

[54] **METHOD AND APPARATUS FOR MOUNTING A SLEEVE ON A COMBINED FERRULE AND ELECTRICAL CONDUCTOR**

[76] Inventor: **William H. Cramer**, 1598 N.E. 104th St., Miami Shores, Fla. 33153

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[51] Int. Cl. .... **B23p 19/02**

[58] Field of Search ..... **29/235, 450**

[56] **References Cited**

**UNITED STATES PATENTS**

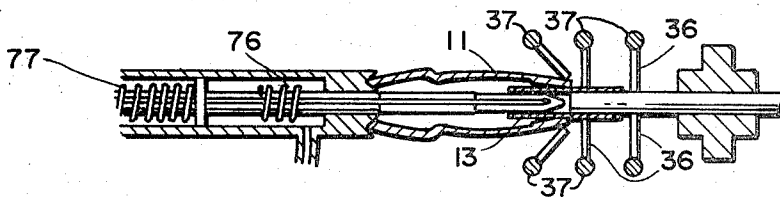
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Primary Examiner—Richard J. Herbst  
Attorney, Agent, or Firm—Salvatore G. Militana

[57] **ABSTRACT**

A method and apparatus for mounting a pliable molded sleeve on a combined ferrule and electrical conductor forming an ignition wire for internal combustion engines having a feeding device for depositing a sleeve in a cradle in alignment with a spindle which impales the sleeve. The spindle is provided with a shoulder that pushes the sleeve toward a conductor on the end of which a ferrule has been mounted. The combined conductor and ferrule are held by a plurality of pairs of swinging gates. As the spindle impales the ferrule, compressed air is directed to pass through the sleeve causing it to expand and slide over the ferrule. As the sleeve engages each of the pairs of swinging gates, the gates swing out of the path of the sleeve to permit the sleeve to be properly fitted over the combined conductor and ferrule.

