 156 on shaft 20. This cam is so positioned on shaft 20 that before head 9 starts to rotate the bolt 152 is withdrawn and while it is at rest bolt 152 is pulled forward by spring 157 to lock head 9.

Also mounted upon shaft 23 is another cam 37 (Figs. 2 and 4) which imparts reciprocatory movement to a pitman 38 through engagement with a cam wheel 39 on the lower end of the pitman. Shafts 40 are connected to the upper end of pitman 38 (Fig. 2) through which the reciprocatory movement of the pitman is translated to certain operating parts to be described.

The upper end of base 14 is closed by a plate 41 (Figs. 2 and 3) provided with openings for the passage of shafts 20 and 40 and may also support bearings for these shafts. Above plate 41 and filling the circular hole in the center of head 9 is a similar plate 42 mounted upon plate 41 in such a way (Fig. 2) that space is left between the two plates for the Geneva movement. Plate 42 serves to enclose and protect the Geneva movement and also acts as a support for a large number of the operating elements and the guiding members associated with these elements.

Three upwardly projecting guide rods, one of which is shown at 45 in Fig. 2 affixed in plate 42, carry coil springs 47. These rods pass through a carriage 46 which rests upon the tops of coil springs 47, and act as guides therefor to prevent longitudinal displacement. Attached to carriage 46 are the upper ends of shafts 40 which, as already explained, are connected to pitman 38. Hence carriage 46 may be reciprocated in a vertical direction by means of cam 37, springs 47 serving to maintain contact between the cam and its roller on the pitman. Shaft 20 also projects through an opening in carriage 46 so that reciprocation of the carriage is not impeded or affected thereby.

The lowest portion 48 of cam 37 is of uniform curvature (Fig. 4). Consequently, when cam roller 39 engages with this portion, carriage 46 is maintained, under the influence of springs 47, in its highest position, and the cam is so positioned upon shaft 23 and the extent of its uniformly curved portion is such that carriage 46 will remain in its uppermost position substantially throughout each fractional rotation of head 9, and performs its reciprocatory movement, under the influence of the higher portions of cam 37, during the periods when head 9 is stationary. Carriage 46, which is provided with a number of arms, carries various parts overlying the different positions into which cavities 10 in head 9 can be rotated and which can be described best in connection with each of the plug assembly operations.

The first step, as already generally stated, is that of inserting a plug body openside up in one of the cavities 10 of head 9. This is shown pictorially at "Position A" in Fig. 1 and by Fig. 9. Assuming head 9 to be at rest, one of the cavities 10 will be in the proper position with the end of the elastic cord projecting upward, as shown in Fig. 10, as the result of the last operation upon another plug as will be explained hereinafter. Directly above cavity 10 is the magazine 11 supported from center plate 42 by a suitable bracket 11^a so that its lower end opens directly above the cavity 10. The magazine may be filled with plug bodies openside up, as shown in Fig. 7. Therefore, a plug body will pass into cavity 10 as soon as it is released from the magazine.

Obviously, it is essential that the plug bodies should be fed one at a time and only when head

9 is at rest and also that they must be fed with the contact receiving recesses 3 in the definite position with respect to the plane of the two wires to be attached thereto already described. The plug bodies are aligned in the magazine by means of two diametrically opposed ribs 50 (Figs. 10 and 12) which slidably engage with complementary notches 3a (Fig. 11) in the edges of the plug bodies. The edge of each cavity 10 is also provided with projections 51 shaped and positioned so that each plug body will be received therein in the same position as that which it had in the magazine. Additional assurance that each plug body will be properly received and maintained in cavity 10 is attained by making its central aperture 2 somewhat oval to correspond with the shape of tube 18a which projects into it. The proper position of the plug body in cavity 10 is, as already stated, such that when the two insulated wires are bent outwardly in diametrically opposite positions they will bisect the recesses which receive the contact elements.

The feeding mechanism, by means of which a single plug body is fed into a cavity 10 at each fractional rotation of head 9, is associated with magazine 11. A short distance above the lower end of the magazine two arms 52 and 53 (Figs. 7, 8, 9 and 10), preferably in the form of two thin blades, are so positioned and arranged that they can pass through horizontal slots 54 in the walls of the magazine a sufficient distance to obstruct the further downward passage of a plug body (see Fig. 10). These arms are connected to operating mechanism which will later be described so that they can be swung out to disengage them from the plug body and permit it to pass downwardly out of the magazine.

A similar pair of blades 62 and 63 are positioned above blades 52 and 53 a sufficient distance and are operated in a similar manner through horizontal slots 72 in the walls of magazine 11 to engage the plug body next to the bottom one (Fig. 10). These blades are also connected to operating mechanism which moves them in and out of plug body engaging position. The operative movements of the two pairs of blades 52 and 53 and 62 and 63 are so related that when the lower blades are open to release a plug body the upper blades close to prevent the downward passage of the following plug body. Then when he lowest plug body has been released the lower blades close and the upper blades open and the next plug body passes downward by gravity, or is forced downward by spring pressure past the upper blades and into contact with the lower blades.

The above action of the two pairs of blades is accomplished as follows:—Blades 52a is connected to its companion blade 53 by a cross link 54 pivoted to blade 52 at 55 and to blade 53 at 56 (Fig. 8). Blade 53 is also mounted upon bracket 42a affixed to center plate 42 by means of a pivot 57. Consequently, cross link pivot 56 lies between the pivot end of blade 53 and its outer end. Blade 52 is also mounted upon bracket 42a by means of a pivot 58 between cross link pivot 55 and its outer end. Its inner end is extended into an arm 59 upon the end of which is mounted a roller 60 which engages with the cam 61 upon shaft 20, the engagement being maintained by a suitable spring. As will be seen from Fig. 10, blades 52 and 53 lie on opposite sides of magazine 11 so that the outer ends will enter slots 54 in the magazine sufficiently to prevent the downward passage of a plug body.

