

# United States Patent

Arnold et al.

[15] 3,641,652

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## [54] MAGAZINE-EQUIPPED SLUG-DRIVING TOOL

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[22] Filed: Sept. 20, 1968

[21] Appl. No.: 761,097

[52] U.S. Cl. ....29/203 D, 29/200 H, 29/203 H

[51] Int. Cl. ....H05k 13/04, H01r 43/04

[58] Field of Search.....29/203 D, 203 H, 212, 212 D, 29/203 HT, 203, 200 H, 203 DT; 81/313

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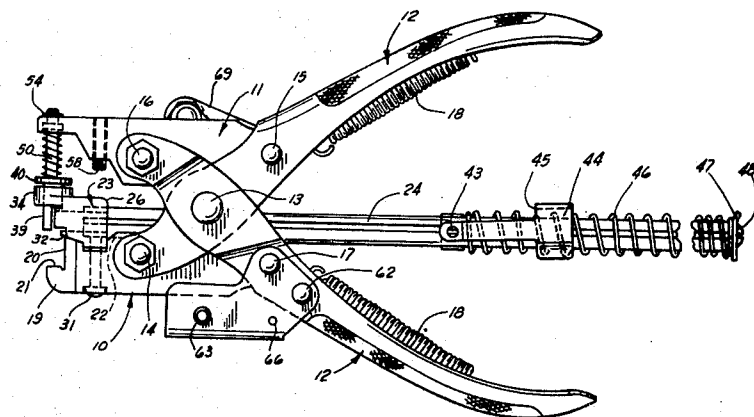
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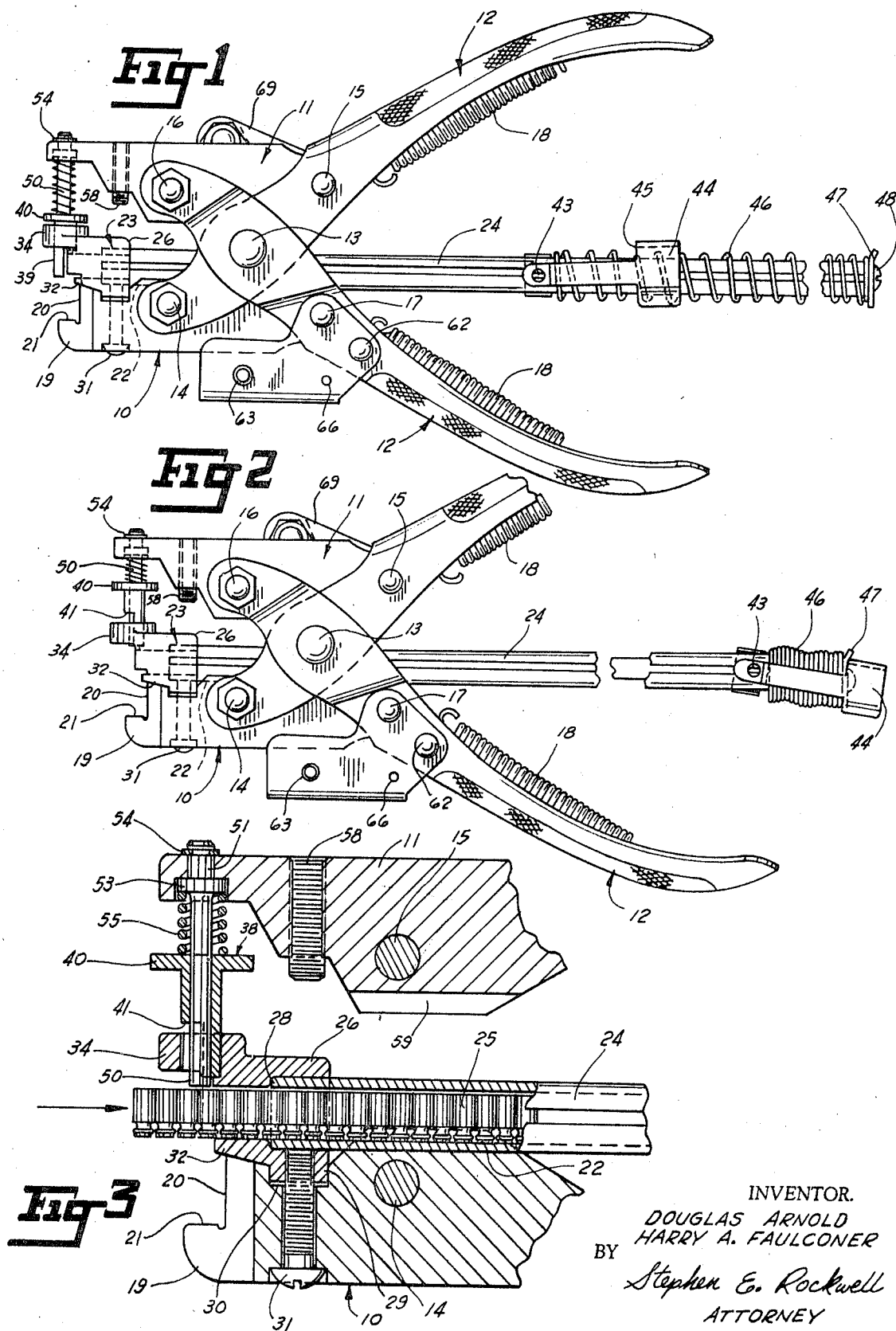
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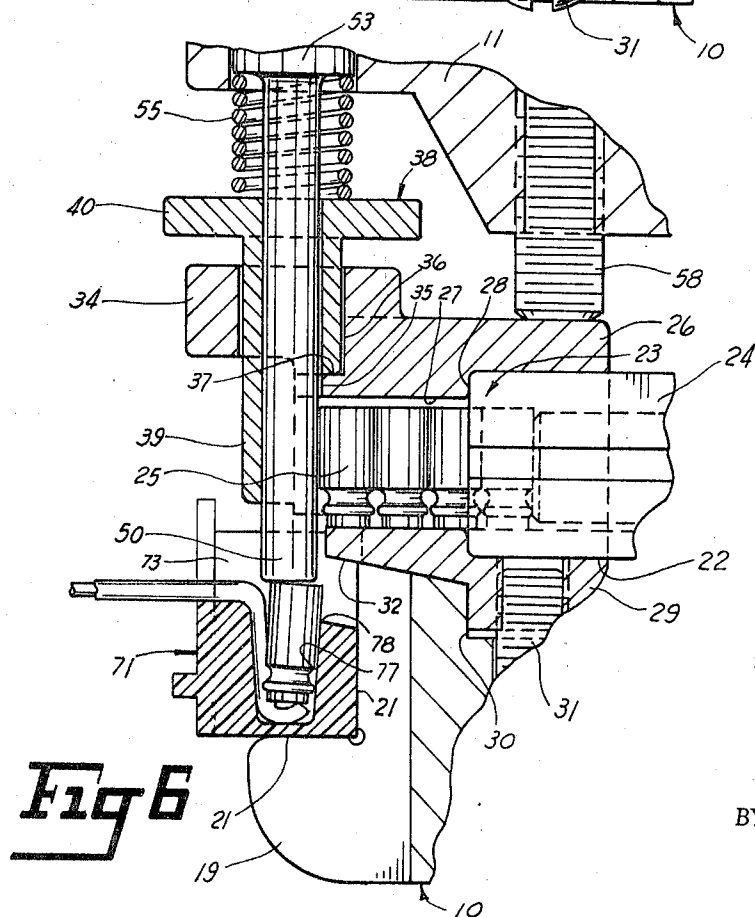
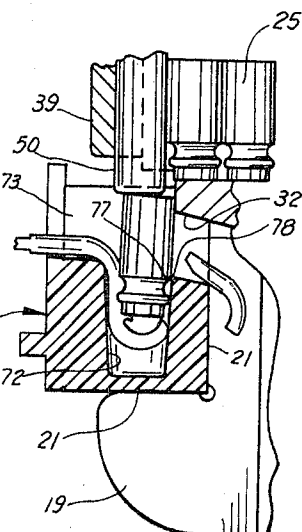
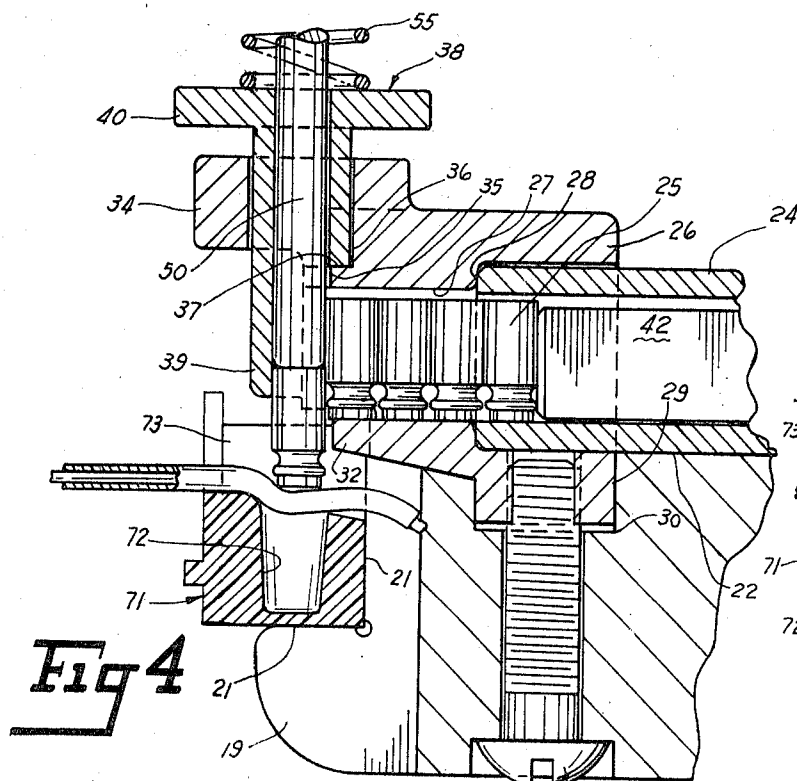
### [57] ABSTRACT

