Jan. 16, 1962 M. M. MINOBE 3,016,774

POWER OPERATED WRENCH FOR SCREW-ON-TYPE CONNECTORS

Filed March 9, 1959 4 Sheets-Sheet 1

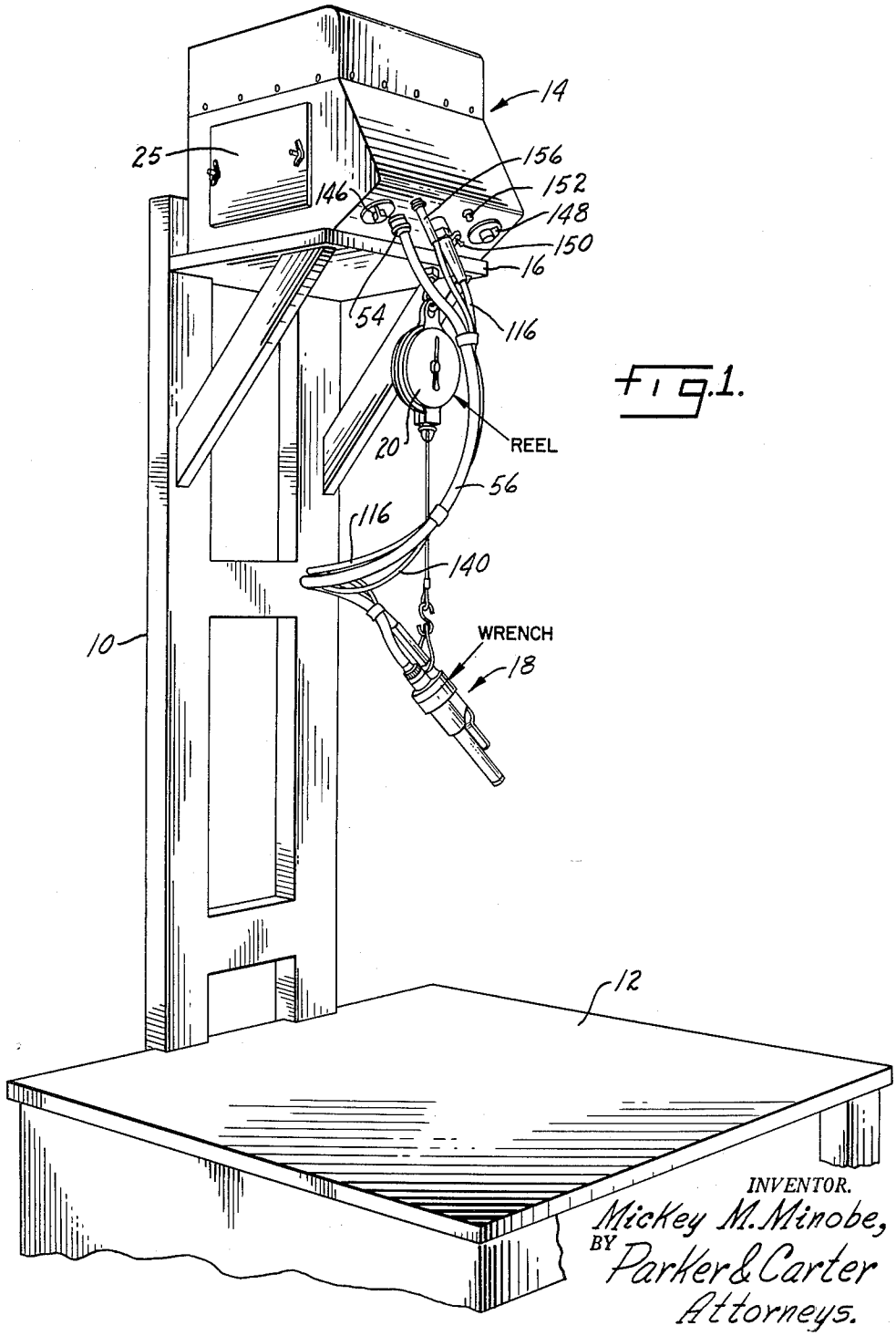


Fig. 1.

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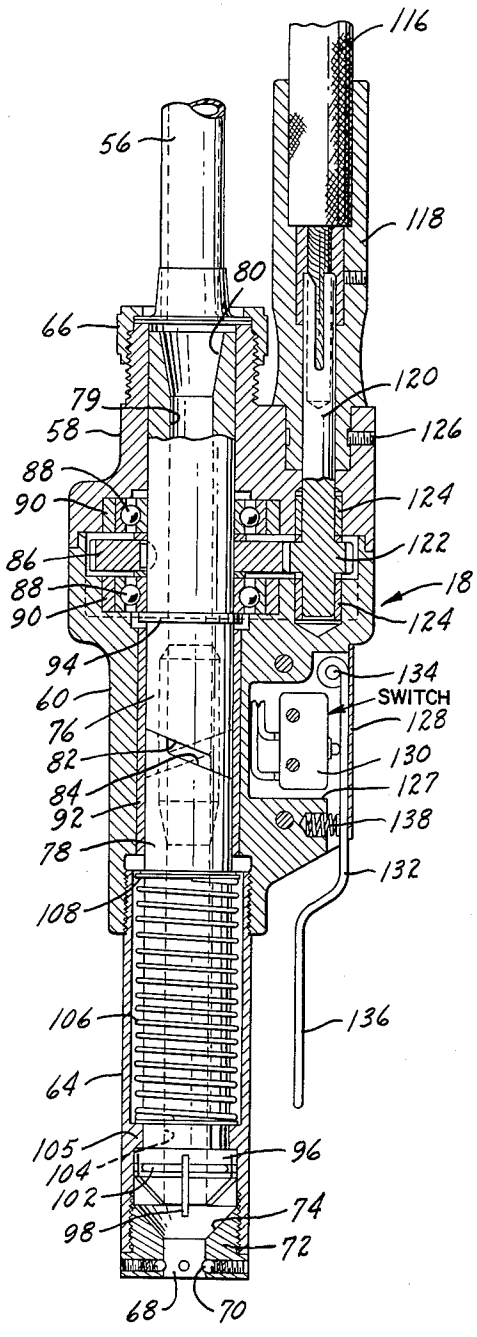


