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R. B. DICKSON

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3 Sheets-Sheet 1

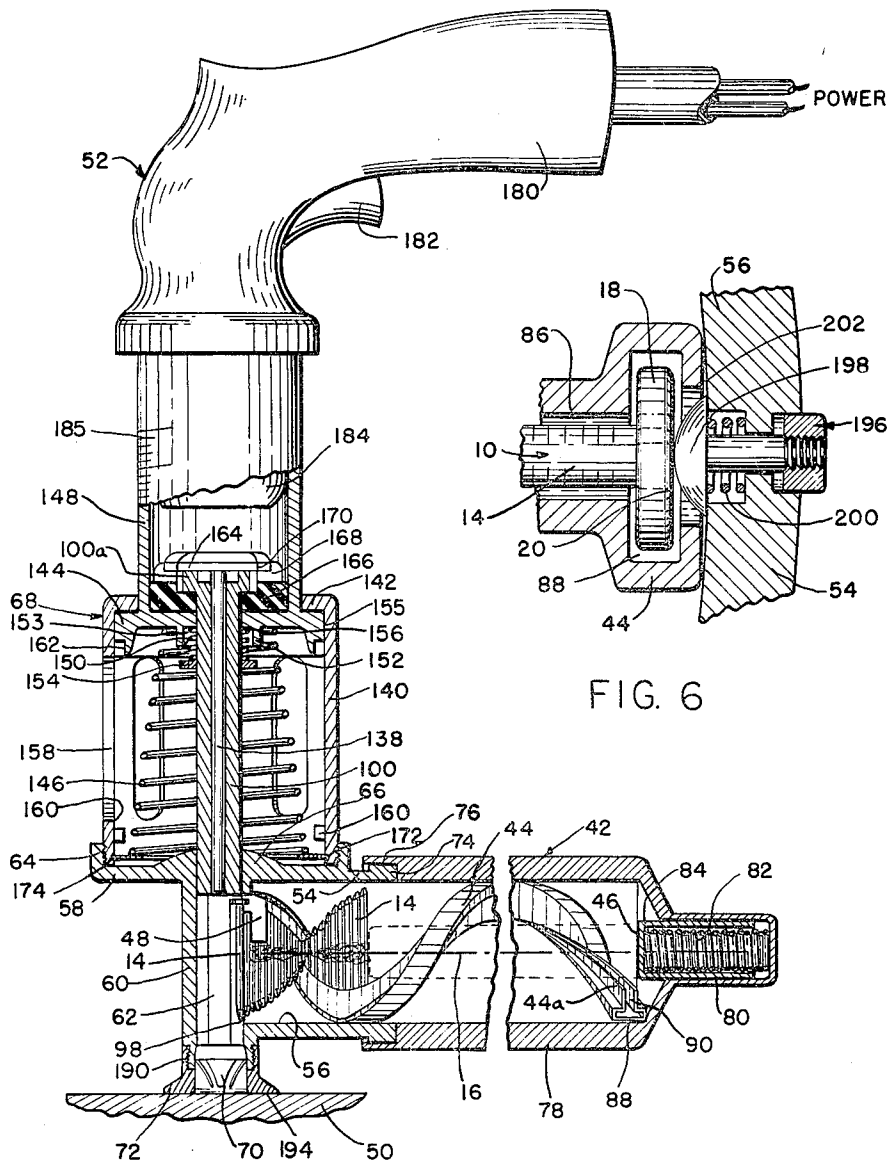


FIG. 6

FIG. 1

INVENTOR.
ROBERT B. DICKSON

BY

Robert B. Dickson

ATT'Y.