There is provided a tool which may be hand powered or power operated of a magazine-equipped type, for ejecting slugs and performing work by inserting these slugs in workpieces defining receptacles therefor, which tool supports the workpieces. The tool comprises one or more plungers, each of which has the sequential function of moving through the magazine to eject a slug therefrom and to insert it by driving the slug into such a receptacle.

16 Claims, 27 Drawing Figures







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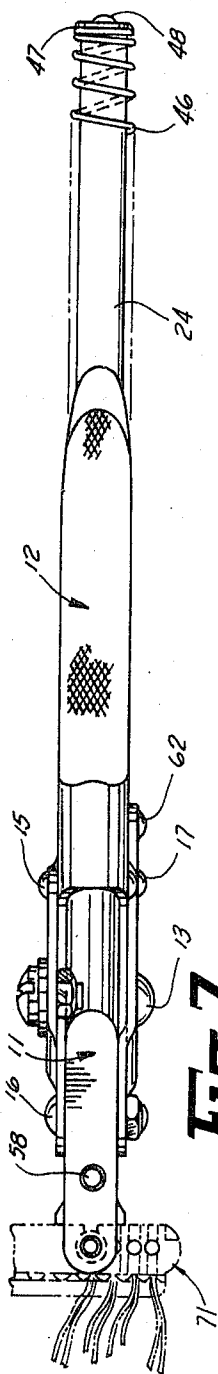