Fig. 3.

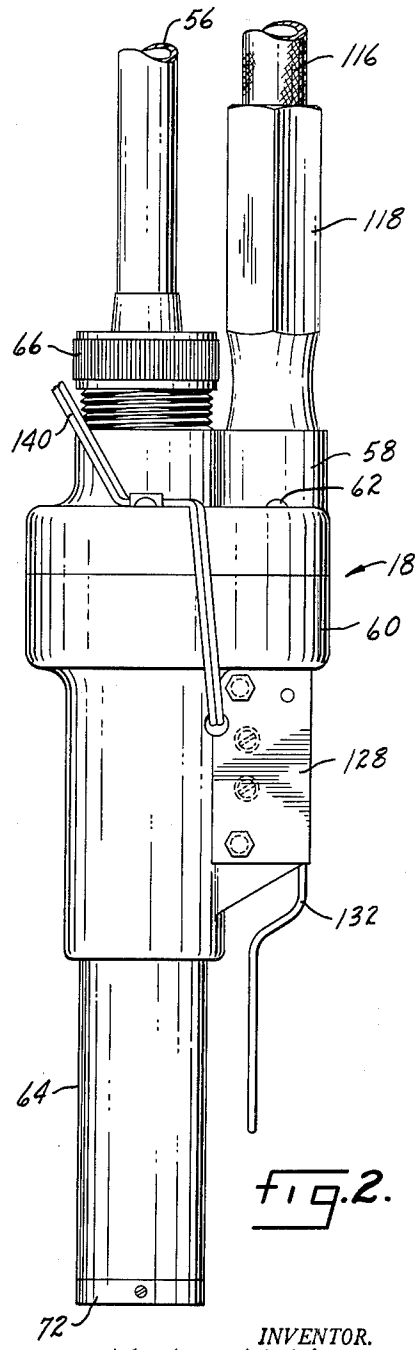


Fig. 2.

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POWER OPERATED WRENCH FOR SCREW-ON-TYPE CONNECTORS

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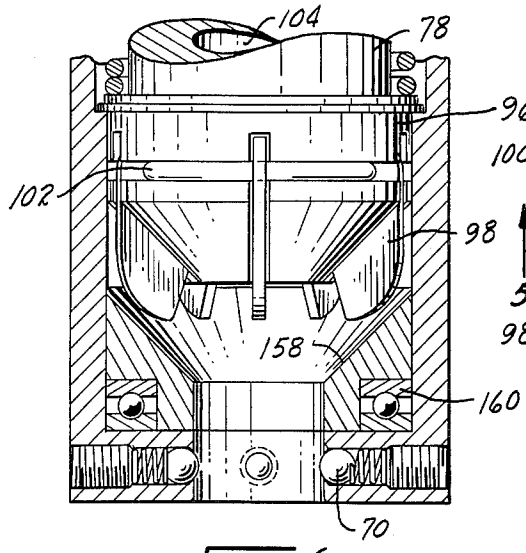


Fig. 6.

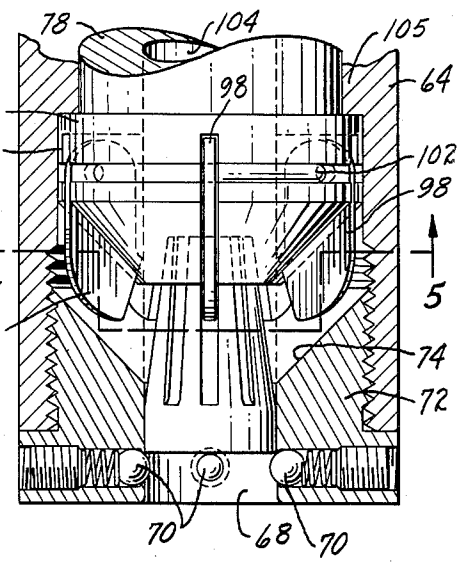


Fig. 4.