More specifically, referring to Figs. 9 and 10, when arm 59 is rocked to the left by cam 61, blade 52 will enter one of slots 54 sufficiently to prevent a plug body within the magazine from passing it. Simultaneously blade 53 will enter the other slot through the pulling of arm 59 through cross link 54. On the other hand, when arm 59 rocks to the right through the engagement of roller 60 with a lower portion of cam 61, blades 52 and 53 will move outwardly a sufficient distance to release the plug body within the magazine. The other pair of blades 62 and 63 are positioned above blades 52 and 53, as already stated. Blade 62 is similar to blade 52 and blade 63 is similar to blade 53. Likewise, they are similarly connected by a cross link 64. Blade 62 is pivoted to bracket 42a by pivot 57, and is extended into an arm 66 provided at its inner end with a roller 67 which engages with a cam 68 also upon shaft 20. Blade 63 is pivoted to bracket 42a by pivot 58. Cross link 64 connects blades 62 and 63 at a pivot 70 on blade 63 and a pivot 71 on blade 62. Therefore, when arm 66 swings to the right under the action of cam 68, blades 62 and 63 will approach each other, entering horizontal slots 72 of the walls of magazine 11 to engage the plug body next to the bottom one; and when arm 66 is swung to the left by cam 68, blades 62 and 63 will separate releasing the plug body and permitting it to pass downward into contact with blades 52 and 53. Cams 61 and 68 are so shaped and so positioned upon shaft 20 that when the lower blades 52 and 53 have opened the upper blades are closed, so that the lowest plug body in magazine 49 can pass downward without affecting the position of the remaining plug bodies.

Thereafter, the lower blades 52 and 53 immediately close again and remain so until they are again operated to release another plug body. This occurs, of course, only after head 9 has made one of its fractional rotations, bringing another cavity 10 into position beneath magazine 11. Cam 68 is so shaped and so positioned upon shaft 20 that the upper blades 62 and 63 open immediately after the closing of lower blades 52 and 53 to permit another plug body to pass downward into engagement with the lower blades. This occurs while the plug body which has been released by lower blades is passing into the cavity 10 in head 9. At other times, upper blades 62 and 63 remain closed so that the lowest plug body in the magazine is normally locked between the upper and lower pairs of blades.

While a plug body is thus held between the two pairs of blades 52, 53 and 62, 63 it is picked up by a pair of guides 73 and 74 (Figs. 7, 8 and 11) working in diametrically opposed longitudinal slots 75 in magazine 11. These guides are pivotally mounted (Fig. 8) on arm 76 of plate 46 so that they reciprocate therewith, and each is provided near its lower end with a notch 77 adapted to engage the edge of the plug body. Above and below the notch 77 each arm is curved inwardly, as at 78 and 79, to form surfaces which can be acted upon to cause it to swing outwardly. Each arm is also normally maintained in position to contact with a plug body, i. e., urged inwardly, by means of a leaf spring 80 also mounted upon arm 76.

When plate 46 descends through the action of pitman 38, guides 73 and 74 also descend, carrying with them the lowest plug body in magazine 49 which has become engaged with the notches 77, as shown in Fig. 11. The guides descend far

enough to seat the plug body in cavity 10, when they are released from the plug body through contact of their curved ends 79 with the edges of head 9 which act as cams to cause them to swing outwardly (Fig. 12). The plug body must be positively seated in cavity 10 so that its upper edge is flush with the face of head 9. To insure this the upper edges 80[a] of notch 77 project beyond the lower edges and are so positioned upon guides 73 and 74 that they are in substantial contact with head 9 at the end of its downward travel and still overhanging the edge of the plug body, although the lower edges of the notches have been swung out of engagement with the plug body, as shown in Fig. 12.

Under the influence of pitman 38, carriage 46 immediately ascends carrying guides 73 and 74 with it. They will swing inwardly as soon as their ends 79 are freed from the edges of head 9 under the urge of springs 80. Just before the ascent is completed, curved surfaces 78 of guides 73 and 74 engage with the edge of the lowest plug body in the magazine and the blades swing outwardly until notches 77 snap over the edge of the plug (Fig. 11) which, as already stated, is locked against movement up or down by the pairs of blades 52, 53 and 62, 63. This occurs at the top of the stroke of guides 73 and 74 (represented by Fig. 11).

In this manner one plug body at a time is fed to a cavity 10 at the proper time and is firmly and accurately seated therein. Preferably the lower end of magazine 11 is very close to head 9 so that before a plug body is released from the ribs 50 it has also engaged with projections 51 in the socket which, of course, are in accurate alignment with ribs 50. Thus, there is no possible way in which a plug body can fail to be correctly positioned.

The first operation, that of "Position A" of Fig. 1, is now completed.

Thereupon the Geneva movement operates again, either through clutch pedal 30 or the automatic means already described acting upon lever 32, to rotate head 9 one-sixth of a revolution so that the cavity 10 which carries the plug body with the insulated wire projecting upwards through its central aperture, is transported to "Position B" of Fig. 1 where the second operation is performed.

This operation consists of first longitudinally slitting the insulation of the end of the cord which projects above the plug body and then bending the two insulated wires thus exposed in diametrically opposite directions, as shown in Fig. 13, so that they overlie the recesses 3 to receive the contact elements as already generally described.