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R. B. DICKSON

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3 Sheets-Sheet 2

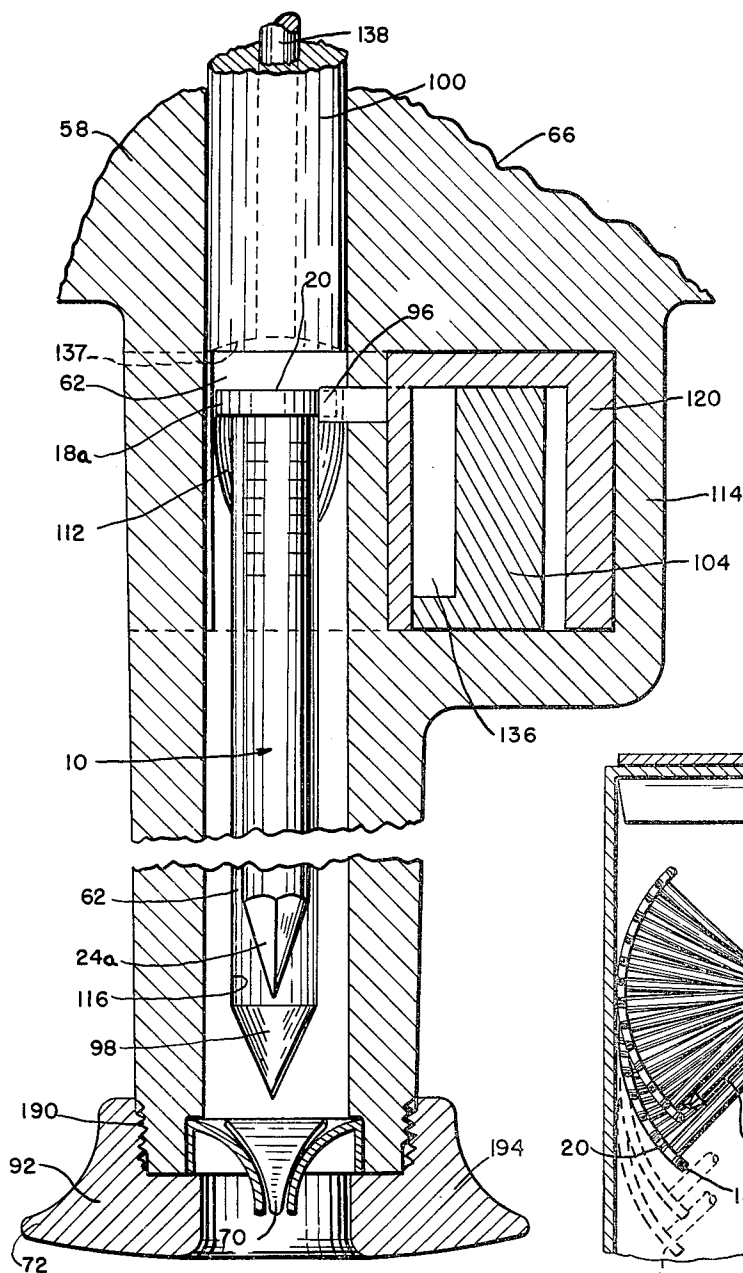


FIG. 5

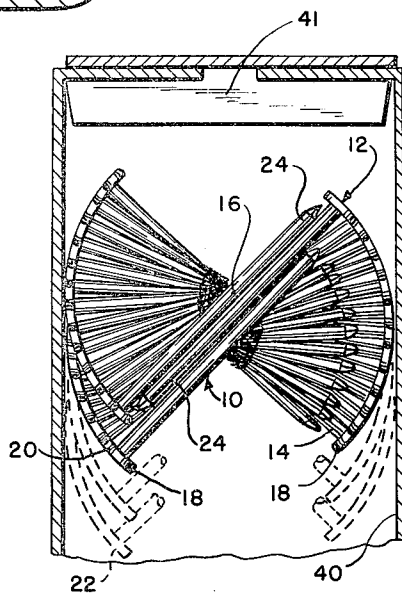


FIG. 2

INVENTOR.

ROBERT B. DICKSON

BY

Robert B. Dickson

ATT'Y.