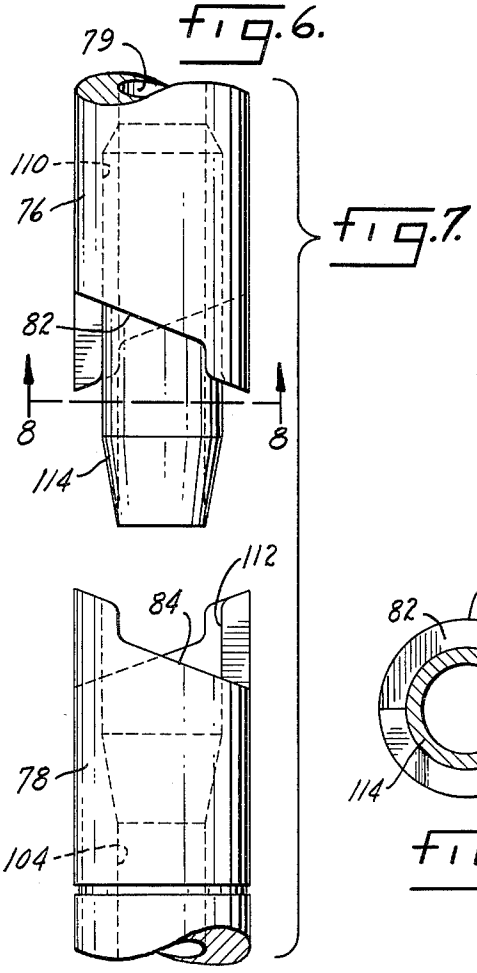


Fig. 7.

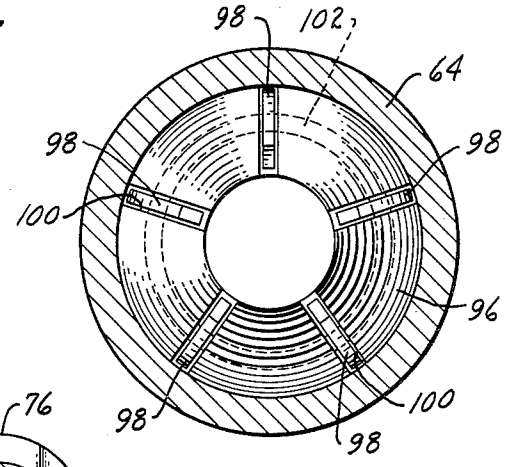


Fig. 5.

Fig. 8.

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POWER OPERATED WRENCH FOR SCREW-ON-TYPE CONNECTORS

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Fig. 9.

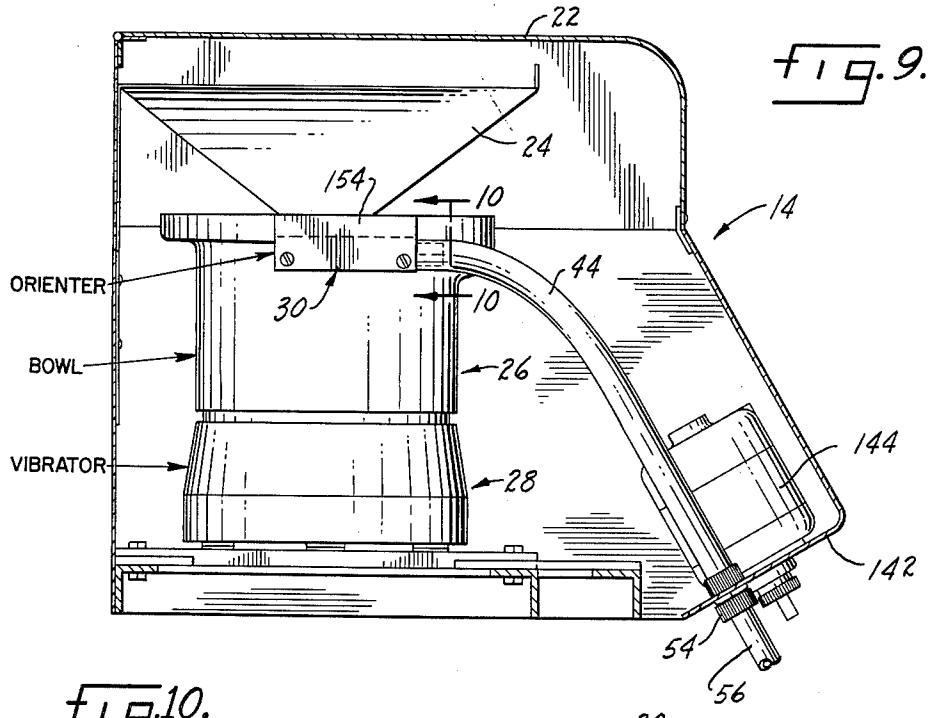
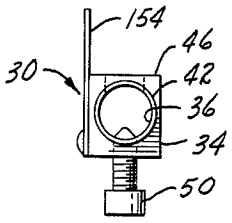


Fig. 10.