**5 Claims, 18 Drawing Figures**



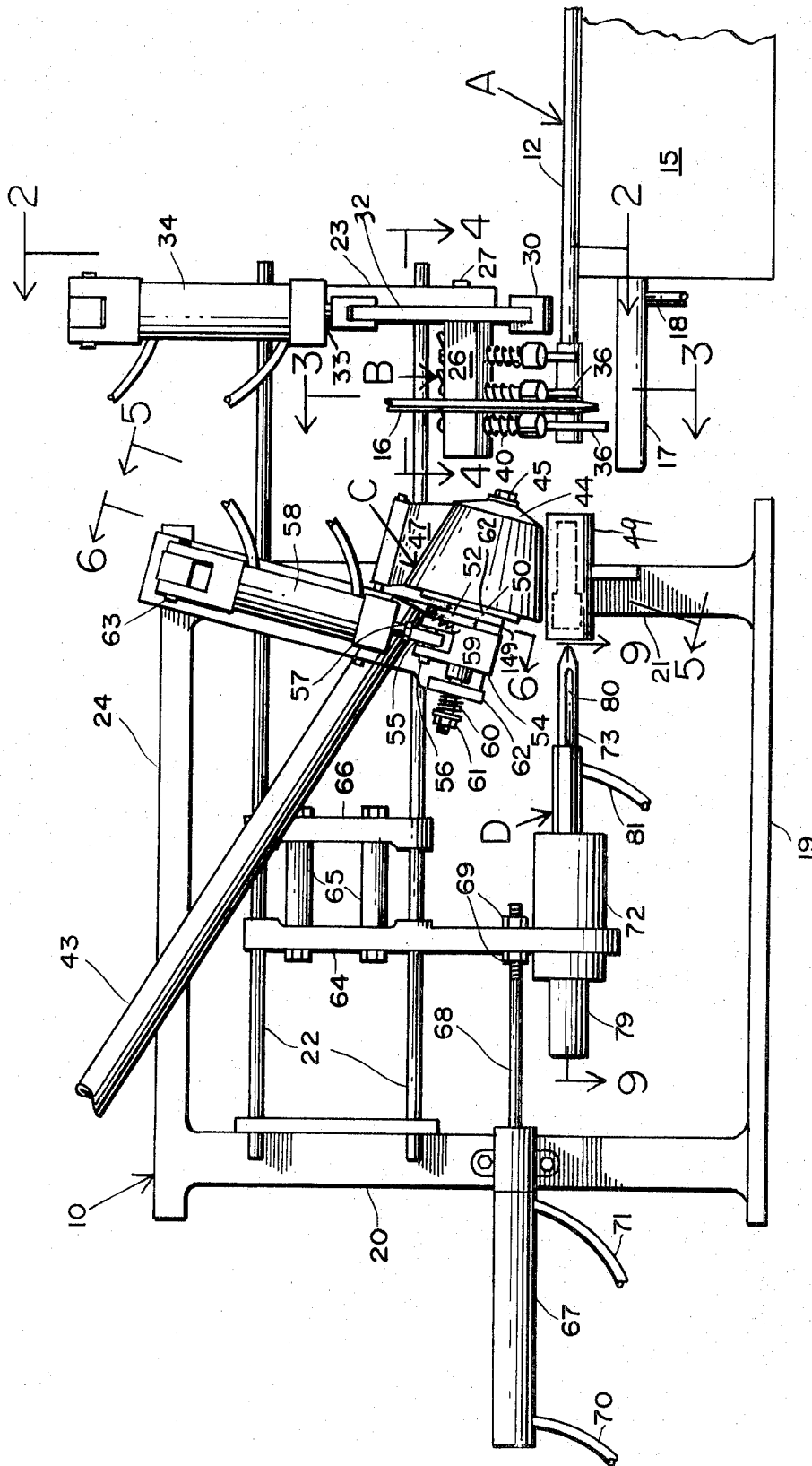
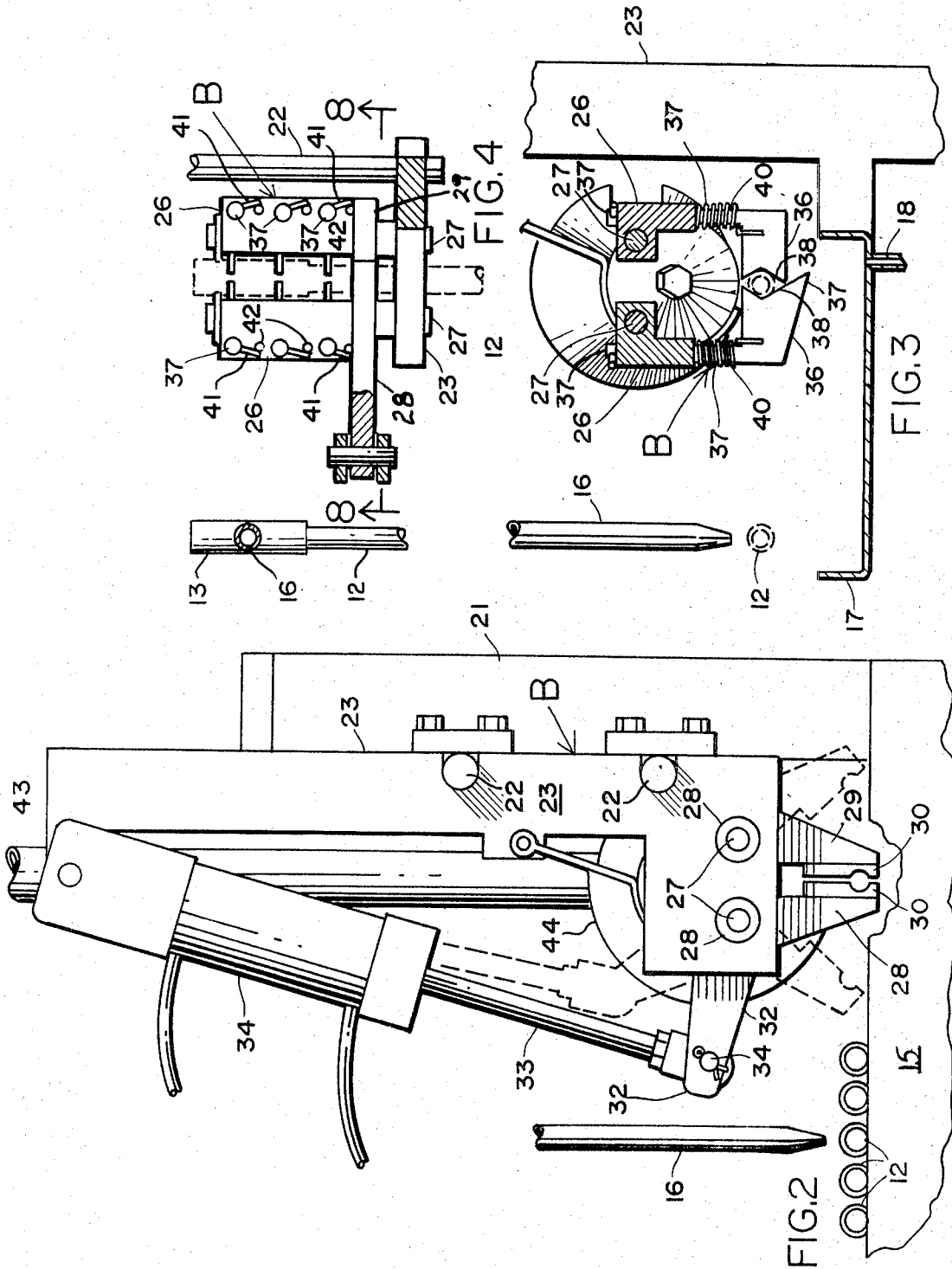