For slitting the outside insulation of the electric cord, I employ the apparatus shown in Figs. 13 to 20. This consists of a relatively thick knife 81 fixed in a suitable slide 81[a] longitudinally slidable in a guide block 82 which is mounted on center plate 42 by means of a suitable bracket (Figs. 18 and 20). The shape of this knife is generally similar to that of the pointed end of an ordinary kitchen knife (Fig. 14), that is to say, it is provided with a backwardly and downwardly curving sharp edge. Attached to the rear end of this knife is a piston 83 which is connected to one arm 84 of a bell crank 85, the other arm 86 of which carries a cam roller 87. Affixed to shaft 20, is a cam 88 having a cam surface on its upper side with which roller 87 engages and by means of which bell crank 85 is rocked, with the result that piston 83 and knife 81 are reciprocated. As will be seen from Figs. 15 and 16 this reciprocatory movement of the knife will cause it to approach and penetrate the insulation surrounding the two insulated wires of the cord. As already stated, the cord is so positioned that the knife will pass directly between the two insulated wires severing the surrounding insulation without disturbing the insulation around each individual wire. This occurs immediately after head 9 has been rotated to bring the plug body under discussion into the proper position. Thereafter, the knife immediately recedes again to its normal position shown in Figs. 18 and 20.

To insure the accurate cutting of the insulation above described, an extension 89 attached to the bracket which holds the guide block 82 and projecting outwardly, as shown in Figs. 18 and 20, terminates in a transverse plate 90 vertically positioned just outside of the projecting end of the insulated cord. A slot 91 in plate 90 permits the knife to pass through it during the slitting stroke. Plate 90 thus serves as a back plate for the support of the cord while the insulation is being cut. As a further insurance of the proper slitting of the insulation, slide 81[a] which carries knife 81 is also provided with two outwardly curving prongs 92 located on either side of the knife, as shown in Figs. 14, 16 and 18, which move forward with the knife and support the cord on either side during the cutting operation. Thus, during this operation, the cord is supported from three sides by rigid supports so that it cannot possibly move out of proper alignment with the cutting knife. Since prongs 92 project beyond the knife and, consequently, when in extended position, beyond back plate 90, plate 90 is provided with apertures 93 through which they can pass as best shown in Fig. 16.

The insulation of the cord having been slit as above described and the knife and prongs having receded, the machine is ready for the second step of this particular operation which is the spreading of the ends of the insulated wires to position them above the recesses in the plug body. This is accomplished by a spreader 94 mounted upon an arm 95 affixed to carriage 46, so that it reciprocates therewith.

Spreader 94 is composed of a downwardly projecting arm 96 rigidly attached to arm 95, the lower end of which terminates in a centrally positioned point 97 (Figs. 19 and 21) adapted to pass between the two insulated wires. The end of arm 96 on either side of the point is curved upwardly as best shown at 98 in Fig. 21, so that as arm 96 descends the two insulated wires will be separated and symmetrically bent in diametrically opposite directions, as shown in Fig. 13 and in dotted lines in Fig. 21. Arm 96 is also provided with two vertically aligned slots 99 through which screws 100 pass. By means of these screws another arm 101 is slidably mounted upon arm 96. In its lowermost position its end, consisting of a horizontal 102, lies a little below and just behind the lower end of arm 96, as shown in Figs. 19, 20 and 22. It is normally maintained in this position by means of a spring 103 which forms the operating connection between it and arm 96.

Lower arm 101 is so positioned with respect to arm 96 that when carriage 46 descends it will pass directly behind the upwardly projecting insulated wires which are then confined between it and backplate 90. The length of arms 96 and 101 are such that as carriage 46 descends

arm 101 will ultimately make contact with the top of head 9, after which arm 96 will continue its descent to spread the wire until the end of the downward oscillatory movement of carriage 46 is reached. Thus, arm 101 during the spreading of the insulated wires remains stationary directly behind them and, with backplate 90, prevents any movement of the insulated wires except in the indicated directions. Thereupon carriage 46 ascends again, carrying arms 96 and 101 with it and the operation under discussion is completed.

Then through the mechanism already described, head 9 is again rotated through ⅙th of a revolution, bringing the plug body into the next position, "Position C" of Fig. 1, where the next operation is performed. This consists of connecting a contact element 4 (Fig. 2) to each insulated wire and inserting the element into its recess 3 in the plug body. These things are accomplished by the following mechanism shown in Figs. 23 to 31.

A magazine 12, also mounted upon plate 42, is adapted to hold a number of contact elements 4 in a vertical position, wire gripping jaws down. Magazine 12 is in two identical parts 12^a and 12^b lying on either side of means whereby the contact elements are transferred from the magazine to the plug body. Each consists of a channel 104 of suitable size and shape to securely receive the wire gripping ends of the contact elements, as shown, and is also provided with a transversely curved guide 105 to support the prong ends of the elements. For each part of the magazine there is also provided some suitable means of maintaining continual pressure upon the contact elements, tending to force them towards the transferring mechanism. That shown consists of a slider 106 sliding in channel 104 provided with a head 107 which presses against the outermost contact element in the magazine. Slider 106 is urged in the proper direction by a pinion 108 driven by a spring 109 and meshing with a rack 110 in the underside of the slider. The outer end 111 of the slider may be curved upwardly to form a handle, whereby it may be pulled outward against the tension when it becomes necessary to refill the magazine. By these means the contact elements in the magazine are maintained in a compact mass, all accurately aligned and the inner one pressing against the transferring mechanism.