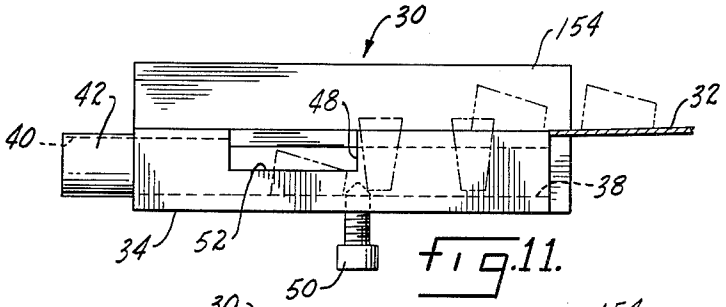
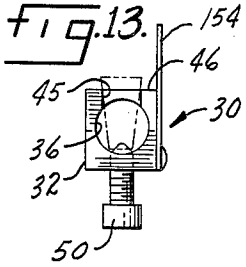


Fig. 11.

Fig. 13.



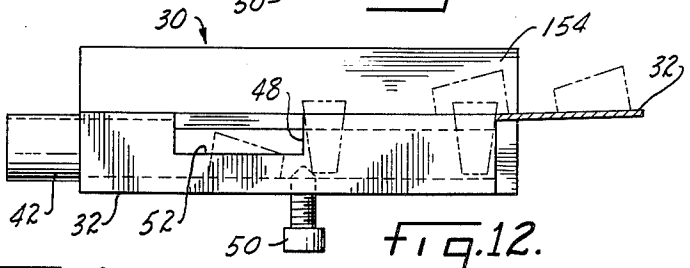
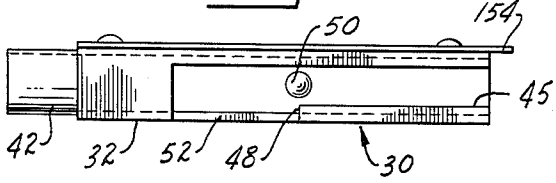


Fig. 12.

Fig. 14.



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United States Patent Office 3,016,774
Patented Jan. 16, 1962

3,016,774

POWER OPERATED WRENCH FOR SCREW-ON-TYPE CONNECTORS

Mickey M. Minobe, Sycamore, Ill., assignor to Ideal Industries, Inc., Sycamore, Ill., a corporation of Delaware

Filed Mar. 9, 1959, Ser. No. 798,286
13 Claims. (Cl. 81—54)

This invention is in the field of devices or machines for automatically or semi-automatically screwing or turning connectors of the pig-tail or screw-on type on the stripped ends of electric wires and the like. Connectors of this general type are shown in U.S. Patent No. 2,749,-384, for example.

A primary object of my invention is a new and improved automatic assembling device for pig-tail connectors in which the torque may be regulated.

Another object is a device of the above type which automatically compensates for wear.

Another object is a nut runner of the above type which does not injure or mar the connectors.

Another object is a device of the above type which is simple but reliable and requires little maintenance.

Another object is an assembling device for connectors which automatically feeds connectors from a hopper through a tube to a power wrench.

Another object is an orienting device for automatically turning all connectors in the same direction before they are fed through a tube to the driver or wrench.

Another object is an orienter of the above type which returns or recycles the connectors if the tube leading to the driver is full.

Another object is a control for a nut runner which may be used to vary the applied torque, depending upon the wishes of the operator.

Another object is an automatic nut runner or connector wrench in which the connectors are free to move up and down in the passage through the wrench when the power is off but are held in place when the power is on.

Other objects will appear from time to time in the ensuing specification and drawings in which:

FIGURE 1 is a perspective of the over-all assembly;

FIGURE 2 is a side view of the driver assembly or wrench;

FIGURE 3 is an axial section through FIGURE 2, with parts not sectional;

FIGURE 4 is an enlarged view, partly in section, of the lower end of the device in FIGURE 3;

FIGURE 5 is a section along line 5—5 of FIGURE 4;

FIGURE 6 is like FIGURE 4 but of a modified form;

FIGURE 7 is a side view of the camming mechanism and drive shaft, shown in FIGURE 3, with the parts exploded, on an enlarged scale;

FIGURE 8 is a section along line 8—8 of FIGURE 7;

FIGURE 9 is a side view, partly in section, of the cabinet shown in FIGURE 1;

FIGURE 10 is an end view of FIGURE 9, showing the orienter;

FIGURE 11 is a side view of the FIGURE 10 orienter showing its operation;

FIGURE 12 is like FIGURE 11 but showing a different operation;

FIGURE 13 is an end view of FIGURES 11 and 12; and

FIGURE 14 is a top view of the orienter in FIGURES 11 and 12.

In FIGURE 1 the device has been shown as including a generally upright frame **10** with an assembly or working platform **12** part way up and a cabinet **14** on top mounted on a suitable upper platform **16** or the like. A connector wrench **18** may be suspended from the cabinet

in a manner to be set forth hereinbelow, and from the frame by a reel **20**. As shown in FIGURE 9, the top of the cabinet **14** may have a suitable door or hatch **22** which may be opened to provide access to a hopper or container **24**. The cabinet may have a side access **25**, if desired. The hopper may be constructed to hold any given number of connectors and may be funnel shaped to feed the connectors to a bowl, indicated generally at **26**. The connectors may be of the so-called pig-tail or screw-on type, such as shown in U.S. Patent No. 2,749,-384, and obtainable at the present time, for example, from Ideal Industries, Inc. of Sycamore, Illinois, sold under the trademark "Wire-Nut." The bowl has a vibrator, indicated generally at **28**, which is constructed to provide suitable oscillations or vibrations to the bowl for feeding the connectors from the center of the bowl around a helical path around the inside of the bowl upwardly to a discharge point. The bowl and vibrator, as such, are known in the art and not important to the present invention. The function and operation of the bowl and vibrator is to feed the connectors to an orienter, designated generally **30** in FIGURE 9. The connectors come off of a ledge or plate on the bowl, designated generally **32** in FIGURE 11, single file, and are received by the orienter **30**.