FIG. 1



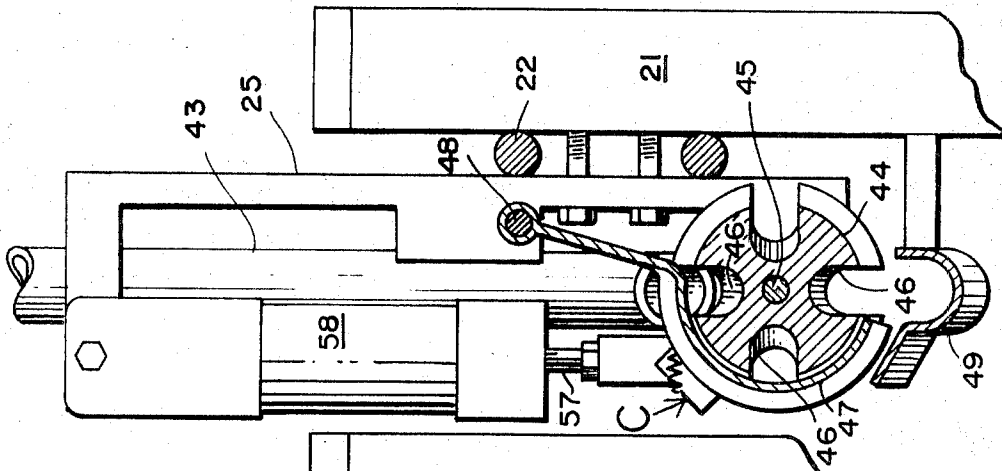


FIG. 5

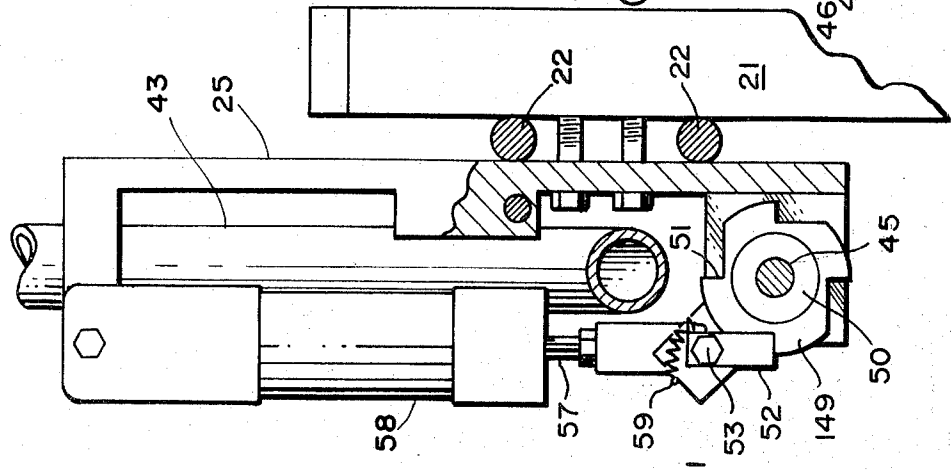


FIG. 6