**Fig 7**

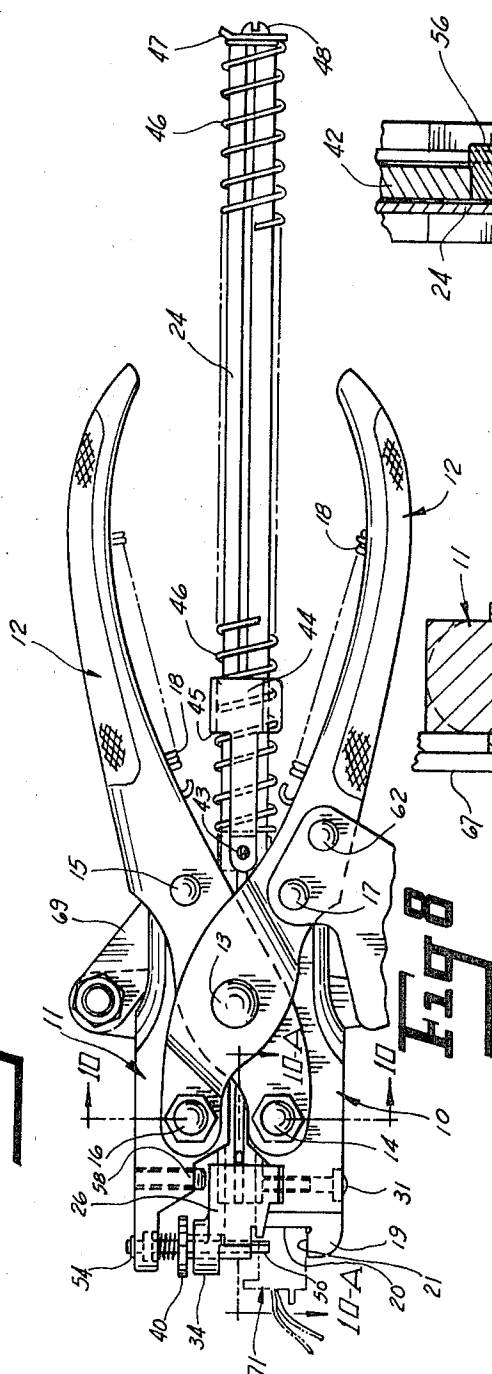


**Fig 8**

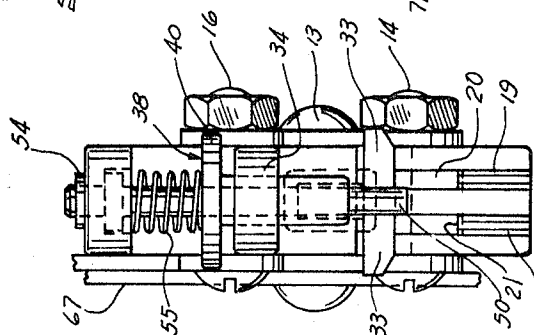


**Fig 9**

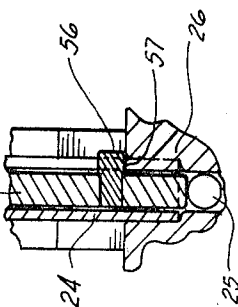


**Fig 10A**

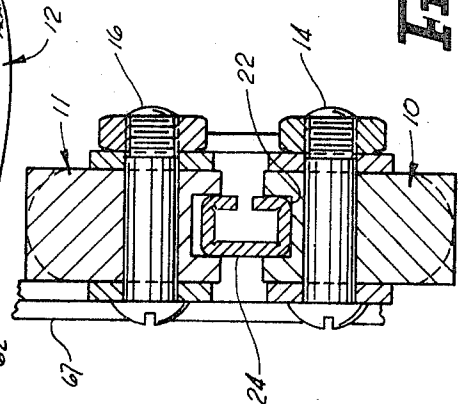


**Fig 10**

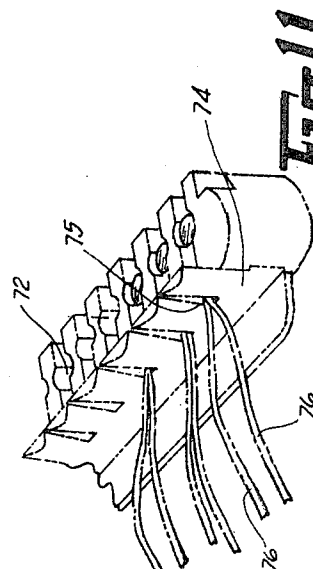


**Fig 11**

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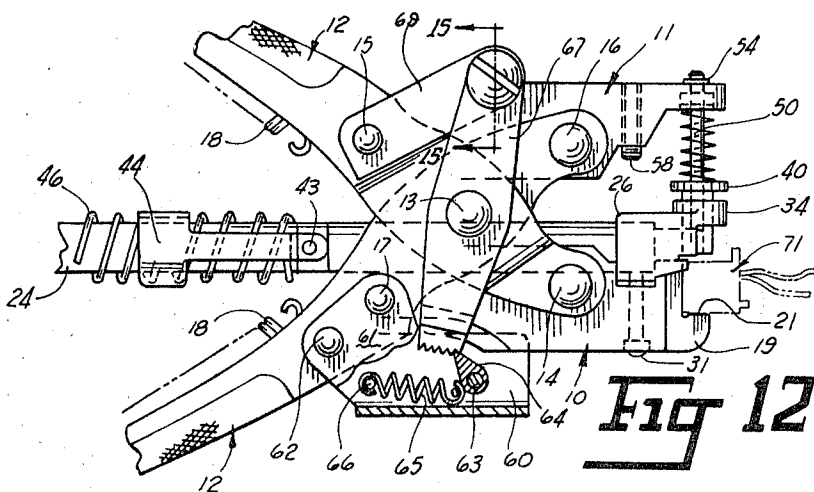


**Fig 12**

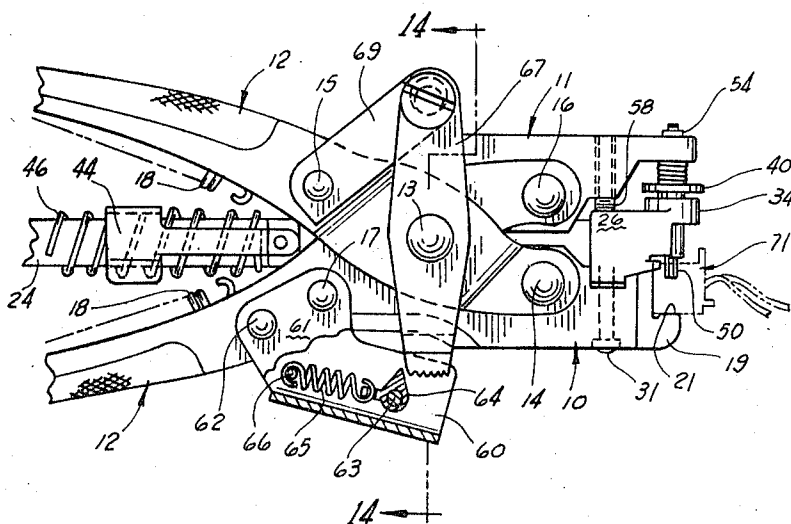


**Fig 13**

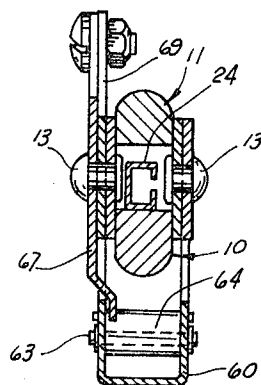


**Fig 14**

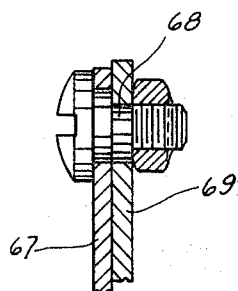


**Fig 15**

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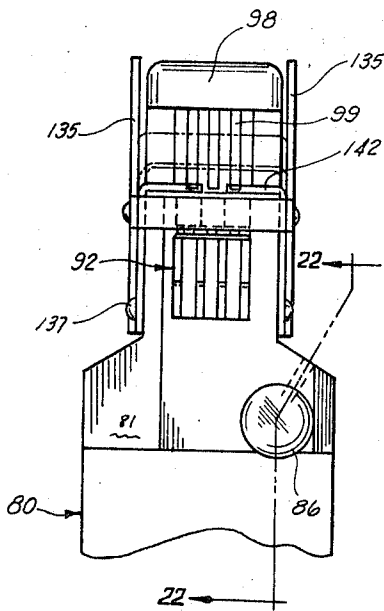