As shown in detail in FIGURES 10 through 14, the orienter may have a body or elongated base **34** which may be generally square in cross section and provided with an elongated channel or passage **36**. The passage may have an inlet **38** at one end and a discharge or outlet **40** at the other. The base or housing may be tapered down or reduced or otherwise made into a nozzle or spigot **42** for connection to a suitable flexible tube **44** in FIGURE 9, which leads the connectors away from the orienter to the point of use.

It will be noted in FIGURES 10 and 13 that the channel **36** is circular in cross section and has a diameter that will accept the connectors. A slot **45** or the like opens through the top of the base toward the inlet end so that the channel at the inlet is, in a sense, open. It will be noted in FIGURE 13 that this slot is not as wide as the diameter of the channel. In fact, it should be less than the diameter of the connectors at the large end but greater than their diameter at the small end. This is to say that the slot has a width between the largest and smallest diameters of the connectors so that the small end of the connector will extend down in the slot and in the channel while the large end will be above the upper surface **46**.

At a point down the channel, the slot **45** is enlarged, as at **48** in FIGURE 14, to a dimension larger than the dimension of the large end of the connector. At or adjacent this point, a trip device **50**, shown in this case as a screw threaded into the channel coming up from below, sticks into the channel a distance such that the bottom or small end of the connectors will hit it. Thus, at the same time that the top end is free due to the enlargement **48**, the bottom end will trip over the screw **50**, and the connector will fall forward into the channel **36**. Thus, the open large end of each connector will always come to the outlet opening **40** first and the small end will follow. So the connectors will pass down tube **44**, single file, large end first. Additionally, the trip screw **50** will function as a means for mounting the orienter.

In the event that connectors are not being used by the wrench described hereinafter at a sufficiently rapid rate, the connectors may stack up in the tube **44** and back up into the orienting device. For this I provide a lateral opening or discharge or spill **52** which is in the form of a side opening or the like communicating with the channel **36**. If the connectors are stacked up in the

channel and a connector is already lying in the channel by the enlargement 48, the next connector coming along and tripping over the screw 50 will merely fall out the side through the opening 52 and back down in the bowl. Thus, the connectors will not jam up but will merely recycle in the bowl until the connectors begin to move again.

The connectors feed down through the tube 44 inside of the cabinet to a suitable coupling 54 on the face thereof and then to an outside flexible tube 56 leading down and connected to the wrench 18. Leaving the additional details of the structure in and around the cabinet and going to the wrench 18 in FIGURES 2 and 3, I prefer that the wrench may be made up of upper and lower housing parts or portions 58 and 60 suitably connected by screws 62 or the like. A lower extension in the form of a driver housing 64 may be screw threaded into the lower housing 60 preferably by a left hand thread. Parts 58, 60 and 64 define an elongated housing with a passage built-in leading from an inlet at the upper end, defined by a suitable coupling 66 which connects the flexible tube 56 to the housing, to a lower discharge 68. It will be noted in FIGURE 3 that the passageway which goes through the wrench narrows down to the opening or outlet 68 and a plurality of spring pressed balls 70, shown as four in this case, close the opening somewhat. The diameter of the opening 68 is slightly greater than the diameter of the large end of the connectors. The balls stick in somewhat so that the connectors will not pass without being pulled through. The balls form a detent to keep the connectors from falling out of the lower end of the assembly but will not stop them from being withdrawn. The balls are mounted in a driver head 72 which is mounted in the driver housing 64, preferably by a left hand thread. The inner surface of this driver head or socket has a cam or conical surface 74 defining a rotating or working or turning station opposite a drive shaft which is made up of an upper drive shaft 76 and a lower drive shaft 78. These two elements together shall be referred to hereinafter as the drive shaft with 76 designated the upper drive shaft and 78 the lower drive shaft.

Considering the upper drive shaft in detail, as shown in FIGURE 3, it will be noted that it has a hollow central passage 79 which flares out at the upper end as at 80 so that connectors coming down the flexible tube and through the fitting 66 will not hang up on a lip or ledge. The lower end of the upper drive shaft has cam surfaces designated generally 82. The upper end of the lower drive shaft has corresponding cam surfaces 84 which engage the cam surfaces on the upper drive shaft and operate in a manner set forth hereinafter. The upper drive shaft is driven from a power source through a gear 86 keyed or otherwise suitably held on the upper drive shaft. Bearings 88 may be provided on each side of the gear around the upper drive shaft and steel liners or inserts 90 may be used so that movement of the bearings will not wear away the housing which I preferably make of aluminum. I may also provide a suitable wear-resistant liner or insert 92 around the drive shaft, as shown in FIGURE 3, to resist wear. The upper drive shaft may be provided with a suitable flange or a shoulder 94 against which the bearing assembly rests.