The mechanism by means of which a pair of contact elements is transferred from the magazine to the plug body, consists of a head 112 sliding between the adjacent ends of the two parts of the magazine 12 with only the necessary clearance. Each side of the head opposite the magazine is provided with a recess 113 no deeper than and preferably of slightly less depth than the thickness of a contact element and shaped to conform to the prong or upper end of the contact element as positioned in the magazine. Head 112 is normally positioned so that recess 113 is in horizontal alignment with the contact elements in the magazine, so that the inner one in each section of a magazine rests in a recess 113 and in vertical alignment with the recess 3 in the plug body into which it is to be inserted. When head 112 is made to descend it will carry with it in each recess 113 a contact element. Head 112 is also provided with two pairs of thin blades 114 and 115 pivoted to head 112 near their lower ends and so shaped that when their upper ends are swung outwardly, the lower ends will engage with the contact element in recess 113 near its wire gripping portion to press that portion together and into electrical contact with the wire within the insulation, as shown in Fig. 27. This action of blades 114 and 115 is effected by a toggle consisting of a pair of links 116, one attached to the upper ends of blades 114 and the other similarly attached to the other pair of blades 115, and both pivotally connected to a plunger 117 which projects downwardly into head 112 through a central longitudinal aperture provided for the purpose. Plunger 117 is provided with an abutment 118 which is rigidly attached to arm 119 projecting from plate 46. The upper end of head 112 is also provided with an extension 120 of somewhat smaller dimensions than the head proper. A coil spring 121 surrounds plunger 117 and is maintained in position by abutment 118 and extension 120. Spring 121 is of such length that it is maintained under compression so that normally head 112 is urged downwardly upon plunger 117. When carriage 46 is in its normal highest position, abutment 118 and extension 120 will be separated the maximum distance permitted. During the first part of the descent of head 112, spring 121 serves as the operating connecting link, so that head 112 descends simultaneously and to the same extent as carriage 46, carrying two contact elements with it, one on each side as already described. During this operation the upper ends of blades 114 and 115 are in their inwardly swung position (Fig. 26), so that their lower ends do not engage with the contact elements, the wire gripping jaws of which maintain their normal slightly open condition.

When head 112 his descended sufficiently, each of the insulated wires which, as already described, are lying horizontally within the plug body will enter the wire gripping jaw of a contact element, causing it to open still further. After a slight further descent of head 112, the contact elements carried by it will engage with the upper edges of recesses 3 of the plug body; but because the wire gripping jaws have been somewhat opened by the insertion of the wires, considerable pressure would be required to force them into the recesses. This would put a severe strain upon the machine, unless the edges of the contact elements were severely beveled, which would reduce their contact with the recess walls to an undesirable extent. This is avoided by means of the toggle operated blades 114 and 115 as follows:

When head 112 has descended sufficiently so that the contact elements carried by it have picked up the insulated wires and have struck the edges of recesses 3, the resistance offered overcomes the strength of spring 121 and head 112 pauses in its descent. However, carriage 46 and, consequently, arm 119 continues to descend, carrying with it plunger 117 against the resistance of spring 121, with the result that the toggle links 116 are swung downward and the upper ends of blades 114 and 115 are swung out in consequence. This brings the lower ends 123 of the blades into engagement with the contact elements, and the jaws thereof are forced together and into contact with the electric wires within the insulation, as shown in Fig. 27. During this operation the abutment 118 has been approaching extension 120 until they finally engage. Then head 112 can no longer resist the downward motion of arm 119 and is positively driven downward with it to seat the wire gripping jaws of the

contact elements securely in recesses 3 of the plug body, carrying the wires with them, as shown in Fig. 25. The downward stroke of these parts of the mechanism terminates when the contact elements are thus firmly seated, after which the upward stroke begins immediately. The first part of this results in the withdrawal of the plunger 117 and the consequent release of blades 114 and 115. The continued ascent of plunger 117 carries the entire head 112 with it to its normal position, at which time another pair of contact elements pass from the magazine into the recesses 113 of head 112.

To assist in guiding the contact elements during their downward travel from the magazine to the plug body, I provide the magazine channels 104 with downwardly extending guides 124 positioned on either side of the channel adjacent the central opening through which the transferring mechanism passes and spaced apart sufficiently to permit the prong ends of the contact elements to pass between them while head 9 is rotating but close enough together to engage the sides of the somewhat wider wire gripping jaws to support them during the downward travel of head 112. Thus, the upper part of each contact element is supported during its downward travel by the pressure of the other elements in the magazine against head 112 and its lower end is supported by guides 124.

The plug body now equipped with its contact elements firmly seated in their recesses and each in electrical contact with a wire of the electric cord, is now ready for the next operation which, as will have been observed from Fig. 1, "Position D", consists of inserting the retaining disk 6 in the open end of the plug body to close it and to retain the contact elements in position.

To effect this step, head 9 is again rotated ⅙th of a revolution to bring the plug body beneath the disk seating devices. These consist of a magazine 13 (Fig. 33) within which a pile of disks is maintained, mounted upon plate 42. So as not to interfere with other parts, magazine 13 is positioned behind cavity 10 containing the plug being assembled. Surrounding the lower end of magazine 13 is a plate 125 which projects outwardly over cavity 10, as shown in Fig. 33. The underside of plate 125 is longitudinally recessed, as shown at 126, in Fig. 34 and is provided with a closing plate 127. The depth of recess 126 is slightly greater than the thickness of a disk 6, so that the disk can slide freely therein. Within recess 126 is a sliding carrier 128 having a thickness slightly less than the thickness of a disk and also having an elongated opening 129, the inner end of which is shaped to conform to the contour of a disk, as shown in Fig. 35, including a notch 130 adapted to receive one of the projecting lugs 7 of the disk.