**Fig 20**

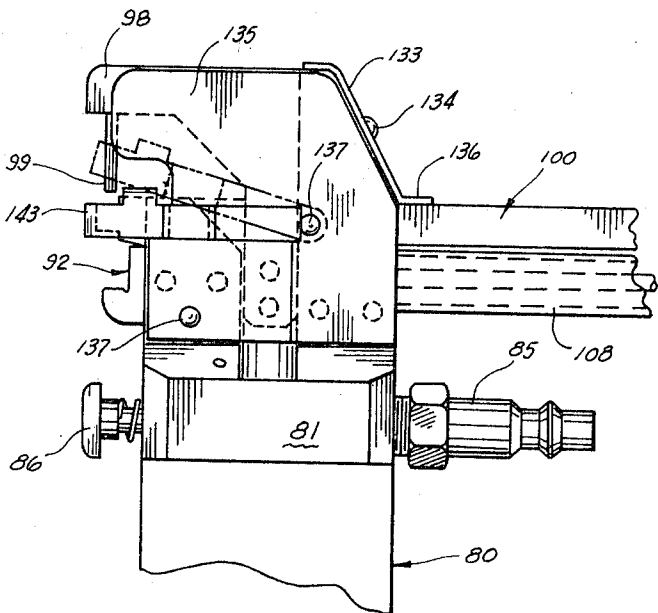


**Fig 21**

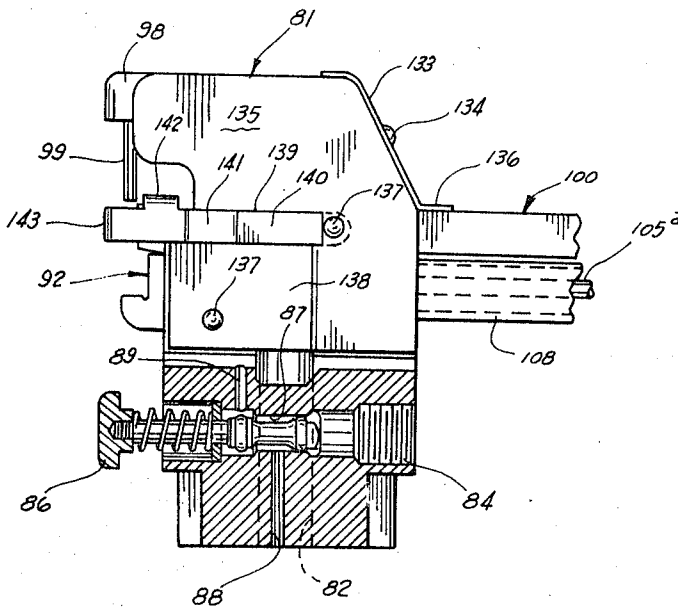
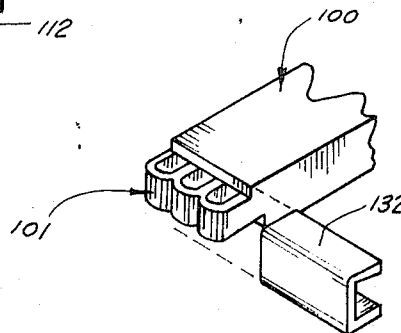
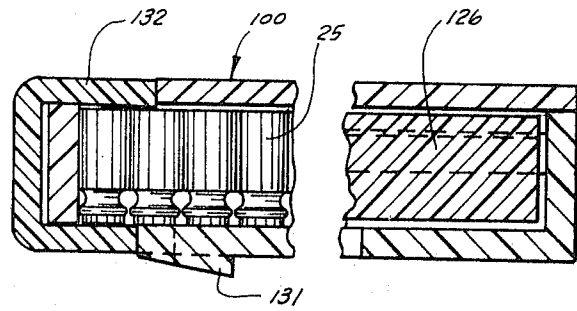
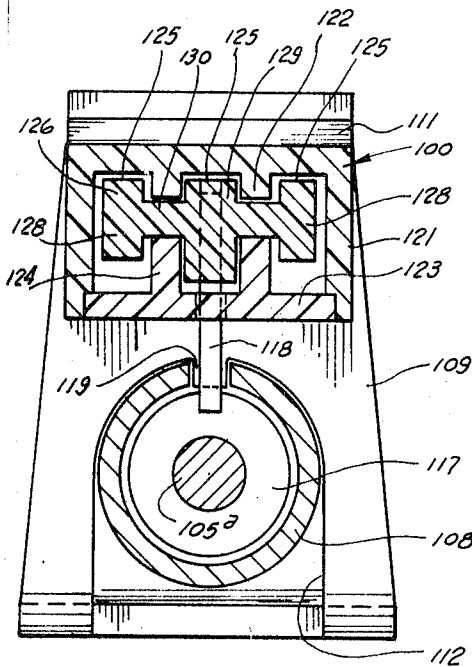
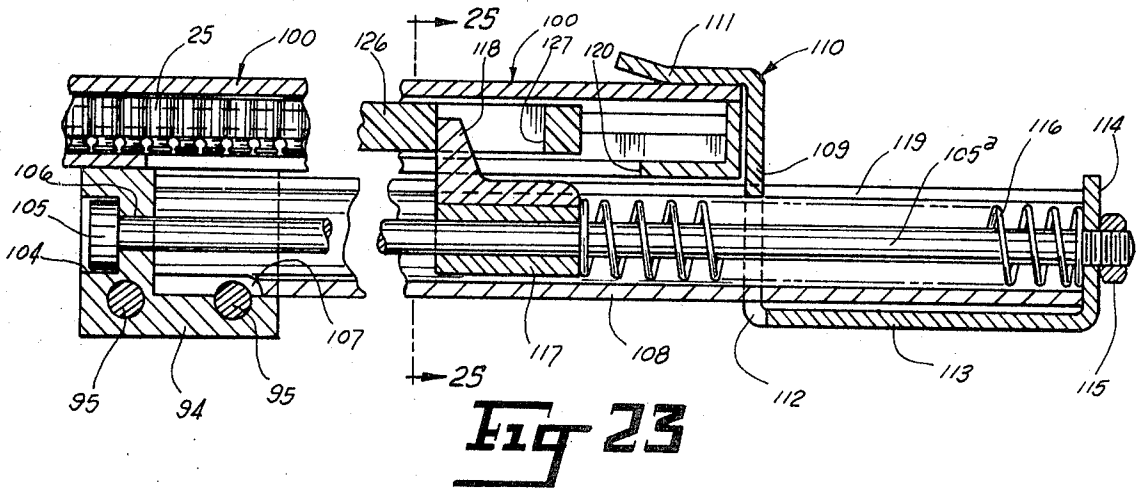


**Fig 22**

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**MAGAZINE-EQUIPPED SLUG-DRIVING TOOL**

This invention relates to a magazine-equipped slug-driving tool and relates more particularly to such a tool which may be powered by hand or may be power operated. The tool ejects slugs sequentially from a magazine and performs work by inserting these slugs in complementally formed openings or sockets such as in workpieces, which tool supports the work in such manner that one or more slugs may be driven into the openings or sockets therein by the tool to substantially fill them.

The tool comprises one or more plungers. Each plunger serves the function of ejecting a slug from the magazine and thereafter driving it home. The construction may be such that a plurality of slugs may be ejected from a common magazine and driven simultaneously by plungers.

Such tools may be used for diversified applications in various arts. By way of example only, such tools may be employed to drive slugs for the purpose of establishing electrical communication or connection between a pair of electrical wires. A multiplicity of relatively fine, insulated wires may be connected to a terminal block in such a manner. It is also contemplated that such tools may be employed to electrically interconnect heavier insulated wires of a type suitable for the electrical wiring of residences and other buildings, wherein a pair of wires may be electrically shorted by use of a slug within an insulated cup or receptacle.

The shorting of the wires may take place by a crimpless, solderless connection by parting the insulation on the wires sufficiently to expose portions of the bared conductors either to a slug within the receptacle or to a conductive lining within the receptacle. In the first-mentioned instance a slug is employed which is formed of metal having suitable conductive properties while in the second instance the slug is formed of a non-conductor such as a plastic material. Hence it will be understood that the tool may dispense and drive either metallic slugs or nonmetallic slugs. As described in the aforementioned copending application, the insulation of the wires is parted by the driving of the slug into engagement therewith and into engagement with the inner wall structure of the receptacle.

One object of the invention is to provide a simple yet efficient magazine-equipped tool for driving slugs, such as characterized above. Another object is to provide such a tool which will drive a plurality of slugs simultaneously. Further objects of the invention will be apparent from the following detailed description.

In the drawings:

FIG. 1 is a broken side elevational view of a magazine-equipped slug-driving tool embodying the invention, of the hand-operated type, having a single plunger showing the plunger raised to the position which it occupies to eject a slug from the magazine and drive it;

FIG. 2 is a fragmentary view similar to FIG. 1 but illustrating the magazine in condition to be loaded with a series of slugs;

FIG. 3 is a similar elevational view on an enlarged scale but showing the tool in longitudinal section, illustrating the loading of slugs into the magazine;

FIG. 4 is a fragmentary sectional view similar to FIG. 3 but illustrating the magazine in closed condition, showing a slug being ejected from the magazine by the plunger, about to be driven into a socket formed in a workpiece supported by the tool;

FIG. 5 is a view similar to FIG. 4, illustrating the tool during the driving of the slug;

FIG. 6 is a view similar to FIG. 5 showing the plunger more fully extended, with a stop operative to prevent further extension of the plunger during a slug-driving operation;

FIG. 7 is a fragmentary view illustrating the tool in top plan showing the same in association with a terminal block and wires connected thereto;

FIG. 8 is a fragmentary side elevational view of the tool showing the plunger extended and the magazine empty;

FIG. 9 is a fragmentary front view of the tool with the plunger in the condition of FIG. 8;

FIG. 10 is an enlarged sectional view taken on line 10—10 of FIG. 8;

FIG. 10<sup>4</sup> is a sectional view taken on line 10<sup>4</sup>—10<sup>4</sup> of FIG. 8;

FIG. 11 is a fragmentary perspective view of a terminal block into which the tool drives slugs;

FIG. 12 is a broken fragmentary elevational view of the tool showing the plunger almost fully retracted with the motion-compelling mechanism of the tool about to disengage to permit the plunger to be extended again;

FIG. 13 is a view similar to FIG. 12 but showing the motion-compelling mechanism disengaged after the plunger has reached the fully extended position thereof to permit the plunger to be retracted;

FIG. 14 is a sectional view taken on line 14—14 of FIG. 13;

FIG. 15 is a sectional view taken on line 15—15 of FIG. 12;

FIG. 16 is a broken top plan view of a modified form of the tool which is power operated showing the tool with the side cover plates and the forward magazine retainer removed;

FIG. 17 is a fragmentary front end view of the tool in the condition of FIG. 16;

FIG. 18 is a broken fragmentary view of the tool of FIG. 16 shown partially in section in the condition of FIG. 16;

FIG. 19 is a sectional view taken on line 19—19 of FIG. 16;

FIG. 20 is a fragmentary front end view of the tool showing the side cover plates and forward magazine retainer assembled therewith;

FIG. 21 is a fragmentary side elevational view of the tool in the condition of FIG. 20;

FIG. 22 is a sectional view taken on line 22—22 of FIG. 20;

FIG. 23 is a broken enlarged sectional view in elevation illustrating the slug-feeding details of the tool of FIG. 16;

FIG. 24 is an enlarged broken longitudinal sectional view of a magazine employed with the tool of FIG. 16;

FIG. 25 is an enlarged sectional view taken on line 25—25 of FIG. 23; and

FIG. 26 is a fragmentary perspective view on a smaller scale illustrating the forward end of the last-mentioned magazine.