The lower end of the lower drive shaft may have a head 96 which carries a plurality of radially arranged jaws or dogs 98 disposed in radial slots 100, as shown in FIGURE 4. The dogs may be mounted on a suitable snap ring or wire 102, as shown in FIGURE 4, which fits in a circumferential slot in the head. As explained hereinafter, when the drive shaft is in its lower or extended position, the dogs move radially inwardly to grip a connector disposed at the turning or working station and cause the connector to be rotated. But when the drive shaft is in its withdrawn or retracted position, as shown in FIGURE 3, the dogs are free to move out and allow the connector to pass through the channel 104 in the lower drive shaft and head.

The drive housing or extension 64 may have a suitable inwardly disposed shoulder 105 which the head of the drive shaft engages when the drive shaft is in its upper or withdrawn position, as shown in FIGURE 3. A suitable coil spring 106 or the like may be disposed on the other side of the shoulder 105 and engages a snap ring 108 or the like which fits in a suitable groove in the lower drive shaft. Thus, when the drive shaft is extended to its lower position, the spring will be compressed. But when released, the spring will return the drive shaft to its upper or withdrawn position.

I prefer to use five dogs or jaws around the drive head. The dogs are thin enough to fit in the grooves or flutes of a connector of the type mentioned above. The unit shown may therefore be used to drive a connector with five or ten flutes, for example, but it might be otherwise. The number of dogs used, the spacing, etc. is not presently considered important.

The gear 86 on the upper drive shaft is rotated by a power means to be described in detail hereinafter. The upper drive shaft rotates the lower drive shaft through the engagement of the cam surfaces 82 and 84. The lower drive shaft is pushed up against the upper drive shaft by the spring 106 and maintains a degree of frictional engagement between the cam surfaces. However, the arrangement is such that rotation of the upper drive shaft will force the lower drive shaft down and the cam surfaces, in effect, function as a type of slip clutch. When the drive head reaches the turning station, the dogs or jaws will be forced in by the cam or conical surface 74 until the dogs grab the connector by its fluted exterior. This stops the downward movement of the lower drive shaft and thereafter the upper drive shaft will directly drive the lower drive shaft with no slip between the cam surfaces. If the dogs or jaws wear away or other looseness develops, the lower drive shaft will move down just that much more. But the cam surfaces will take up the play. In short, regardless of the distance traveled by the lower drive shaft, the upper drive shaft will directly drive it when the dogs engage the outside of the connector at the working station.

This arrangement also has the advantage that when the device is energized and the connector is turned, it cannot be pushed back up in the housing. The dogs will hold it in place. But when the power is turned off, the spring 106 will raise the lower drive shaft to the position shown in FIGURE 3 and the column of connectors can be easily pushed back up in the assembly. The advantage of this is that if the operator sticks the wires up in the discharge opening 68 when the power is not on, he will merely push the column of connectors up a little. But if the power is on, the lower drive shaft will be down and the dogs will positively engage the bottom connector and will prevent it from being pushed up.

The connectors in a column come one by one down the flexible tube 56 through the channel in the drive shaft to the working station. It will be noted that the connectors pass through the cam surfaces 82 and 84. I have enlarged the channel inside of each drive shaft adjacent the cam surfaces as at 110 and 112 and position a liner or sleeve 114 therein to prevent the engaging cam surfaces from marring or otherwise damaging the connectors. In a sense, the sleeve or liner masks the cam surfaces to prevent damage to the connectors.

The drive to the gear 86 comes in through a flexible shaft or wire 116 or the like which is connected by a coupling or adapter 118 to a suitable shaft 120 or the like which carries a pinion 122. The shaft may have sleeve bearings 124 and the inner portion of the adapter may be held by a set screw 126 or the like. The pinion 122 meshes with the drive gear 86 and the other end of the flexible shaft 116 is connected to a motor in a manner set forth hereinafter. The connection between the shaft 120 and the flexible wire may be a key arrangement to allow some longitudinal play.

A suitable cavity 127 on the outside of the housing may

have a suitable switch cover **128** and a microswitch **130** or the like may be disposed therein to be operated by a handle or trigger **132** suitably pivoted as at **134** and inwardly bent or otherwise formed so that the end portion **136** will lie opposite the housing to be easily accessible to the hand of the operator when he grips the extension or lower housing **64**. A suitable spring **138** may be mounted in the housing so that the trigger or handle is always biased to open the miscroswitch. Suitable leads **140** may be connected to the microswitch to control the power to the drive shaft.

Referring again to the upper cabinet **14** in FIGURE 9, I prefer that it have an inclined front wall **142** so that the operator may easily reach the controls which project from the lower surface thereof. A motor **144** that drives the flexible cable or Bowden wire **116** may be mounted inside the housing as shown in FIGURE 9. The feed tube **56** for the connectors is also connected to this front wall at the coupling **54**. A controllable rheostat **146**, shown in FIGURE 1, may be disposed on one side of the housing to control the voltage to the motor so that the torque delivered by the motor to the drive shaft may be varied. Another rheostat **148** in FIGURE 1 may be disposed on the other side of the housing to control the current to the vibrator **28**. An off-on switch for the entire unit may be disposed at **150** and a lamp **152** may be used to show when the unit is on or off. A suitable transformer may be used in the cabinet to convert the line current to a reduced voltage and leads **140** from the transformer may take the reduced voltage through a coupling **156** to the microswitch **130** on the driver assembly.