The walls of magazine 13 are also provided with lug receiving grooves, one of which is in vertical alignment with notch 130 so that the disks will be fed into recess 126 in the proper position, as shown in Fig. 35.

Carrier 128 is reciprocated in recess 126 by means of a lever 131 suitably linked to the rear end thereof and freely pivoted on a stud 132 on plate 42. Carrier 128 is urged in an outward direction by means of a spring 132^a connected between lever 131 and any convenient stationary point. The effect of spring 132^a however is controlled by a crank 133 also freely pivoted on stud 132 and provided with a pin 133^a which engages with the outside edge of lever 131. Crank 133 is connected to an eccentric 134 on shaft 20 by means of a link 135 so that it is rocked by the eccentric when shaft 20 rotates. As a result, lever 131 is positively moved in an inward direction through the engagement of pin 133^a and the inward rocking of crank 133 and moves outward under the urge of spring 132^a as permitted by pin 133^a when eccentric 134 rocks crank 133 forward, provided carrier 128 meets no excessive resistance. Such resistance might result from the introduction of an imperfect retaining disk 6 which might jam between carrier 128 and the recess within which it slides. If this occurs and is of any appreciable amount it will overcome the tension of spring 132^a, with the result that the carrier 128 and lever 131 will remain stationary even though crank 133 continues its outward swing under the influence of eccentric 134. In such case the pin 133^a, which is the operating connection between crank 133 and lever 131, simply disengages from the edge of lever 131. In this way any possibility of damage to the machine through the straining or breaking of its parts during this operation is obviated.

Normally, carrier 128 is in the position shown in Fig. 35 with the inner end of its opening directly below magazine 13 and with a disk 6 resting within it, also as shown in Fig. 35. When carrier 128 is moved outward it carries disk 13 with it to a position directly over the plug body in recess 10 and in correct alignment therewith as shown in Fig. 36.

Directly above the disk, when in this position, is an opening 136 (Fig. 37) through which a disk seating plunger 137 can pass. This plunger which is shown in Fig. 34 consists of a hollow cylindrical head 138, the interior of which is of sufficient size and depth to permit it to pass over the contact prongs positioned in the plug body. Head 138 is attached to a stem 139, the upper end of which is mounted upon an arm 140 on carriage 46 so that the plunger will reciprocate with it.

The disk having been positioned over the plug body as already described, carriage 46 descends, driving plunger 137 downward to cause it to contact with disk 6, forces it downward over the contact prongs, and seats it in the open end of the plug body, the lugs on the disk snapping into the corresponding openings in the plug body.

During its descent, disk 6 is guided by converging guides 141 attached to the underside of plate 127. These guides also compress the wings of the disk slightly to facilitate its entry into the plug body, as shown in Figs. 38 and 39.

Then plunger 137 ascends again and carrier 128 recedes inwardly to its original position, and the plug being assembled is transported through another ⅙th of a revolution of head 9 to position it for the next operation. The plug is now fully assembled with the cord electrically connected. There remains, therefore, only the removal of the plug from the recess 10 in which it has been riding throughout the assembling, the measuring of the cord into the desired length, severing it and testing it to determine that the electrical contact is good. The removal of the plug from recess 10 may be manually performed, simply by picking it out of its recess by means of the upwardly projecting contact prongs and pulling it far enough to draw out the required amount of cord. However, this operation may be automatically performed as will be hereinafter described.

After the plug has been thus removed, head 9

again rotates another, and the final, ⅙th revolution to its last position where the cord is severed and the plug tested for electrical contact. The severing of the cord is accomplished by means of shears 143, one blade 144 of which is rigidly mounted upon bracket 145 attached to center-plate 42. The other blade 146 is pivoted on bracket 145 and is connected to an eccentric 147 on shaft 20 through a crank 148 and arm 149. Shears 143 are so positioned with respect to head 9, and the eccentric 147 is so mounted on shaft 20, that the shears will be open when head 9 performs its final fractional rotation and the cord will be received between the blades of the shears when head 9 comes to rest, as shown in Figs. 41 and 42. When shaft 20 is again rotated eccentric 147 will operate to close the shears, severing the cord.

Shears 143 are positioned a sufficient distance above head 9, as shown in Fig. 44, that when the cord is severed the end remaining in cavity 10 is of the proper length for assembly to the next plug body received by that cavity when head 9 is rotated to bring that particular cavity into the first assembly position again.

Substantially concurrently with the severing of the cord it is short-circuited just above the point of severance, for the purpose of testing the electrical connections within the plug, as will hereinafter be described. This short-circuiting is accomplished by means of the device shown in Figs. 44 and 45, which consists of two insulating piercing arms 180 and 180ª, one of which is attached to shaft 181 of crank 148 and the other of which is pivoted upon bracket 145. A gear 182 is also attached to shaft 181 and meshes with a similar gear 183 mounted upon the pivot of arm 180ª and attached to that arm. When shaft 181 is rotated by crank 148 through the action of eccentric 147, arms 180 and 180ª will approach or recede from one another. The forward edge of each of these arms is provided with a sharp or serrated edge similar to that of the contact element of the plug, and they are so shaped that when crank 148 moves to close shears 143 the two sharp edges will be brought sufficiently close together to pierce the insulation of the insulated wire and make contact with both of the wires within, as shown in Fig. 45, thus short-circuiting the cord at that point.