In the form of the tool shown in FIGS. 1 through 15 of the drawings there is provided a combination work and magazine support indicated generally at 10 and a plunger support indicated generally at 11. These supports are pivoted to handles 12 as in the parallel action plierlike tool of U.S. Pat. No. 3,157,075 granted Nov. 17, 1964, and the supports mentioned above are operated by the handles 12 to effect movement of the plungerlike support 11 toward and away from the support 10 in parallelism thereto.

The pivotal and biased arrangement of the handles 12 need not be detailed here owing to the aforementioned disclosure. It is sufficient to point out here that the handles 12 throughout the handgrip portions thereof are generally of channel shape and that the handles 12 extend through one another and are pivoted intermediate their ends as at 13 by a connection formed by a nut and bolt. The supports 10 and 11 at either side of the pivot 13 are of blocklike form elongated generally lengthwise of the handles 12. One of the handles at the forward end thereof is pivoted at 14 by a similar nut and bolt connection to the block 10 and intermediate the ends thereof and beyond the pivot 13 from the pivot 14 has a pivot pin 15 extending through the sidewalls of the channel thereof, which pin is received in a longitudinal guide slot, not shown, formed in the elongated support block 11. The other handle 12 is pivoted in a similar manner to the support block 11 at 16 and to the support block 10 at 17 to provide the parallel action of the supports 10 and 11 on opening and closing movements of the handles. The handles are biased to their open positions shown in FIG. 1 by a pair of tension springs 18 within the respective channels. Each spring 18 has one end thereof secured in fixed relation to one of the handles and the other end thereof secured in fixed relation, not shown, to one of the blocks as by extending through a hole formed in the block. The support blocks 10 and 11 are normally maintained in their separated positions by the springs 18.

At the forward end thereof, as shown in FIGS. 1 and 9, the support 10 has a pair of integral forwardly extending bladelike flanges 19 in spaced-parallel relation to one another, each

having an upwardly or vertically arranged edge portion 20 and a horizontal edge portion 21. The flanges 19 provide a bucking comb to support the work in a manner which will appear hereinafter. The support 10 has a channel 22 extending lengthwise thereof receiving an elongated magazine assembly indicated generally at 23.

The magazine assembly comprises an elongated channel-forming member of C-shape in cross section indicated at 24 for the reception of a series of slugs 25 (FIG. 3), one behind another maintained in series in loading the magazine, as shown in FIG. 3, and while in the magazine by being cemented one to another. As previously indicated, the slugs may be formed of metal or of a nonmetallic substance such as plastic, for example. The aforementioned manner of securing the slugs one to another in series for loading purposes and while in the magazine may be the same as that employed to hold a series of staples together for loading such staples into a stapling device. As will be apparent from the drawings the slugs for the tool are arranged not in end-to-end relationship but in axially parallel relationship to one another or side by side.

The channel-forming member 24 at the forward end thereof is received in the rear end of a magazine headpiece indicated at 26 having a slug opening 27 therethrough (FIG. 4) shouldered as at 28 to provide an abutment for the forward end of the member 24 which may be cemented in a conventional manner within the head opening. The magazine head 26 has a depending squared portion 29 (FIG. 4) received in a slot 30 in the support 10. A tapped bore is provided in the last-mentioned support to threadedly receive a screw 31 which also extends into a similarly tapped hole in the head 26 to secure the magazine assembly in place with reference to the support 10.

The magazine head 26 has an extension of the floor of the slug opening as at 32 which projects externally of the magazine head in a forward direction beyond flat (FIG. 9) transverse surfaces 33 of the head. In a plane above the slug opening 27 and projecting forwardly of the head extension 32 is another extension 34 provided with a vertical bore 35, as shown in FIG. 4, which is counterbored, as at 36, to provide a semicircular abutment surface 37, the bore 35 opening to the front of the head 26 below the projection 34 as shown.

A nosepiece 38 of generally tubular form is vertically slidable in the bore 36 and has a semicircular longitudinal section cut away from the lower end thereof leaving a longitudinal semicircular end portion 39 extensible beyond the counterbore 36 through the bore 35 when rotated to an angular position to clear the abutment 37, in which position the portion 39 of the nosepiece may oppose the slug opening 27 in the head. The nosepiece 38, which is part of the magazine assembly, has a radial flange 40 at its upper end.

As shown in FIG. 2, the cutaway semicircular portion of the nosepiece provides a shoulder 41 which, when the nosepiece is in the lower, angular position thereof shown in FIG. 4, rests on the abutment 37 of the head 26. In this position of the nosepiece 38 the extension 39 thereof opposes the slug opening 27 in the head and when the nosepiece is in the position of FIG. 1 and the handles of the tool are in the positions shown therein, the nosepiece extension 39 blocks or closes the front end of the magazine to such an extent that slugs therein cannot slide out of the magazine lengthwise of the latter. The forwardmost slug in the magazine is urged against and frictionally held by the inner surface of the semicylindrical extension 39 of the nosepiece through the action of a spring-biased pusher 42 disposed in the channel member 24 rearwardly of the slugs therein, as shown in FIG. 4, the pusher 42 being urged forwardly.

The pusher 42 is of rodlike form and has adjacent its rear end a transverse pin 43 fixed thereto projecting from the channel 24 through the opening thereof. Pivoted on the pin 43 through one arm thereof is a spring yoke 44, the other arm of which has top and bottom flanges in embracing relation to the channel member 24 but permitting some pivotal movement of the yoke as will appear hereinafter. At its rear end the yoke 44 also has portions thereof in embracing relationship to the channel 24 and providing an abutment as at 45.

The plunger 42 is biased by a coiled compression spring 46 which embraces the channel member 24, having one end thereof supported by the arms of the yoke 44 and having the other end thereof abutting a magazine cap 47 at the rear end of the channel member 24, which cap is fixed thereto as by a screw 48. When it is desired to load or unload the magazine, the spring yoke 44 is grasped by the user's fingers and pushed rearwardly compressing the spring 46. The abutment 45 of the spring yoke may be latched over the end cap 47 by pivotal movement of the yoke to the position shown in FIG. 2. The pusher 42 is held in its rearmost position when the spring yoke is in the last-mentioned position thereof.

A slug-driving plunger 50 operates in the tubular nosepiece 38 and is supported thereby. The support block 11 drives the plunger downwardly and in the preferred arrangement shown in FIG. 1 the upper end of the plunger 50 is held captive by the support 11. As shown in FIG. 3, the support 11 is provided with a plunger bore 51 which is counterbored in a downwardly facing direction to receive a flange 53 on the plunger and against which the flange 53 bottoms. The plunger extends through the bore and at its upper end above the support 11 receives a split ring 54 to maintain the plunger 51 captive in the support. A compression spring 55 embraces the plunger 50 and reacts at one end against the radial flange 40 of the nosepiece 38 and at the other end against the flange 53 of the plunger. The spring 55 serves to urge the nosepiece downwardly to the position of FIG. 1. The nosepiece 38 may be raised against the pressure of this spring and rotated to the position of FIG. 2 to thereby open the front end of the magazine assembly and latch the nosepiece in open position. The nosepiece is latched by engagement of the lower end of the semicircular portion 39 thereof against the abutment 37 of the magazine head 26. It will be understood from the foregoing that the nosepiece may be unlatched and returned to the position of FIG. 1 as after loading or unloading the magazine by simply rotating the nosepiece by the flange 40 until the portion 39 thereof disengages the semicircular abutment 37 of the magazine head and then releasing the nosepiece for its return under the influence of the spring 55.