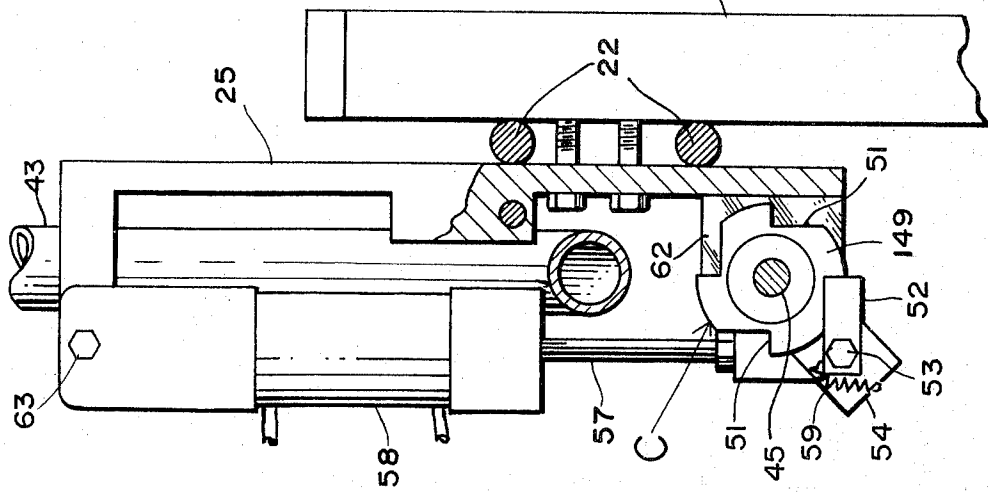
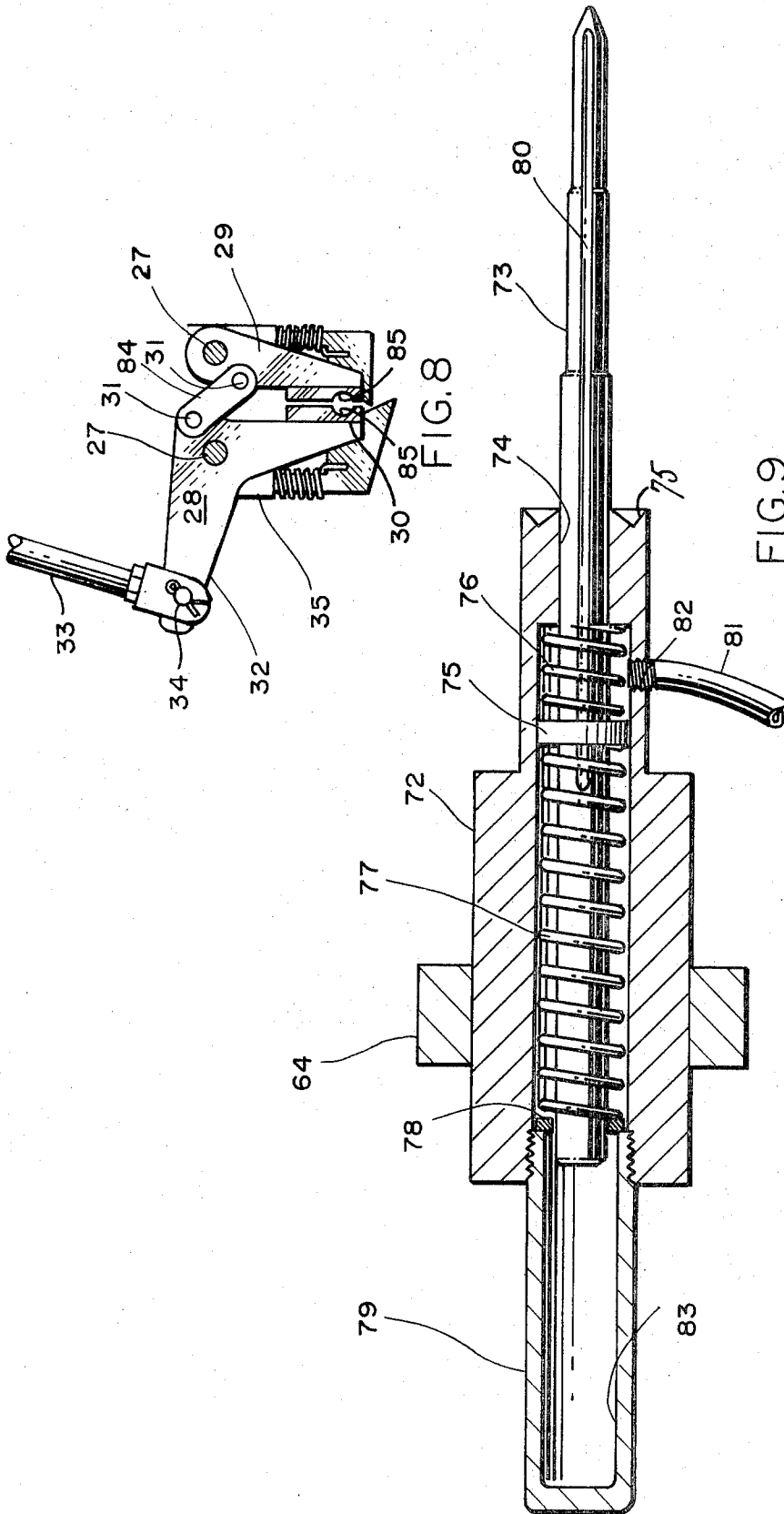
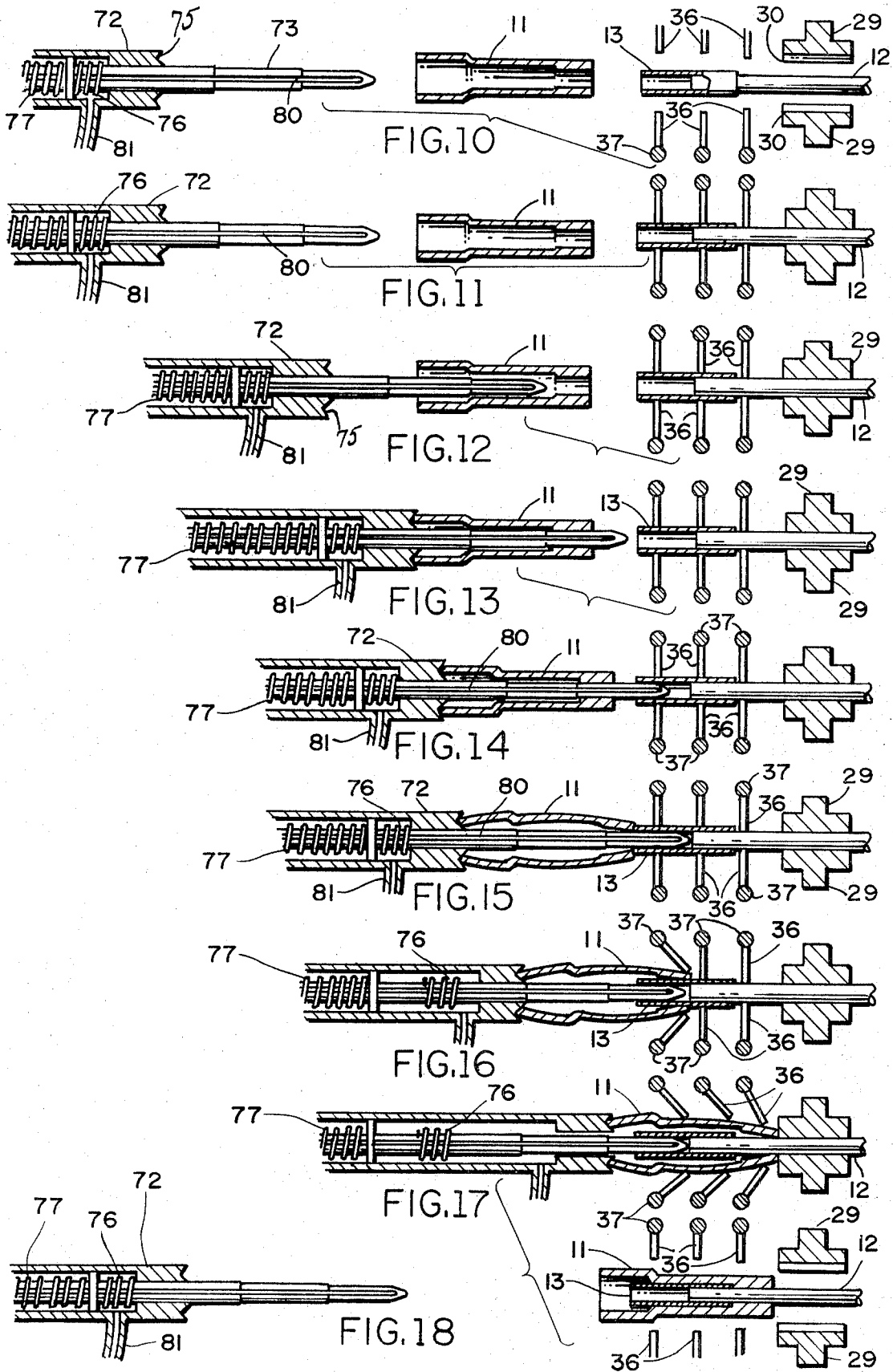