By suitably positioning gear 182 upon shaft 148 and correspondingly adjusting the intermeshed gear 183 this can be made to occur just an instant before the wire is severed by shears 143 and by the same mechanism that operates the shears. That is to say, both the short-circuiting of the cord and the cutting of it is performed through crank 148 under the guidance of eccentric 147. The rest of the operation for testing the electrical connections within the plug will be described hereafter.

In view of these last operations and the several others performed upon the cord itself, it is desirable to insure its retention in tube 18ª in unchanging position throughout the entire assembly operation. This is provided for by six latches, one of which is shown at 160 in Fig. 24ª swingably mounted upon head 9 so as to be able to enter a slot in each tube 18ª sufficiently to press firmly against the wire within and thus lock it in position. Normally, each latch 160 is in locking position, this being insured by a spring 162. But after each plug is completely assembled, and while the cord is being drawn out to its required length before severance it must be freed so that it will readily pass through tube 18ª. This is effected by a cam 163 (Fig. 24ª) fixed to the center-plate 42 and so positioned and shaped that it will pick up the end of latch 160, swing it inwardly out of engagement with the cord and hold it out of engagement for the required time. When the cord is automatically measured the drawing out occurs during the fractional rotation of head 9, which brings the cavity 10 bearing the plug into the position at which the cord is severed.

Therefore, cam 163 should be so shaped as to disengage latch 160 as soon as head 9 starts to rotate and to keep it disengaged until just before rotation terminates. A cam, such as that shown, having an abrupt rise 164 at the initial end and an extended high portion 164ª concentric with head 9, will be found satisfactory. It will be understood, of course, that the particular shape and dimensions of this cam as of many other parts will be made to conform to requirements.

As already stated, the cord with the plug attached may be drawn out manually to the required length before it is severed. This manual operation should be effected simply by grasping the plug with the hand when head 9 has reached position E of Fig. 1 and pulling the cord out the required length. However, this step may be performed mechanically by the following mechanism, which also includes the remainder of the mechanism for testing the electrical connections not heretofore described.

Assuming a plug body completely assembled has reached Position E of Fig. 1 ready for removal from its cavity 10, directly above the cavity in this position is a plug removing device 165 (Fig. 47) operated by reciprocating carriage 46. This consists of a body 166 of hard fibre or other non-conducting material mounted upon the lower end of a stem 167, the other end of which is attached to an arm of carriage 46. Pivotally mounted upon body 166 as at 168 and 196 are two arms 170, the lower ends of which are adapted to grip the edges of the plug body. For this purpose the lower end of each arm is provided with a notch 171.

Normally arms 170 are urged towards each other by a spring 172. Below notch 171 each arm 170 terminates in a beveled edge 173 so that when the ends of the arms strike the plug body they will swing outwardly until notches 171 snap over the edge. This occurs at the lower end of the downward stroke of stem 167. The upward stroke of stem 167, therefore, carries the assembled plug with it, removing it from cavity 10 and holding it while head 9 rotates again to the position at which the cord is severed (Position F of Fig. 1). As the cord is severed the plug is released from arms 170 by the following means:— The upper ends 175 and 176 of arms 170 are bent inwardly so that one lies directly below the other. Between them and attached to one of them, say arm 175, is a small block of insulating material 177. Thus the insulation between the two arms is maintained. Directly above arm 175 on head 166 is mounted a cam lever 178 provided with an upwardly projecting arm 179. Cam lever 178 is so pivoted as at 184 that if arm 179 is rocked to the left the cam will depress ends 175 and 176 of arms 170 to cause their lower ends to separate and release the plug. This action of cam lever 178 may be accomplished by any suitable means, such as a finger 185 mounted upon link 149 and shaped so as to rock arm 179 when link 149 moves outwardly to operate the cutting shears.

While the plug is held in raised position by the removing device 165 heretofore described, head 9 will be rotating to the cord cutting position. During this rotation, as already stated, the cord will be drawn out to the required length, six feet, for example.

It is necessary, therefore, that the plug be securely held during this period and to assist removing device 165. In doing this an auxiliary support is provided. This consists of an upwardly extending arm 186 pivoted in any suitable way on pedestal 14. The upper end of arm 186 terminates in an arcuate section 187 suitably shaped and positioned to partially surround the plug body when held by the removing device 165 in raised position. Arm 186 is normally maintained in this position by a spring 188. However, to permit the plug to pass the end of the arcuate section 187 just prior to its engagement therewith, a means is provided to swing arm 186 outwardly at that time. This is accomplished by any suitable device, such as a cam 189, on the edge of head 9 suitably shaped and positioned to accomplish the above purpose. There will, of course, be six of such cams, one for each cavity 10.

To draw out the cord mechanically into the desired length, I show an endless chain or belt 190 carried by two sprockets or pulleys 191 and 192, one of which (191 for example) is driven from any part of the machine which is driven from shaft 20 by any suitable arrangement of shafts and gears (not shown). Sprockets 191 and 192 are mounted upon a suitable bracket 193 attached to the pedestal 14 of the machine. Chain 190 is provided with two equally spaced hooks 194 and is so positioned that when a hook 194 arrives in the vicinity of sprocket 191 it will engage with the electrical cord, as shown in Fig. 48.

Thereafter as soon as the plug is firmly held by the removing device 165 and auxiliary support 187, further travel of hook 194 upon its chain 190 will pull the cord through tube 18^a until hook 194 reaches the other end of its travel at sprocket 192. The distance between sprockets 191 and 192 will be determined, of course, by the desired length of the cord which will be approximately twice that distance.