Oct. 19, 1965

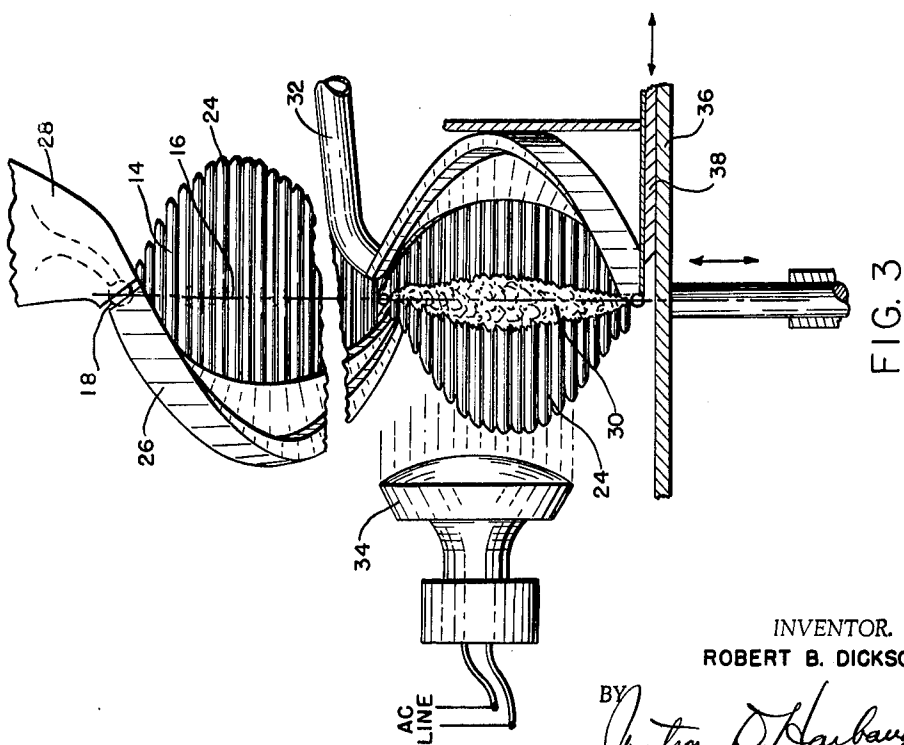
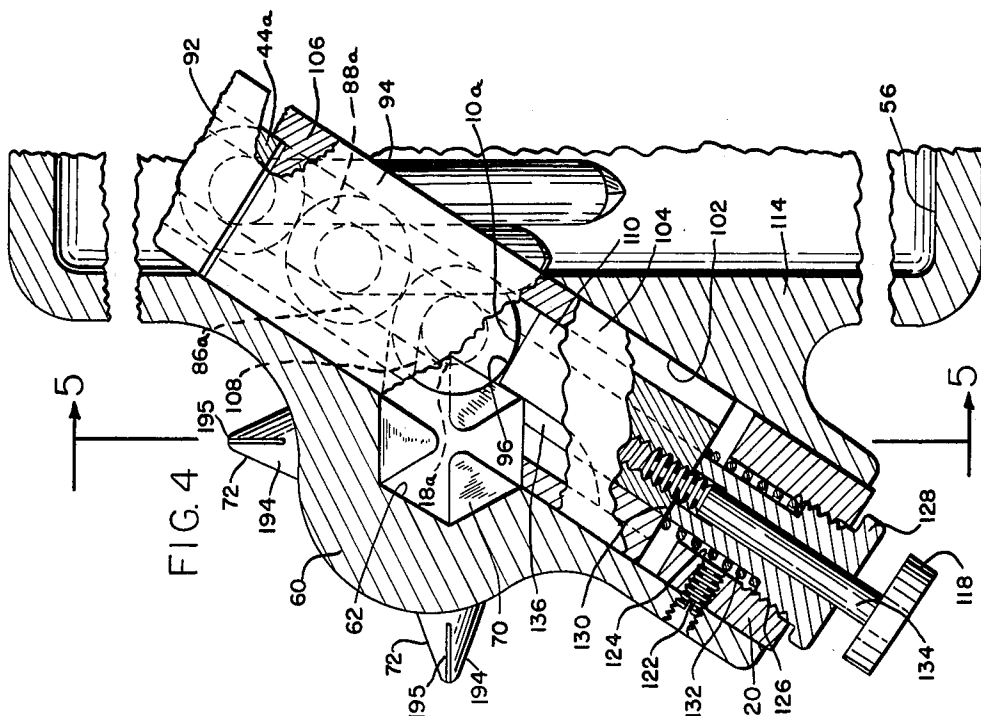
R. B. DICKSON

3,212,633

NAILER

Filed Nov. 5, 1963

3 Sheets-Sheet 3



INVENTOR.
ROBERT B. DICKSON

BY *Robert D. Harbaugh*
ATT'Y.

1

3,212,633
NAILER

Robert B. Dickson, Evanston, Ill., assignor to Dickson Weatherproof Nail Company, Evanston, Ill., a corporation of Delaware

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The present invention relates to power driven nailing equipment and to the use of nails, particularly common nails, both loose and in clips and to the feed and the driving of the nails, preferably with repeated blows of an automatic hammer.