In the arrangement shown in FIGURE 4, the unit may be subjected to considerable wear since the dogs will be sliding against the cam surface **74**. But in the modified form shown in FIGURE 6, I may mount the cam surface to rotate with the drive shaft. For example, the cam surface **158** is mounted on a ball bearing **160** so that wear will be substantially reduced. The detent arrangement may be the same as before.

The use, operation and function of my invention are as follows:

I provide an upright unit which has an upper cabinet to receive connectors, line them up and feed them, open end first, through a flexible tube to an automatic driver assembly. The driver assembly itself is at the lower end of the tube and is constructed to be power operated to automatically turn the connectors down on the stripped ends of two or more wires. The tube for feeding the connectors has been referred to as a plastic tube but it might be a coil spring. The upper housing or cabinet holds the various power elements and suitable wiring is provided so that the amount of torque delivered by the motor may be varied and the amount of vibration to the connector feeding arrangement may be changed or varied.

The driver assembly itself is made of light material and I prefer that the motor that drives the assembly be located in the cabinet, but it might be otherwise. The driver assembly is constructed to positively grip and rotate connectors at the lower end of the tube or channel. It will be noted that the operator can easily push the wires up into the discharge opening **68** and if the power is on the lowermost connector will be positively rotated. The torque may be varied by the rheostat control **146**. The operator can adjust it so that the wires will not be twisted out of his hand. When the power is off and the lower drive shaft is withdrawn, the column of connectors is free. If the operator pushes the wires up in the driver assembly, the connectors will move up and nothing will happen.

The dogs on the drive shaft are automatically cammed in so that they positively grip the connector and stop the downward movement of the lower drive shaft. Wear will have little effect because the cam surfaces will compensate. The camming surfaces **82** and **84** not only constitute a clutch between the drive parts **76** and **78**, but they also function as a cam to force **78** into its driving or extended position, compressing spring **106**.

The orienter shown in FIGURES 10 through 14 is important since the connectors must be presented large end first to the driver assembly. In the arrangement shown, the connectors will automatically be oriented. In the event that connectors are not being used, the unit will automatically recycle and connectors will be dumped back into the bowl. The trip mechanism **50**, in addition to tripping these connectors, may also be used as a mounting means. The side plate **154** connected to the orienting device prevents connectors from spilling over the edge and insures that they always go out through the side opening **52** for recycling.

It is important that variable amounts of torque be delivered so that the operator can set the unit to the torque he desires. It is also important that the torque be directly applied to the drive shaft so that no slip or other inaccurate operation occurs. Additionally, the clutch type arrangement in the drive shaft has the advantage that the unit will automatically compensate for any inaccuracies or variations in the size of the connectors. When the power is not turned on and the lower drive shaft is withdrawn, the weight of the column of connectors will automatically pivot the jaws or dogs out. But when the power is on, the lower drive shaft will be forced down and the dogs will be positively forced into the grooves or flutes of the lowest connector.

Since the drive shaft will be turning clockwise, as viewed from above, I prefer that the various connections of the housing parts be by left hand threads so that the unit won't tend to come apart.

I have stated that the sleeve **114** is pressed up in the upper drive shaft, but it might be in the lower one. I prefer, however, that it be pressed up in the upper one so that the lower drive shaft will move back and forth on it. The particular counterbalance or reel, indicated generally at **20** in FIGURE 1, is a conventional item so that when the operator releases the driving assembly, it will automatically be drawn up to the position shown generally in FIGURE 1. But any other suitable arrangement might be used.

Instead of the hand operated switch on the driving assembly itself, as shown, I might use a different switch in certain installations. But the arrangement shown is preferred.

If one of the connectors should come down the tube to the driver assembly reverse, small end first, no damage will be done since the small end will stick out the lower end of the driving assembly and the operator can merely grab it and pull it out.

While I have shown and described the preferred form and suggested and shown several variations of my invention, it should be understood that suitable additional modifications, changes, substitutions and alterations may be made without departing from the invention's fundamental theme. It is, therefore, wished that the invention be unrestricted, except as by the appended claims. For example, I have stated and shown five dogs or gripping fingers **98**. However, more or less could be used depending upon the particular fluted exterior of the connector. I have noted, however, that with three fingers the connectors may have a tendency to cock and the device may not work efficiently. Accordingly, I prefer to use four or more dogs depending upon the exterior design of the connector.

I have shown the torque control in the form of a rheostat for the motor. But a different arrangement might be used for varying the torque delivered thereby at the slip point. But I prefer the simple rheostat arrangement for the motor as shown and described.

The switch **130** on the driver assembly could be any suitable simple switch and the details are unimportant.

I have stated that it might be a foot switch or it also might be a bench switch. The voltage of the switch is unimportant except that if it is hand operated, I prefer that a suitable relay be used to bring the voltage down to 30 volts or less from a safety standpoint. I have also shown the driver extension or housing 64 connected to the main housing by a left hand thread, and the driver head 72 also connected by a left hand thread, and this is the preferred way. But I might use a snap ring or set screw, or both, in either case.