Since, by this device, as shown in Figs. 50 and 51, the cord is pulled in a direction substantially at right angles to the tube 18^a, a rail somewhat above head 9 is provided over which the cord passes, as shown in Fig. 48, and whereby most of the friction is eliminated. Part of this rail is attached to pivot support 186, as shown at 195 (Figs. 47, 48 and 49) and rocks with that support. The remainder of the rail 195^a may be rigidly mounted upon any suitable part of pedestal 14, as shown in Fig. 49. The two parts of the rail interlock to form an unbroken unit when plug support 187 is in plug supporting position and together form an arcuate guide for the cord extending substantially from the rest position of head 9, at which the plug is removed from cavity 10, i. e., positions E and F of Fig. 1, to the rest position immediately following this at which the cord is severed. By this means the cord may be drawn out through tube 18^a without undue friction while head 9, carrying tube 18^a with it, rotates from one position to another, as shown in Figs. 52 and 53, and without delaying the other assembling operations.

The speed of chain 190 is so adjusted that hook 194 will travel from the position at which it picks up the cord to its other extreme position while head 9 is performing this fractional rotation. Consequently, when cavity 10 has reached the position at which the electrical connections are tested and the cord is severed, the cord has been drawn out to its proper length which has been assumed to be six feet. Since chain 10 is driven from shaft 20, it will move and stop in synchronism therewith, thus insuring that hooks 194 will be properly positioned to perform their functions at all times.

The manner in which the cord is short-circuited adjacent the severing point has been described. However, the means for testing the electrical connections in the plug at this time has not. Arms 170 are not only mounted upon a block of insulating material 166, but are insulated from each other at their upper ends by another insulating block 177, as already described. Each of arms 170 makes contact with one of the contact prongs of the plug by means of contacts 197 and 198, and is in a suitable electric circuit, which may be provided with some sort of signalling device, so that when the cord is short-circuited adjacent the cutting point, as already described, a current will pass through the circuit and the cord to operate the indicator, thus showing that the electrical connections within the plug have been made. If no signal results, faulty connections are indicated.

A suitable circuit for the above purpose is diagrammatically shown in Fig. 50. It consists of wires 195 and 196 connected to a suitable source or power, such as line wires 199, and running to the arms 170 and contact elements 197 and 198 of removing device 165. In the circuit may be any desired indicator such as light 200, or bell 201. Also, in the circuit of one of the wires (wire 195 of Fig. 50) is the coil of a solenoid 202, the purpose of which will be hereinafter described.

As soon as removing device 165 picks up the plug in cavity 10, contact is made with the respective prongs of the plug by contact elements 197 and 198, completing the circuit at that end, provided the electrical connections have been successfully made within the plug during assembly. Therefore, when the cord is short-circuited adjacent the point of severance as already described, the circuit will be closed and a signal will be given. These signalling devices, however, are not essential, since imperfect electric connections may be indicated by the stopping of the machine.

Heretofore it has been assumed that the machine, after it comes to rest at each of the six positions of head 9, is started again by operation of foot pedal 30 (Fig. 2). It is perfectly feasible and desirable to make the machine completely automatic and of continuous operation. To this end I make use of the electrical circuit already described, in one wire (195) of which is included a solenoid winding 202 as already stated.

Solenoid 202 is provided with a plunger 203, one end of which is capable of reciprocating within the solenoid in the well known manner, and the other end of which is pivotally connected to clutch operating lever 33, as shown in Fig. 2. When the end of lever 33 rests within the depression 35 of cam 34, as already described, plunger 37 is in its most extended position. This is the situation when the clutch is disengaged and the machine is at rest, as will be understood from the previous explanation. When the cord is short-circuited, if the electrical connections within the plug have been satisfactorily made and there is no need of stopping the machine, a current will pass through the electrical circuit en-

ergizing the solenoid which will attract plunger 203, drawing it into the coil. This will prevent lever 33 from entering depression 35 of cam 34 and will also maintain the clutch in engagement. The electrical impulse is only of short duration, but it will be found sufficient to permit cam 34 to rotate enough so that when lever 33 is released by the solenoid it will swing against the high part of cam 34 and will not enter depression 35 until the cam has made a complete revolution. If desired, a simple dash-pot of any well known construction may be applied to plunger 203 to retard its movement when the solenoid is deenergized.

In this way the machine will be automatically maintained in operation unless some defect in the electrical connections within the plug has occurred. In that case there will be no current through the circuit when the cord is short-circuited, solenoid 202 will remain unenergized, lever 33 will enter depression 35 of cam 34, the clutch will be disengaged and the machine will stop and remain idle until the operator has removed the defective plug and started it again by depressing pedal 30 as heretofore described.

Assuming that the electrical connections have been satisfactorily made and the cord severed and the plug released from removing device 165, the plug and cord will hang upon a hook 194, as shown in Fig. 51, until the hook reaches the end of its journey, where the cord and plug are discharged into a suitable receptacle or conveyor. One means of accomplishing this (shown in Figs. 51 and 52) is to mount the hooks 194 swingably upon chain 190 and to maintain them in their normal position by means of springs 205 connected to short arms 206a on hooks 194 and to chain 190. Each of the hooks is also provided with a lip 206 which will prevent the cord from slipping up on the shank of the hook. Each hook is also provided with a downwardly depending finger 207, which is adapted to engage with a tipping device 208 positioned at the point at which the cord and plug are to be discharged. When the hook reaches this point as indicated in Fig. 51, finger 207 strikes tipping device 208 causing the end of the hook to swing downward, whereupon the cord and plug will slip off into a suitable receiver or conveyor diagrammatically shown at 209.