As shown in FIG. 10<sup>a</sup> a stop is provided to limit forward movement of the slug pusher 42 to a position in which the last slug in the magazine is pushed for ejection therefrom. This stop is constituted by a pin 56 fixed to the forward end portion of the pusher 42 and extending transversely thereof into the mouth of the channel 24 in such manner that it may strike a projection 57 on the magazine head 23 extending into the mouth of the channel 24.

The tool is provided with adjustable stop means to limit the travel of the slug-driving plunger 50 in a driving direction. It includes a tapped bore through the support block 11 threadedly receiving a stop member 58 projecting through the last-mentioned bore so that its lower end may form an abutment engageable with the magazine head 26. The threaded member 58 may be adjusted by rotation by a suitable tool. As shown in FIG. 3, the support member 11 has an inverted channel 59 formed in the bottom thereof which provides clearance for the support 11 with the channel member 24 of the magazine when the handles of the tool are closed bringing toward one another the supports 10 and 11.

As shown in FIG. 4, the plunger 50 is of a diameter approximating the diameter of the slugs. The bottom of the plunger is substantially flat and cooperates with the flat upper ends of the slugs, one at a time. The plunger 50 is of a length sufficient to extend entirely through the slug opening 27 of the magazine head as indicated in FIG. 6. It will be understood that when the handles of the tool are in their open position shown in FIG. 1, the plunger 50 occupies a position above a slug which is held against the semicircular portion 39 of the nosepiece in the above-described manner. The slug in this position has its lower end uncovered forwardly of the magazine floor extension 32 so that the slug may be ejected from the magazine when pressure is applied in a downward direction to the top of the slug by the plunger 50. The plunger 50 is shown in its fully extended position in FIGS. 8 and 13 as well as in FIG. 6.

The tool includes a motion-compelling mechanism best shown in FIGS. 12 through 15 to insure that the slug-driving plunger 50 of the tool drives the slug to the full extent required. Normally such motion-compelling mechanisms are located between the handles of plierlike tools. That is, they often extend into the channels of the handgrip portions of the tool. However, this is not possible in the tool of FIGS. 1 through 15 owing to the fact that the slug magazine occupies a position between the handles. Hence the motion-compelling mechanism is mounted externally of the handles and forwardly of the handgrip portions thereof and comprises what is believed to be a unique construction wherein a channel-shaped member 60 is provided having the shape shown in FIG. 13 and provided with a pair of offset ears 61 which overlap the respective sides of one handle 12 and are secured thereto by the aforementioned pivot pin 17 and a headed fastener 62. Within the channel member 60 and pivoted on a pin 63 extending through the walls thereof is a pawl 64 having an eye thereon to which one end of a tension spring 65 is secured to bias the pawl to the position of FIG. 13, the other end of the spring 65 being secured to a pin 66 extending through the walls of the channel member 60.

Cooperating with the pawl is a bladelike ratchet 67 having teeth formed in one end thereof and pivoted intermediate its ends by the pivot 13. As best shown in FIG. 14, the end portion of the ratchet 67 having the teeth thereon is bent inwardly to extend within the channel member 60, as shown in FIG. 14. The ratchet is mounted for adjustment on the pivot 13 to vary the throw of the slug-driving plunger 50 by means of an eccentric 68 formed on a fastener extending through an opening in the other end of the bladelike ratchet as shown in FIG. 15. The last-mentioned fastener which is headed and has a threaded portion for the reception thereon of a nut, supports the ratchet from one end of a locking arm 69 through which the fastener extends, having the other end thereof mounted on the pivot 15. The eccentric portion of the fastener lies within the fastener opening in the arm. The ratchet is adjusted by loosening the nut of the last-mentioned fastener and turning the fastener to the desired angular position of the eccentric 68. The nut is then retightened to hold the parts firmly in adjusted position.

FIG. 12 illustrates the pawl 64 about to disengage the teeth of the ratchet 67 as the handles 12 and the supports 10 and 11 approach their fully open positions. When the pawl is so engaged, the motion-compelling mechanism prevents closing movement of the handles. When the pawl is free of the ratchet and the handles are in fully open position, closing movement of the handles effects engagement of the pawl with the ratchet teeth in a manner such that the handles may not be reopened until the pawl has disengaged the ratchet as shown in FIG. 13 wherein the handles are shown in their fully closed positions.

As previously indicated, the slug-driving tool may have many uses, one of which is for establishing an electrical connection between a pair of electrical wires. For present purposes the slugs 25 driven by the tool may be considered as being formed of metal though, as previously indicated, the slugs may be formed of a nonmetallic, nonconductive substance for other purposes including such splicing, if desired.

The operation of the tool will be understood from the foregoing description. In FIGS. 4 through 8, the tool is shown associated with work indicated generally at 71 in the form of a terminal block constructed of a nonconductive material such as plastic-shaped to define a strip presenting longitudinally spaced cavities 72. Between the cavities and extending above them are partitions 73 formed as an integral part of the strip, and projecting above these partitions 73 is an integral longitudinal fanning strip 74 which is slit vertically as at 75 opposite each cavity 72, each slit 75 extending downwardly from the upper edge of the strip only to the top of the means defining the cavity 72.

Pairs of insulated electrical wires 76 to be electrically connected one to the other are laid across the tops of the respective cavities 72 which are to be utilized and held in position by

being squeezed by the walls of the corresponding slits 75 in the fanning strip 74 through which slits the wires extend as indicated in FIG. 11. With the wires thus positioned in the terminal block, the block is inserted in the tool so that the bottom thereof is supported by the bucking comb provided by the flanges 19 as well as in the side face of the terminal block from which the free ends of the wires extend, as shown in FIG. 4. These free ends of the wire extend between the flanges 19 of the bucking comb. When positioned in such manner the terminal block or strip has the bottom thereof firmly supported by the edge portions 21 of each flange 19 while the last-mentioned side of the block or strip is supported from the edge portions 21 of the flanges 19. The block is positioned axially thereof with reference to the tool by the forward projection 32 of the magazine head which is received snugly between two of the partitions 73 so that the foremost slug in the magazine is properly aligned with the cavity which it is to fill. When the terminal block is properly supported on the tool with the aforementioned extension 32 received between two of the partitions 73, the rearwardly facing edges of the partitions 73 about the flat surfaces 33, FIG. 9, of the magazine head.

It will be apparent from the foregoing that when the work is so positioned with reference to the tool, the handles of the tool may be moved from their open positions of FIG. 1 toward their closed positions. During this closing movement of the handles the foremost slug in the magazine is ejected from the latter by the plunger 50 on its carrier and driven into the work as sequentially shown in FIGS. 4, 5 and 6 of the drawings. While the slug is being driven in this manner, it may shear off the loose ends of the wires as indicated in FIG. 5 by causing the knife edge 77 of the slug to cooperate with a knife edge 78 of the means defining the cavity 72. Also during this movement the lower portion of the slug bites into the insulation of the wires, parting the insulation, to expose bared portions of the conductors to the slug to thereby connect them electrically as the wires are squeezed between the slug and the wall structure of the cavity. The slug is driven with pressure into the cavity with portions of the wire, forming such a tight fit that subsequent dislocation of the slug is strongly inhibited. It will be understood from the foregoing that when one cavity of the terminal block has been filled with a slug, the handles of the tool may be released and the tool disengaged from the block and reengaged therewith in registry with another cavity to be filled by a slug.

In FIGS. 16 through 23 and 25 of the drawings there is shown a modified form of slug-driving tool which is power operated having a plurality of plungers which operate simultaneously to drive slugs from a magazine which in this illustrated form is a separable magazine shown in FIGS. 24 and 26, which, when emptied of slugs, may be discarded and a new magazine substituted therefor. The tool is of the type which is operated pneumatically though it will be obvious from the following detailed description that it could be operated by other power means and, while the tool is illustrated as equipped with three slug-driving plungers, it will also be obvious that the tool may be equipped with more than three such plungers if desired. Obviously slugs may be driven at a faster rate with this tool and more power may be applied to drive the slugs than in the hand tool previously described.