Power equipped devices have been used for many years for driving nails and brads. Many problems have beset the industry requiring the provision of special nails and magazines inclined to the driving barrel. Expensive strips, wire, webbing or adhesive tapes have been resorted to in order to space the nail shanks and maintain the nail heads in coplanar relationship for straight line feed applications.

An object of the invention resides in handling common nails having single, double or cabinet heads in clips of ten nails which are compactly shipped and easily managed for a gun taking up to fifty nails at one loading, yet the gun can be quickly loaded fully or in part with any common or headed nail one at a time if desired or necessary.

A further object of the invention is to provide a simple, power driven nailer of the repeating type embodying a novel magazine which is easily loaded with clips of nails or independent nails individually or in groups, with the magazine either readily replaceable, or quickly rechargeable without removal.

A further object of the invention is to provide visual, tactual and auditory perception as to the speed and depth at which each nail is being driven in order to capitalize upon the skill of the journeyman for neat and mar-free work as distinguished from the results of a heavy one-blow drive.

Another object of the invention is to provide a nailing gun which fits in with and utilizes the skills of a journeyman to drive and set nails without marring the wood yet can rough-hammer nails home without unsightly marring of the wood surface.

The invention is also characterized by the hammer being advanced and the device guided by one hand and the nail as it is being driven. The depth that the nail advances is followed visually so that the last few blows can be controlled to leave the nail head at whatever level desired.

A further object of the invention is to provide a resting status for a power nailer which prevents movement of the next nail from the magazine into the driving chamber until after actuation of the device whereupon release is immediately accomplished followed instantly by the first of a series of nail driving hammer blows with continuous contact being maintained between the nail and the driving element struck by the hammer.

Another object of the invention is to provide a pneumatic nailer in which the nail feed and driver characteristics are unchanged by environmental forces regardless in which position the device is operating.

Another object of the invention is to provide a power driven nailer which handles common and finishing nails and can terminally "set" either nail with force-tempered blows as controlled for each nail or nail size individually by the operator.

The invention also contemplates ready interchangeable use of electrically driven or pneumatically powered hammers depending upon which type hammer is readily available, or which form of power is available.

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Another object of the invention is to provide a gun which drives common nails at any usually employed angle ranging from 90° to a "toenailing" angle of studs on joists with or without suitable adaptor shoes for particular purposes.

Another object resides in providing a magazine construction which handles all common nails as well as many special nails in a lineal space no longer than the sum total of the nail shank diameters loaded in the magazine.

A further object of the invention resides in maintaining the shank portions of common nails in contact with one another in a magazine whereby nail feed movement to a driving element may be accomplished by forces applied remotely from the driving element as at the entry end of the magazine.

Another object of the invention is to provide a portable, light, power driven nailer that is easily managed by one hand, utilizes electricity or fluid pressure as a power source interchangeably, is comparatively inexpensive, and is easy to service and maintain.

Further objects of the invention will appear from the description which follows and the drawings related thereto in which:

FIGURE 1 is a side elevational view partly in section taken longitudinally and centrally through a portable power nailer embodying the invention.

FIG. 2 is a top plan view partly in section of the nail clip form embodying the invention as packaged with the clips in nested relationship.

FIG. 3 is a side elevational view of an apparatus by which the nail clips embodying the invention are produced.

FIG. 4 is a cross sectional view taken through the bore and feed chamber of the nail driving elements and approximately the level of the nail heads entering the bore for driving purposes.

FIG. 5 is a section taken upon line 5—5 in FIG. 4.

FIG. 6 is a section taken through a portion of the magazine wall showing the construction of a nail supply depletion indicator.

The invention is illustrated in connection with nails that are most used. Such is the common nail that ranges from 1.5 to 2.5 inches in length and the nail 10 particularly disclosed is an eightpenny common nail approximately 2.5 inches long with a wire shank diameter of .13 inch and head diameter of .28 inch. For ready handling the nails are arranged in clips 12 of ten nails each (FIG. 2) in which the shanks 14 contact a little off-center their midpoint in a straight line 16 sometimes referred to herein as an axis and the heads 18 contact edge-to-edge at their periphery in a helical path with their top surfaces 20 defining a cylindrical surface of revolution 22.