The foregoing description has followed the assembly of a single plug positioned in a single recess 10 of head 9. It will be understood that, ordinarily, six plugs will be in course of assembly simultaneously in this machine, one in each of the cavities 10. At each rest position of head 9 a plug is completed and a new one begun, and four other plugs undergo one or the other of the intermediate assembly operations. This requires the presence of six separate spools of electric cord so that one can be fed to each cavity 10 through each tube 18a. For this purpose a frame 150 is attached to rotating table 16 so that it will rotate therewith and with head 9. Upon frame 150 six spools of electric cord 151 are mounted upon suitable axles so that they can revolve freely as cord is fed from them to each of the cavities 10.

It will be understood that the specific description of the machine heretofore given is solely for the purpose of explaining the nature of my invention and that the invention is not limited in any way thereby, but is susceptible to many modifications in detail without departing from the scope of my invention.

What I claim as new and useful and desire to secure by United States Letters Patent is:

1. A machine for assembling an electric cord and plug elements comprising a holder for the plug body, means for feeding an electric cord to the holder, means for connecting the wires of the cord to the contact elements of the plug, and means for inserting the contact elements into the plug body.

2. A machine for assembling an electric cord and plug elements comprising a holder for the plug body, means for feeding an electric cord to the holder, means for connecting the wires of the cord to the contact elements of the plug, and means for inserting a retaining disk into the plug body to positively retain the contact elements therein.

3. A machine for assembling an electric cord and plug elements comprising a holder for the plug body, means for seating a plug body in said holder in assembling position, means for feeding an electric cord to said body, means for connecting the wires of the cord to contact elements and seating the elements into recesses in the body, and means for inserting a retaining disk into the body to positively retain the contact elements therein.

4. A machine for assembling an electric cord and plug elements, comprising a base, a holder for the plug body rotatable thereon, means for intermittently rotating said holder to a multiplicity of assembling positions, a shaft for operating said rotating means, a magazine for plug bodies positioned above the holder in one assembling position, means operated from said shaft for releasing plug bodies from the magazine one at a time, means for conveying the released plug body from the magazine to the holder and seating it therein, said conveying means being carried by a reciprocating carriage, a pitman for reciprocating the carriage, and means for rotating said shaft and reciprocating said pitman.

5. A machine for assembling electric plug elements, comprising a rotatable carrier provided with a cavity for the reception of a plug body, a rotatable shaft, means on said shaft and said carrier for rotating said carrier a fraction of a revolution during a fraction of the time in which the shaft makes a complete revolution, a reciprocable pitman, means for reciprocating said pitman during that part of the rotation of the shaft when the carrier is stationary, and means for rotating said shaft and operating said reciprocating means.

6. A machine for assembling plug elements which includes a rotatable head provided with a multiplicity of cavities each for the reception of a plug body, means for intermittently rotating said head to bring each of said cavities successively into each of several assembling positions, means, for inserting contact elements into said plug body in one assembling position of said head, means for inserting a retaining disk in said body in another assembling position of said head, both of said inserting means being carried by a reciprocable carriage, and means for reciprocating said carriage when said head is at rest.

7. A machine for assembling plug elements comprising a rotatable head provided with a multiplicity of cavities each for the reception of a plug body, means for intermittently rotating said head, a reciprocable carriage positioned above said head, means on said carriage for inserting contact elements and a retaining disk into the

plug body, and means for operating said reciprocable carriage when said head is at rest.

8. The method of assembling an electric cord and plug elements which consists of passing the end of an electric cord through the central aperture of the plug body, longitudinally slitting the covering of the cord to expose the insulated wires therein, making electrical connection between each of the wires and a contact element and simultaneously positioning the contact elements in the plug body, closing said body against removal of said contact elements, and severing said cord.

9. The method of assembling an electric cord and plug elements which consists of passing the end of an electric cord through the central aperture of the plug body, longitudinally slitting the covering of the cord to expose the insulated wires therein, making electrical connection between each of the wires and a contact element without removing the insulation from the wires and simultaneously positioning the contact elements in the plug body, closing said body against removal of said contact elements, and severing said cord.

10. A machine for assembling an electric cord and plug elements comprising a holder for a plug body, means for moving said holder to bring the plug body into several successive assembling positions, means at one of said assembling positions for connecting an electric cord to contact elements and inserting the elements into the plug body, means at another assembling position for inserting a retaining disk into said plug body, all of said means at said assembling positions operating in timed relation to each other and to the movements of said holder.

11. A machine for assembling an electric cord and plug elements comprising a holder for a plug body during assembly, means for attaching an electric cord to contact elements and inserting them into the plug body, means for measuring a predetermined length of the cord attached to the plug, said measuring means consisting of an endless belt provided with hooks adapted to engage said cord adjacent said plug and to draw it out a predetermined distance, and means to operate said belt in timed relation to the operation of said inserting and attaching means.

12. A machine for assembling an electric cord and plug elements comprising a holder for a plug body during assembly, means for attaching an electric cord to contact elements and for inserting said elements into the plug body, means for measuring a predetermined length of cord so attached to the plug, means for connecting each contact element to different conductors, means for supplying electricity to both conductors, means for short-circuiting the electric cord at the measured length from said plug, and means for indicating the passage of current through said contacts and said cord, all of said means operating in timed relation to each other.

13. A machine for assembling an electric cord and plug elements comprising a holder for a plug body during assembly, means for connecting an electric cord to contact elements and inserting the elements into the plug body, means for measuring a predetermined length of cord, means for severing said cord at said predetermined length from said plug, and means for operating all of said means in timed relation to each other, a source of power for said operating means connected thereto by a clutch, and means for automatically disengaging said clutch in case of failure of said connecting means to establish electrical contact between said cord and said contact elements.

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