FIG. 7





# METHOD AND APPARATUS FOR MOUNTING A SLEEVE ON A COMBINED FERRULE AND ELECTRICAL CONDUCTOR

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

This invention is particularly directed to the method and apparatus for mounting a molded sleeve on an insulated conductor that has a metal ferrule attached thereto.

### 2. Description of the Prior Art

The present automatic machines for mounting a molded sleeve on an ignition wire for automobiles have a weakness that prevents the continuous operation thereof without having to stop because of malfunctioning. All of these machines utilize a clamp or gripping apparatus for maintaining the combined conductor and ferrule secured against movement and in alignment with the sleeve carrying spindle. However, at the moment the sleeve has begun to slide over the end of the ferrule, the clamp or gripping apparatus releases itself from the combined conductor and ferrule. Since the conductor is extremely pliable, and the molded sleeve can only be expanded by air pressure very slightly, upon sliding over the ferrule, the conductor, now lying loosely, will buckle and prevent the sleeve from being slid properly in place completely covering the ferrule and partially over the insulated conductor. This results in a malfunctioning of the machine and the producing of non-acceptable ignition wires. The present device contemplates avoiding the above indicated malfunctioning of the apparatus in the production of ignition wires by providing a gate-type clamping or gripping device which grips and holds the ferrule and conductor at all times during the complete cycle of operation during the mounting of the sleeve on the combined conductor and ferrule and also during the withdrawal of the spindle from the ferrule.

## SUMMARY OF THE INVENTION

Therefore, a principle object of the present invention is to provide a method and apparatus for mounting a sleeve on a combined conductor and ferrule in the manufacture of an ignition wire for automotive vehicles wherein the molded sleeves are placed in a proper fashion on the ferrule and conductor by the use of swinging gate devices for gripping the ferrule and conductor as the sleeve is slid into place thereon.

Another object of the present invention is to provide a gripping device for holding the combined conductor and ferrule as the molded sleeve is slid in place thereover and also holds the sleeve in place while the spindle is being withdrawn during the cycle of operation.

A further object of the present invention is to provide a method and apparatus for the production of ignition wire by gripping a combined conductor and ferrule in alignment with a spindle which has impaled a molded sleeve to slide it in position over the combined ferrule and conductor without causing the combined conductor and ferrule from being released.

A still further object of the present invention is to provide a plurality of pairs of swinging gates mounted on a clamping device which grip a combined conductor and ferrule in the production of ignition wires and upon the sliding of a molded sleeve thereover, each pair of gate will swing away from the ferrule and conductor

and engage the sleeve so that at all times the combined conductor and ferrule is held in its proper position at all times during the complete cycle of operation of the apparatus.

With these and other objects in view, the invention will be best understood from a consideration of the following detailed description taken in connection with the accompanying drawings forming a part of this specification, with the understanding, however, that the invention is not confined to any strict conformity with the showing of the drawings but may be changed or modified so long as such changes or modifications mark no material departure from the salient features of the invention as expressed in the appended claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a side elevational view of my apparatus for mounting a molded sleeve over a metal ferrule secured to the end portion of an electrical conductor.

FIGS. 2, 3, 4, 5 and 6 are cross sectional views taken along the lines 2—2, 3—3 4—4, 5—5 and 6—6 respectively of FIG. 1.

FIG. 7 is a view similar to FIG. 6 showing the manner of positioning the molded sleeves in place prior to being impaled onto the conductor.

FIG. 8 is a cross sectional view taken along the line 8—8 of FIG. 4.

FIG. 9 is a cross sectional view taken along the line 9—9 of FIG. 1.

FIGS. 10—18 inclusive are diagrammatic views of the operating mechanism showing the position of various elements in the sequential steps of mounting the sleeve on the combined ferrule and electrical conductor.