Although both contacting areas may be adhered with a frangible cement 30 (FIG. 3), it has been found that adherence at the center contacts of the nail shanks is adequate.

The helix angle is one of approximately 35° and although the clips may be formed to a full helical turn or any part of a full turn, it is preferred to furnish them in units of ten nails each. This provides a little less than a 90° turn as shown in FIG. 2. The heads are about twice the diameter of the shank. In this size and number they are easy to count, assemble, handle and package. The clips nest with each other and pack flat side by side with the center lines 16 spaced and parallel with each other (FIG. 2). Shorter nails down to 1.5 inches in length can be formed on the same helix but the shanks would contact nearer the point ends 24 of the nail, the heads 18 remaining in the same helical path.

In forming the clips a collector 26 (FIG. 3) defining a corresponding helical track is fed with oriented nails at the upper end from a hopper 28. The heads enter

a T-slot or groove of the track along the helix angle mentioned, and in advancing to the bottom the helical configuration is imposed on them of several turns leaving the shanks 14 exposed laterally where they contact at the center line 16 of the helix. On their way down the center contacting portions of the shanks are provided with an adhesive 30 from tube 32 which is quickly dried with applied heat from an infrared lamp 34 to a brittle consistency. The lower end of the helix rests on an elevator 36 and a knife 38 cuts off the lower ten nails from the assembly as a unitary clip.

Two collectors preferably are employed together on a single loading line, or one is rotated 180° each cut, so that the clips interdigitate with heads alternately opposite as the clips nest laterally and move as package assemblies (FIG. 2) into rectangular packages 40 that are as wide as the nails are long, as thick as the axial height of the clips at the contacting nail heads, and as long as needed to accommodate ten, twenty or thirty nested clips 12 as desired. The alternate reversal of the head ends results in each clip head end portion being interdigitated or nested between the pointed ends of the nail clips adjacent thereto.

When received ready for use, the flap 41 of the package 40 is opened at the end and the nested clips are slid therefrom to be dropped one by one into a helical nail feeder magazine 42 (FIG. 1) having a helical feeder track 44 in which the nails are advanced by a follower 46 at the entry end to a terminal magazine feed station indicated at 48 where the nails are severed one at a time and driven into a workpiece 50. With factory nailing machines the clips can be fed automatically. The package can be end opened and the clips dropped straight away one by one into a passageway in which the clips are oriented all ends alike for entrance into a helical feed magazine as a continuous helix of nails. The passageway catches the wider overall axial height of the clip at the head portion and turns each alternate clip into oriented position.

With portable power tools such as shown at 52 in FIG. 1, the clips can be hand inserted one or more at a time into the track 44 in magazine 42. The magazine will take at least four clips, preferably six to eight. Four clips will supply a magazine of 40 nails and a six or seven inch magazine provides a starting charge of half a hundred nails plus any partially used clip already present. Moreover, it will be appreciated from the description herein that loose common nails can also be fed into the magazine 42 if desired at any time as a group or intermingled between clips.

The magazine 42 includes a tubular housing 54 forming a cylindrical compartment 56 on a power tool housing 58 made of light cast metal having a transverse barrel 60 and bore 62 terminating at the top in an internally threaded flange 64 cavity 66 which receives a power unit 68 thereon. The barrel 60 terminates at the bottom in a nail guide 70 and nail position indicator bosses 72.

The tubular housing 54 on its outer marginal end is provided with small bosses defining male members 74 of a bayonet joint union in which the mating slots or grooves 76 are provided in the flange portion of a closure 78 having a cavity 80 which supports a spring 82 moving a follower 84 coaxially to the tubular housing.

The helically shaped track 44 is peripherally supported in the tubular housing to receive nail clips 14 in helically aligned and guiding relationship. The plan contour of the nail 10 adjacent to and including the head 18 (FIG. 6) is approximated in the cross-sectional contour of track and preferably is defined by an elongated element having a T-groove 86 therein, the element preferably is rolled from straight stock like a helical spring into a helix in which the head portion 88 of the groove defines a helical lead angle of approximately 35° and the space between the legs 90 of the T-groove defined a helix angle, of 45° or more, leaving approximately one-third to one-half of the length of the nail shank 14 exposed at the cen-

ter of the tubular housing 54. If a 2.5 inch nail is fed, a center third portion of the shank will be exposed. If a 1.5 inch nail is fed, it will be the terminal portion of the shank that is exposed. If the nail heads 18 are twice the diameter or more of the shank 14, the head helix angle will be 35° or less accordingly. If the heads 18 are less than twice the diameter of the shank 14, a magazine and helix of 35° will still take the nails with the clip provided with a 35° helix angle.