In the modified form there is provided an air cylinder indicated generally at 80 which may function as a handle for the tool. Attached to the cylinder as by a threaded connection, not shown, is a cap indicated generally at 81. The cap has a vertical bore 82 therethrough in which operates a piston rod 83. The cap 81 is provided with an air inlet 84 controlled by a spring-biased valve 86. The valve chamber 87 communicates with a downward air passage 88 communicating with the interior of the air cylinder 80, and the cylinder has an air outlet 89, which outlet in the normal position of the valve 86 is open to the air passage 88 to exhaust air from the cylinder. When the valve 86 is depressed by the finger of the operator, the inlet 84 is placed in communication with the air passage 88 and the air passage 89 is blocked off so that air enters the

cylinder 80. The air inlet 84 may be supplied with a conventional threaded nipple 85 for connection as by a hose, not shown, to a source of compressed air.

When the valve member 86 is released, it returns to the normal position thereof shown in FIG. 22 in which the interior of the cylinder is in communication with the air outlet 89. Admitting air to the cylinder in the previously described manner serves to retract the piston rod 83 which extends without the cap. Spring means, not shown, may be employed to move the piston rod in the other direction so that the rod 83 is extended.

As shown in FIG. 18, the cap 81 has extending upwardly therefrom in integral relation a bifurcated forward part 90 and a bifurcated rearward part 91, the bifurcated upward extensions 90 and 91 of the cap being spaced apart as shown a distance approximately that of the diameter of the piston rod 83. The bifurcations of the upward extensions 90 and 91 face forwardly and rearwardly. In the forward bifurcation a bucking comb block 92 is secured in place to the extension 90 as by fasteners 93. The comb is similar to that provided by the flanges 19 of the previously described tool for the support of a terminal block in the manner previously described. It will be noted, however, that the bucking comb 92 provides four blades or teeth while the previously described bucking comb constituted by the flanges 19 has but two blades or teeth. Secured in the bifurcation of the rear extension 91 is a block 94 fixed thereto as by fasteners 95. This block 94 is best shown in FIG. 23.

Between the extensions 90 and 91 of the cap there is provided a yoke-shaped plunger carrier 96 (FIG. 19) secured to the outer end of the piston rod as by fasteners 97. The yoke has a forward extension 98, as shown in FIG. 18, from which three plungers 99 depend in laterally spaced-apart relationship. The plungers 99 may have their upper ends fixed in the extension 98 in any suitable manner.

When the piston rod 83 is retracted by air pressure to drive three slugs by the plungers 99, the plungers 99 slide through a magazine, indicated generally at 100, to be described in detail hereinafter. In this illustrated form the nosepiece 101, which in function is similar to the previously described nosepiece 38, is integral with the magazine as shown in FIG. 26 to provide open-ended chambers, three in number, through which the respective plungers 99 operate. Also in this instance the magazine has as an integral part thereof three forwardly extending protrusions 103 (FIG. 17) corresponding to the protrusion 32 of the tool of FIG. 1 located below and slightly rearwardly of the nosepiece 101, which projections 103 serve the same function, which is registry with the aforementioned terminal block as aforesaid.

The slug-feeding details of this tool are best shown in FIG. 23 wherein the block 94 has a recess 104 in the forward face thereof receiving the head 105 of a tie rod 105<sup>a</sup> which extends through a bore 106 in the block. The bore 106 communicates at its rear end with a greatly enlarged bore 107 of the block 94, which bore 107 receives the forward end of a barrel 108 and is suitably secured thereto.

The barrel at its rear end portion extends through a vertical part 109 of a retaining clip, indicated generally at 110, which forwardly of the part 109 has a forward extension 111 to overlie the rear end of magazine 100 when the magazine is assembled with the tool. The barrel 108 passes through an opening 112 formed in the vertical portion 109 of the retaining clip 110. Rearwardly of the portion 109 the retaining clip is provided with a rearward extension 113 which at its rear end has an upward extension 114 at the rear end of the barrel and through which the rear end of the tie rod 105<sup>a</sup> extends as shown in FIG. 23. The rear end of the tie rod may be threaded to cooperate with a nut 115 externally of the upward extension 114 of the retaining clip which closes the barrel at the rear end thereof. As shown in the last-mentioned view, the tie rod extends through a bore in the upward extension 114 of the retaining clip.

A compression spring 116 is disposed in the barrel in embracing relation to the tie rod, having one end thereof reacting

against the upward extension 114 of the retaining clip and having the other end reacting against a pusher 117. The pusher 117 is in the form of a sleeve slidably received on the tie rod 105<sup>a</sup>, having an upward bladelike part 118 extending radially therefrom through a slot 119 formed in the barrel extending lengthwise thereof, the part 118 being suitably secured to the sleeve. Forward movement of the pusher 117 may be limited by engagement thereof with the block 94. The blade 118 of the pusher 117 extends upwardly through a longitudinal slot 120 formed in the bottom of the magazine.

The magazine 100 is shown to advantage in FIG. 25. It may be conveniently formed of plastic material and comprises a unitary body 121 providing side and top walls and a pair of laterally spaced-apart longitudinally extending ribs 122 depending from the top wall thereof. As shown in FIG. 25, the bottom 123 of the magazine is formed to extend between the sidewalls and has a pair of longitudinally extending laterally spaced-apart ribs 124 in alignment with the respective ribs 122. The aforementioned ribs 122 and 124 define longitudinal slug chambers 125, each receiving a series of slugs prior to assembly of the magazine, which slugs may be similar to those shown and described with reference to the tool of FIG. 1. It may be well to point out here, however, that the slugs may take other forms than that shown. They might be spherical, for example.

The magazine contains a follower 126 which may be considered in a broad sense part of the slug pusher. The follower 126 may also be formed of plastic and is elongated lengthwise of the magazine, having in the rear end thereof an opening 127 into which the pusher blade 118 extends when the magazine is assembled as shown in FIG. 23. The blade 118 may abut the forward wall of the opening 127 in the pusher to urge the follower forwardly under the influence of the spring 116 when the magazine is assembled with the tool. Of course, when the magazine is assembled, the follower is inserted in the magazine in a position behind the positions which the slugs occupy in the magazine. As shown in FIG. 25, the follower 126 comprises two vertical sections 128 separated from a central vertical section 129 and joined thereto by arms 130 which slide over the ribs 124 of the magazine bottom 123 and which arms are disposed between the last-mentioned ribs and the ribs 122 of the body. These vertical sections 128 and 129 serve to drive the series of slugs forwardly in the magazine in their respective chambers 125 under the influence of the spring-biased pusher 117.

As shown in FIG. 24, the bottom of the magazine which is shown here disassociated from the tool has a depending flange 131 which is provided to cooperate with a leading face, not shown, of the comb block 92 to prevent axial dislocation of the magazine in a rearward direction when it is assembled with the tool. Also, as shown in this view, the magazine is provided with a cover 132 which is constructed to slide on and off the magazine in the region of the nosepiece. When assembled over the nosepiece it prevents slugs from dropping out of the magazine prior to assembly with the tool. The magazine cover 132 is removed after the magazine is assembled in the tool and prior to use of the tool. The cover 132 may be held in place when the magazine is not in use as by being dovetailed to the body of the magazine, as shown in FIGS. 24 and 26. It will be understood from the foregoing that when the magazine is assembled with the tool, it is supported both on the upper surface of the bucking comb block 92 and the block 94 as well as the retainer clip 110.