Referring to the drawings wherein like numerals are used to designate similar parts throughout the several views, the number 10 refers to my apparatus for mounting a sleeve 11 on an electrical conductor 12 to the end of which a metal ferrule 13 had been previously affixed to produce an ignition wire for use in an automobile engine. My apparatus 10 consists of various sections A, B, C and D, each producing a distinct and different function indicated as follows: Section A feeds the combined conductor 12 and ferrule 13 to the apparatus 10. Section B grips the ferrule 13 and the conductor 12 during the mounting of the sleeve 11 by the apparatus 10. Section C delivers the sleeves 11 in proper position to be mounted over the end of the conductor 12 to completely enshroud the metal ferrule 13 and section D causes the sleeves 11 to be slid into position on the conductor 12.

Section A as shown by FIG. 1 is nothing more than a feeder and support for the combined electrical conductors 12 and ferrules 13 consisting of a table 15 on which a row of combined conductors 12 and ferrules 13 is positioned with the conductor 12 being engaged by the gripping mechanism B as is explained in detail hereinafter. The feeding of the combined conductor 12 and ferrule 13 may be done manually or automatically as by a conveyor, this structure forming no part of the present invention. As the combined conductors 12 and ferrules 13 move along the support 15, the ferrule portion 13 passes directly below a pipe 16 that discharges a lubricant onto the metal ferrules 13, the excess lubricant being collected in a pan 17 mounted below the pipe 16 and pumped back to the discharge pipe 16 by way of a return pipe 18. (shown only in part).

The various elements of my apparatus 10 are supported by a frame consisting of a base plate 19 on which posts 20 and 21 are mounted in spaced relation to each other joined at their top portion by an elongated frame member 24. Secured to the posts 20 and 21 are horizontally disposed rods 22 that extend beyond the post 21 to support an L-shaped post 23 of the gripping mechanism B whose function is to hold the combined conductor and ferrule 12, 13 at the position of and adjacent to the ferrule 13 as the sleeve 11 is slid thereon.

This holding function is accomplished by a pair of oppositely positioned jaw members 30 and a plurality of pairs of oppositely positioned swinging gates 36, all of which are so mounted as to swing to and away from each other simultaneously about rods or pivot pins 27. Pivot pins 27 are pivotally supported and mounted in openings formed in the L-shaped post 23. The pivot pins 27 are received through bores in jaw and gate support members 26 and in a pair of cranks 28 and 29 which are fastened to the support members 26 for simultaneous pivotal movement therewith. The cranks 28 and 29 also pivot simultaneously by virtue of a link 84 being pivotally connected to the cranks 28 and 29 as at 31. The lower ends of the cranks 28 and 29 are provided with the conductor engaging members 30 that have semi-circular grooves 85 opposite each other to engage the conductor 12 when the cranks 28 and 29 are brought together. The arm 32 of the crank 28 is connected as at 34 to the end of a piston rod 33 which extends to a cylinder 34 and connected to a piston (not shown) within the cylinder 34. Hoses permit air under pressure to flow into and out of the cylinder 34 on either side of the piston to compel the cranks 28 and 29 to swing towards and away from each other when the conductor 12 is being gripped and released respectively.

Each of the support members 26 are provided with a plurality of vertically disposed bores through which spindles 37 extend and on the lower end of which are mounted the gates 36. The gates 36 are provided with a notched portion 38 for engaging the ferrule 13. One of the gates 36 is provided with an extended tip portion 37 in order to lift to its proper position a ferrule and conductor member 13, 12 that may have sagged slightly from the horizontal because of its weight and lack of support at that portion of the conductor 12. A coil spring 40 mounted on each of the spindles 37 yieldingly urge the rotation of the spindles 37 and the swinging of the gates 36 in the direction away of the jaw members 30. A combination of a pin 41 secured to the top end of the spindle 37 and a stop member 42 mounted on the top surface of the support member 26 prevents the swinging of the gates 36 beyond a position normal (right angle) to the combined conductor 12 and ferrule 12. The gates 36 are free to swing in a direction of the jaws 30, 30 when an appropriate force is applied thereto as is explained hereinafter.

The mechanism C for feeding sleeves 11 in my apparatus 10 is supported by a support member 25 secured by bolts to the post 21 and consists of an inclined tubular member 43 in which the sleeves 11 are placed and permitted to slide to its free end which is positioned adjacent to a sleeve receiving and rotating feeder 44. The rotating feeder 44 that is mounted for rotational movement about a spindle 45, is provided with a plurality of open slots or pockets 46 shaped and sized to receive