I claim:

1. In a device for automatically rotating connectors of the screw-on type for assembly thereof on the stripped ends of electric wires or the like, an elongated housing with an inlet opening at one end for the reception of such connectors and an outlet opening at the other end for the discharge thereof, a turning station at the other end adjacent the outlet opening, a drive shaft in the housing having a head on one end generally aligned with the turning station and outlet opening and constructed to be moved therein between a turning position and a withdrawn position, jaws on the head of the drive shaft constructed to grip such a connector in the turning station when the drive shaft is in its turning position and to release the connector when in its withdrawn position, means for feeding such connectors to the inlet opening in the housing, means for rotating the drive shaft, and means for moving the drive shaft between its withdrawn and turning positions.

2. In a device for automatically rotating connectors of the screw-on type for assembly thereof on the stripped ends of electric wires and the like, a housing with an inlet opening for the reception of such connectors and an outlet opening for the discharge thereof, a turning station at the outlet opening, a drive shaft in the housing constructed to be moved therein between a turning position at the turning station and a withdrawn position, movable jaws on the end of the drive shaft constructed to grip such a connector in the turning station when the drive shaft is in its turning position and to release the connector when in its withdrawn position, means for forcing the jaws inwardly when the drive shaft is in its turning position, means for feeding such connectors to the turning station, power means for rotating the drive shaft, and means for moving it between its withdrawn and turning positions.

3. The structure of claim 2 further characterized by and including means for automatically moving the drive shaft from its withdrawn position to its turning position in response to rotation thereof, and a spring for returning the drive shaft to its withdrawn position when it is not rotating.

4. In an assembly for automatically turning connectors of the screw-on pig-tail type down on the stripped ends of electric wires and the like, an elongated housing with an inlet opening at one end for the reception of such connectors and an outlet opening at the other end for the discharge thereof, a passage through the housing between the openings, a drive shaft in the passage including upper and lower rotatably mounted shafts, power means for rotating the upper shaft, camming surfaces between the shafts constructed to move the lower shaft toward the outlet opening in response to rotation of the upper shaft, a spring biasing the lower shaft toward the upper shaft at all times, a gripping mechanism on the lower shaft for gripping a connector at the discharge opening, and a stop for stopping the axial movement of the lower shaft caused by rotation of the upper shaft when the gripping mechanism is adjacent the discharge opening and for causing unitary rotation of the lower shaft with the upper shaft.

5. The structure of claim 4 further characterized in that the shafts are hollow in the form of tubes and constitute the supply passage between the inlet and outlet openings in the housing for feeding connectors therethrough, and a sleeve element within the camming surfaces to prevent damage to connectors moving through the shafts.

6. The structure of claim 5 further characterized in that the sleeve element is a separate inserted liner.

7. The structure of claim 4 further characterized in that the power means for rotating the upper shaft includes a gear around the upper shaft and connected to it, and a pinion engaging the gear to drive it.

8. The structure of claim 4 further characterized in that the stop is free to rotate with the lower shaft.

9. The structure of claim 2 further characterized in that the drive shaft includes upper and lower rotatably mounted shafts, the power means being connected to rotate the upper shaft, camming surfaces between the upper and lower shafts constructed to move the lower shaft toward the outlet opening in response to rotation of the upper shaft by the power means, and a spring in the housing biasing the lower shaft toward the upper shaft at all times.

10. The structure of claim 2 further characterized in that the means for forcing the jaws inwardly when the drive shaft is in its turning position includes a cam surface for simultaneously forcing the jaws inwardly and for stopping axial movement of the drive shaft in the turning stations.

11. The structure of claim 2 further characterized in that the drive shaft includes upper and lower rotatably mounted shafts, the power means being connected to rotate the upper shaft, camming surfaces between the upper and lower shafts constructed to move the lower shaft toward the outlet opening in response to rotation of the upper shaft by the power means, a spring in the housing biasing the lower shaft toward the upper shaft at all times, the shafts being hollow in the form of tubes and constituting at least a part of a supply passage between the inlet and outlet openings, and a sleeve element within the hollow shafts shielding the camming surfaces to prevent damage to the connectors moving through the hollow shafts.

12. The structure of claim 2 further characterized in that the means for forcing the jaws inwardly when the drive shaft is in its turning position includes a cam surface for simultaneously forcing the jaws inwardly and for stopping movement of the drive shaft in the turning stations and for the cam surface being free to rotate when engaged by the jaws on the drive shaft.

13. In a device for automatically rotating connectors of the screw-on type for assembly on the stripped ends of electric wires or the like, a housing with an inlet opening for the reception of such connectors, an outlet opening in the housing for the discharge of the connectors, a passage through the housing between the inlet and outlet openings for the movement of connectors therethrough, a hollow drive shaft forming at least a part of the passage having radially disposed movably mounted jaws at one end thereof adjacent the outlet opening, the jaws being mounted in the said one end of the drive shaft to grip the exterior of the connectors as they arrive, one at a time, at the outlet opening, power means for rotating the drive shaft, means for energizing and deenergizing the power means, and means responsive to the power means being energized for moving the jaws inwardly on the drive shaft to grip the exterior of a connector at the outlet opening of the housing so as to turn it down on the stripped ends of the wires.

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