As shown in FIGS. 20 through 22, the tool of the modified form is provided with protective plates, a rear plate 133 secured to the rear cap extension 91 as by fasteners 134, and two sideplates 135. It will be noted that the rear cover plate 133 extends forwardly over the cap extension 91 at its upper end and at its lower end overlies the magazine 100 as at 136. The sidecover plates, each having the outline best shown in FIG. 22, are secured to the cap extensions 90 and 91 as by fasteners 137. Each cover plate 135 has a raised portion 138 and a free straight horizontal edge 139 to support a magazine

retainer 140 in edgewise relation thereto in the normal position of the last-mentioned retainer.

The magazine retainer 140 is generally of yoke-shape formed of sheet metal having the arms thereof bulged outwardly as at 141 intermediate their ends and having a pair of upper flanges 142 adjacent the forward end thereof laterally directed and approaching one another. The retainer 140 in the assembled position of the magazine shown in FIGS. 20 and 22 closely overlies the nosepiece 101 of the magazine as at 143 after removal of the magazine cover 132 and provides an abutment limiting axial movement of the magazine in a forward direction. The yoke is pivoted on the fasteners 137. The flanges 142 normally abut the top of the magazine to prevent the magazine retainer from swinging downwardly from the operative position of FIG. 20. The arrangement is such that when finger pressure is exerted on the upper rear portion of the cover plates 135 deflecting the plates toward one another, freeing the retainer from the edge portions 139 of the sideplates, the retainer may be swung upwardly on its pivot 137 to the broken line position of FIG. 21 to clear the magazine 100 for removal of the magazine from the tool.

The magazine 100 is removed by filtering the front end thereof and then pulling the magazine forwardly through the cylinder cap 81, thereby disengaging the slug pusher 117 from the follower 126. It will be understood from the foregoing that a new magazine may be inserted in the tool by following the steps outlined above in the reverse order. As previously indicated, the magazine cover 132 is removed before the magazine retainer 140 is swung from its broken line position of FIG. 21 to the full line position thereof in which it overlies the nosepiece 101 of the magazine.

The operation of the tool in the modified form will be readily understood from the foregoing description. It coacts with a terminal block such as that illustrated and described with reference to FIG. 11 in connection with the operation of the tool of FIG. 1 except, of course, that the modified form of the tool drives a plurality of slugs simultaneously into the terminal block and that this is accomplished by the aforementioned power-operated means.

While only two forms of the magazine-equipped slug-driving tool have been shown and described above, it will be apparent to those versed in the art that the tool may take other forms and is susceptible of various changes in details without departing from the principles of the invention and the scope of the appended claims.

What is claimed is:

1. In a slug-driving tool
  - a. a support having a forward end,
  - b. a bucking comb carried by said support for receiving work having a capacity into which a slug is to be driven,
  - c. an elongated magazine on said support containing a plurality of slugs in alignment,
  - d. a nosepiece mounted on the forward end of said support and including an open ended slug chamber in alignment with said magazine, said chamber presenting a forward wall,
  - e. means included as a part of said magazine to bias the slugs therein towards said nosepiece whereby the foremost slug is held against said forward wall,
  - f. a plunger carrier mounted on said support and movable towards and away therefrom,
  - g. a plunger mounted in said carrier and,
  - h. means to align the work supported by said bucking comb with said plunger.
2. A slug-driving tool as defined in claim 1 wherein said work-aligning means comprises at least one forward projection on the forward end of the magazine.
3. A slug-driving tool as defined in claim 1 wherein an operating handle is pivoted to said support and a second operating handle is provided in pivot relationship to said plunger carrier, and a pivot is provided between said handles.
4. A slug-driving tool as defined in claim 1 wherein said plunger carrier has a rectilinear movement toward and away from the work support and is power operated.

5. A slug-driving tool as defined in claim 3 wherein said magazine extends generally lengthwise of the handles and therebetween and has its forward end mounted on said support in fixed relationship thereto with the rear end of the magazine free.

6. A slug-driving tool as defined in claim 3 wherein said magazine extends generally lengthwise of the handles and therebetween and has its forward end mounted on said support in fixed relationship thereto with the rear end of the magazine free, the magazine comprising a C-shaped channel member receiving slugs therein and further comprising a compression spring on the channel member for support thereby, the spring at its forward end reacting against a spring yoke in embracing relation to the spring and pivoted to a spring follower within the channel member, said spring yoke having latching means to latch over the rear end of the magazine upon compression of the spring to hold the follower in the retracted position thereof when loading the magazine through its forward end, said nosepiece being movably mounted for loading of the magazine through the forward end thereof.

7. A slug-driving tool as defined in claim 3 wherein the nosepiece comprises a slidable generally tubular part spring biased to the aforementioned position thereof in which it forms a part of said slug chamber and being movable to a retracted position against said bias in which it may be rotated to be latched in an out-of-the-way position for loading of the magazine through the front end thereof.

8. A slug-driving tool as defined in claim 3 wherein a motion-compelling mechanism is provided for said operating handles comprising a channel member fixed to one handle having a pawl located intermediate of the walls of the channel and pivoted therein, said motion-compelling mechanism also comprising a toothed bladelike ratchet member extending into the channel member for cooperation with the pawl, the ratchet member being pivoted intermediate of its ends by said pivot between the handles and pivoted at its other end by means of an adjustable eccentric to a locking arm, said locking arm being mounted on the other of said operating handles, whereby adjustment of the eccentric functions to vary the extent of travel of the slug-driving plunger.

9. A slug-driving tool as defined in claim 3 wherein said magazine extends generally lengthwise of the handles and therebetween has its forward end mounted on said support in fixed relationship thereto with the rear end of the magazine free, the nosepiece being a slidable generally tubular part spring biased to the aforementioned position thereof in which it forms a part of said slug chamber and being movable to a retracted position against said bias in which it may be rotated to be latched in an out-of-the-way position for loading of the magazine through the front end thereof.

10. A slug-driving tool as defined in claim 3 wherein said magazine extends generally lengthwise of the handles and therebetween and has its forward end mounted on said support in fixed relationship thereto with the rear end of the magazine free, and wherein a motion-compelling mechanism is provided for said operating handles comprising a channel member fixed to one handle having a pawl located intermediate of the walls of the channel and pivoted therein, said motion-compelling mechanism also comprising a toothed bladelike ratchet member extending into the channel member for cooperation with the pawl, the ratchet member being pivoted intermediate of its ends by said pivot between the handles and pivoted at its other end by means of an adjustable eccentric to a locking arm, said locking arm being mounted on the other of said operating handles, whereby adjustment of the eccentric functions to vary the extent of travel of the slug-driving plunger.

11. A slug-driving tool as defined in claim 3 wherein said nosepiece comprises a slidable generally tubular part spring biased to the aforementioned position thereof in which it forms a part of said slug chamber and being movable to a retracted position against said bias in which it may be rotated to be latched in an out-of-the-way position for loading of the magazine through the front end thereof.

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12. A slug-driving tool as defined in claim 4, wherein the plunger carrier has mounted thereto a plurality of slug-driving plungers, each operating through a nose section of the magazine to cooperate with one slug therein, to drive the cooperating slugs simultaneously.

13. A slug-driving tool as defined in claim 12, wherein the plunger carrier is operated by a valved fluid cylinder forming a tool handle and provided with a piston rod secured to the carrier for effecting reciprocating movements of the latter.

14. A slug-driving tool as defined in claim 13 wherein the plunger carrier is of yoke-shape, embracing the magazine, the magazine being detachable and separable from the tool.

15. A slug-driving tool as defined in claim 13 wherein the

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feed mechanism for the slugs includes a pusher part within the magazine rearwardly of the slugs and an opening in a wall of the magazine through which a spring follower extends engaging said pusher part and urging it forwardly.

5 16. A slug-driving tool as defined in claim 13 wherein the plunger carrier is of yoke-shape, embracing the magazine, the magazine being detachable and separable from the tool and wherein the feed mechanism for the slugs includes a pusher part within the magazine rearwardly of the slugs and an opening in a wall of the magazine through which a spring follower extends engaging said pusher part and urging it forwardly.

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