and contain a sleeve 11 as the latter slides from the tube 43 into the particular slot 46 that is then positioned in alignment therewith. A sheath 47 which extends approximately half way around the rotating feeder 44 is secured as at 48 to the support 25 prevents the sleeves 11 from falling out of the rotating feeder 44 until the slot 46 in the rotating feeder 44 is in its lowermost position in alignment with a cradle 49. The cradle 49 is also secured to the post 21. Means for rotating the feeder 44 is provided consisting of a ratchet disc 149 rotatably mounted in the spindle 45 in frictional engagement with the feeder 44 by means of the friction shoe 50 interposed therebetween. An adjustable spring 60 mounted on the end of the spindle 45 and held in place between a nut 61 and a tab 62 secured to the support arm 25 maintain the ratchet disc 149 in tight frictional engagement with the feeder 44. The ratchet disc 149 is provided with a plurality of symmetrically disposed notches 51 that are engaged by a pawl 52 for rotating the feeder 44. The pawl 52 is pivoted as at 53 to a support member 54 which is rotatably mounted on the spindle 45. The support member 54 is bifurcated as at 55, receiving a pin 56 upon which the free end of a piston rod 57 is pivotally mounted. The piston rod 57 extends to a cylinder 58 and connected to a piston (not shown) within the cylinder 58. Hoses connected to the cylinder 58 permit fluid under pressure to flow in and out of the cylinder 58 on both sides of the piston to compel the piston rod 57 to slide in reciprocating fashion and the support member 54 to rotate carrying with it the pawl 52. A coil spring 59 is fastened at one end to the top portion of the pawl 52 and at its other end to base of the support member 54 thereby urging the pawl 52 to maintain itself in contact relation with the outer surface of the ratchet disk 149 at the position the notches 51. The free end of the cylinder 58 is pivotally secured as at 63 to the top portion of the support arm 25.

The sleeve mounting mechanism D is supported by a support bar 64 that is slidably mounted on the slide rods 22. To permit for a smooth sliding movement along the slide rods 22, the support bar 64 is joined as by spacers 65 to a second bar 66 slidably mounted on the rods 22. Movement of the support bar back and forth along the slide rods 22 is effected by a cylinder 67 that is attached to the post 20 and having the free end of a piston rod 68 secured by nuts 69 to the support bar 64. The inner end of the piston rod 68 is provided with a piston (not shown) whose movement is controlled by air under pressure passing through the hoses 70 and 71 mounted at each end of the cylinder 67. At the lowermost portion of the support bar 64 there is mounted a cylinder 72 in which a spindle 73 extends along the full length of the cylinder 72 and beyond the forward end thereof through an opening 74 in the cylinder 72. The spindle 73 is provided with an enlarged portion 75 that forms a shoulder for coil springs 76 and 77. Coil spring 76 extends between the shoulder 75 and the forward end portion of the cylinder 72 while the coil spring 77 extends between the shoulder 75 and a washer 78 at the rear end of the cylinder 72 held in position by a tubular member 79 threaded into the cylinder 72. The cylinder 72 provides a chamber 83 in which the spindle 73 slides back and forth. Along that portion of the spindle 73 forward of the shoulder portion 75 there is a plurality of longitudinally disposed grooves 80 formed thereon to permit the escape of air under pressure that enters



the cylinder 72 by way of an inlet pipe 81 connected at a threaded opening 82 in the cylinder 72.

The step by step operation of my apparatus 10 is illustrated by FIGS. 10 to 18 inclusive showing the manner in which the sleeve 11 is mounted on the combined conductor and ferrule 12, 13 from placing of the latter and the sleeve 11 in their proper positions to the final step of releasing the finished product by the gripping mechanism B.

In the above description of the various sections A, B, C, and D there has been no showing or description of the automatic interconnecting devices that permit one section to operate in timing sequence with the other sections so that the entire operation of my apparatus 10 is automatic requiring no manual operation. For example, the combined conductors and ferrules 12, 13 are shown in FIG. 2 as lying in a row on a table 15 to be fed to the jaw members 30 of the gripping mechanism B. As shown herein, this is done manually; however, applicant's model of this apparatus feeds the combined conductors and ferrules 12, 13 automatically as it removes the completed ignition wire from the jaw members 30.

In the normal operation of my apparatus 10 the chute 43 will be filled with molded sleeves 11, two of the four slots 46 in the rotary feeder 44 will contain a sleeve 11 while the bottommost slot 46 and the one adjacent to it will be void of a sleeve 11. The sleeve 11 that had previously reposed in the bottommost slot 46 will be lying in the cradle 49. As shown by FIG. 2, a row of combined conductors and ferrules 12, 13 will be found on the table 15 and as they pass below the pipe 16 receive a shot of lubricant on the ferrule portion thereof. A combined conductor and ferrule 12, 13 will be placed between the jaws 30, 30 which are open at this time to their dotted line position as shown by FIG. 2 and illustrated by FIG. 10.

At this time, air under pressure is permitted to enter the cylinder 34 through the upper pipe to cause the piston rod 32 to slide downwardly and the cranks 28 and 29 to close the jaws 30 onto a conductor 12. At the same time the gates 36 engage the ferrule 13 as shown by FIG. 11 so that the combine conductor and ferrule 12, 13 will be held firmly in alignment with the spindle 73 and sleeve 11 resting in the cradle 49.

Now, air under pressure will be permitted to pass through the pipe 70 and into the cylinder 67 to cause the piston rod 68 to slide outwardly of the cylinder 67 carrying with it the bracket 64, 65 that is made to slide on the rods 22. The cylinder 72 that is mounted on the bracket 64 likewise is made to slide to the right as seen by FIG. 1. The spindle 73 slides toward the sleeve 11, impales it as shown by FIG. 12 so that continued sliding movement of the cylinder 72 causes the shoulder 75 to engage the end portion of the sleeve 11 as shown by FIG. 13. The sleeve 11 is now made to slide out of the cradle 49 and carried toward the ferrule 13 as shown by FIG. 14 until the tip of the spindle 73 has travelled the length of the ferrule 13 and engages the end of the conductor 12 as illustrated by FIG. 15. Contemporaneously therewith, the forward or right end of the sleeve 11 will have arrived at the position of the ferrule 13 and air under pressure is permitted to enter the cylinder 72 through the inlet pipe 81. Now air under pressure will flow along the longitudinal slots 80 of the spindle 73 to expand the sleeve 11 and enlarge the opening of the sleeve 11 at the position of the ferrule 13 where

the air is escaping into the atmosphere. The bracket 64 and cylinder 72 continue to slide to the right, but since the spindle 73 has engaged the end of the conductor 12 as illustrated by FIGS. 15, the coil spring 77 begins to be compressed and the expanded sleeve 11 begins to slide over the end of the ferrule 13.

Since the beginning of this cycle of operation, the jaws 30 and gates 36 have engaged and held the combined conductor and ferrule 12, 13 firmly. As the sleeve 11 is continued to be pushed over the ferrule, the sleeve 11 engages the first pair of gates 36 causing the latter to pivot about their pivot pins 37 against the force of their respective coil springs 37 as shown by FIG. 16. Similarly, the remaining pairs of gates 36 are engaged by the sleeve 11 and made to swing out of its path. However, the coil springs 37 cause the gates 36 to remain in forceful contact with the sleeve 11 until the sleeve 11 engages the jaws 30 as shown by FIG. 17. At this time air under pressure is permitted to enter the cylinder 67 through the pipe 71 to cause the bracket 64, cylinder 72 and spindle 73 to retract or slide to the left as shown by FIG. 18. During this cycle of operation, the coil spring 77 causes the spindle 73 to slide outwardly of the cylinder 72 against the buffer spring 76 to the position shown by FIG. 18. Contemporaneously therewith air under pressure entering the pipe 81 is cut off and the sleeve 11 resuming its original shape and size to become properly fitted on the combined conductor and ferrule 12, 13 as shown by FIG. 18. Upon the spindle 73 arriving at its fully retracted position, air under pressure enters the cylinder 34 to cause the piston rod 33 to slide upwardly and the cranks 28, 29 to pivot the jaws 29, 30 to their open position to release the combined conductor and ferrule 12, 13. Simultaneously therewith, the rotating feeder 44 is made to rotate a quarter revolution by permitting air to enter the upper hose of the cylinder 58 to compel the piston rod 57 to slide downwardly carrying the pawl 52 which rotates the ratchet 149 and the feeder 44 for a quarter turn. The sleeve 11 lying in the slot 46 that now arrives at the position of the cradle 49 will drop into the cradle 49 ready for the next cycle of operation. At the same time the slot 46 that has now arrived at the top is adjacent to the outlet of the pipe 43 and will receive a sleeve 11 that slides therein by gravity. The cycle of operation now completed will repeat itself as aforesaid.

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

1. The method of mounting a resilient sleeve on a ferrule secured to the end of an electrical conductor comprising gripping said metal ferrule and said conductor at various positions along their length, placing said sleeve in substantial axial alignment with said ferrule, pushing said sleeve toward said ferrule, expanding said resilient sleeve by fluid under pressure, continued pushing of said sleeve over said ferrule and causing said individual gripping forces to swing away from said ferrule and said conductor onto said sleeve in sequence as said sleeve slides over said ferrule and said conductor and discontinuing the flow of fluid under pressure whereby said sleeve resumes its normal size to become firmly positioned on said ferrule and said conductor.

2. The method as recited by claim 1 and the impaling of said sleeve as said sleeve is pushed toward said ferrule and permitting the escape of said fluid under pres-

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sure in said sleeve at the position of the periphery of said sleeve as said sleeve enshroudes said ferrule.

3. Apparatus for mounting a resilient sleeve on a ferrule connected to the end of an electrical conductor comprising a pair of support means, means pivotally mounting said support means, gripping means for holding said ferrule, means rotatably mounting said ferrule gripping means on said pair of support means whereby said support pivot means compels the swinging of said ferrule gripping means toward and away from said ferrule and said ferrule gripping rotating means permitting the swinging of said ferrule gripping means along an axis of said ferrule, means pushing said sleeve toward and on said ferrule whereby upon the sliding of said sleeve on said ferrule said sleeve engages said ferrule gripping means and causes the latter to swing away from said ferrule.

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4. The structure as recited by claim 3 wherein said pivot means for said ferrule gripping means comprises a pair of rods rotatably mounted on said support means, a notched member for engaging said ferrule mounted at one end of each of said rods, a plurality of stop members mounted on said support means, a pin secured to the other end of each of said rods and spring means yieldingly urging said pins into engagement with said stop members when said notched members are extending in a direction toward each other.

5. The structure as recited by claim 4 wherein said sleeve pushing means comprises an elongated rod for impaling said sleeve, an enlarged portion mounted on said rod engaging said sleeve, said elongated rod having a longitudinal slot along its length permitting fluid under pressure to flow therealong into said sleeve.

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