The track can be formed in a continuous process with radially directed pairs of turning rollers and axially directed twisting rollers operating against a radially directed flange roller canted to the helix angle of the mouth of the track.

Although the track 44 can serve as an interchangeable assembly clip component, it preferably is secured to the inner wall 56 of the tubular member 54 and the outer mouth of the track 44 is shaped to only receive the heads of the nail clip. The feed follower 46 slides in and is guided on the inner edges of the track where the helix angle is 45° or more, thereby providing a favorable angle for advancing the nails with pressure at the clip axis 16. Other bracing elements (not shown) may be provided as needed to rigidify the assembly.

Thus, even if loose nails are employed, the nails are held in crossed relation at the axis 16 of the compartment 56 as guided by the side walls of the track and the angle of the helix which permits the nail heads to clear themselves in a spiral direction without any endwise movement of individual nails. Finishing nails in clip form can also be used because the adhesive as well as the fanned-out relationship of the head portions hold the nails in proper orientation.

Whenever it is desired to load the magazine the closure 78 is twisted free and removed leaving the track 44 supported in the tubular housing 54. The spring 82 expands and the follower 46 is withdrawn from its guideway. Additional nail clips are then loaded in the track 44 and the closure is returned. The spring 82 is again compressed in the internal guide after the follower contacts the last nail and thereby provides a nail propelling feed action where the nails solidly cross each other at the axis of the tubular housing. The helical guide is terminally located by suitable means such as end stops and guide ears or pins which hold the inner end 92 of the track 44 in coincidence with a feed arrangement as will now be described.

At the inner end 92 of the track 44 the endmost nails 10a pass successively one at a time from the track into a guide block 94 (FIG. 4) and into terminal engagement with a vertical shoulder 96 that aligns the shank of the nail with the bore 62 in the barrel 60. The endmost nail in this position has the lower or point end disposed where it enters or is cammed as at 98 (FIG. 5) into the bore 62. The head 18 of the nail protrudes into the bore 62 and when the drive piston 100 is forced from its poised position downwardly in the bore 62 the nail head is engaged and displaced. The nail 10 is thereby broken free of its cement and stop restraints and is carried radially inwardly and downwardly in the bore. The point 24a strikes and starts itself in the work 50 after which repeated blows upon the piston 100 forces the nail deeper and deeper without contact between the piston and nail head being relinquished until the nail has been driven to the depth desired.

More particularly, in FIG. 4 it will be observed that the bore 62 is hexagonal and the barrel 60 is broached at a tangent to the bore to provide a rectangular opening 102 therethrough as wide as the widest width of the T-shaped track 44. A block 104 is then made with a corresponding T-groove 88a therein abutting the track end 92 in alignment therewith as guided by two ears 106 which telescope over the sides of the leg portion 44a of the track 44 just below the head portion thereof. The block may be made of two elements fused or riveted together to provide tangential intersection of the bore 62

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with a T-slot 86a having a lateral discharge opening at 108 disposed radially to the bore 62.

A T-shaped stop member 110 is slidably received in the block 104 beyond the opening 108 and has a squared end which carries the stop 96 slidably in the T-groove 88a to limit movement of the nail head 18a. Assuming the axis of the endmost nail as so limited, the block 104 is shaped by a side cutting tool (not shown) below the head 18a to provide a coaxial conical cam 112 (FIG. 5) which shifts the head 18a fully into the bore 62 as it is moved downwardly by the piston, first to clear the squared end stop 96 and then downwardly across the cam surface 112.

Below the block, the wall 114 of the housing is milled out to provide a full access opening 116 for the endmost nail to come into parallel relationship with the bore and a like coaxial cam or chamber 98, as already mentioned, is provided at the bottom thereof to assure movement of the lower end of the nail fully into the bore 62 when the nail head is moved downwardly initially by the piston 100.

For the occasions when it may be desirable to actuate the piston 100 without injecting a nail 10a into the bore, the slide member 110 (FIG. 4) may be pushed by a button 118 to move the squared stop 96 and force back the endmost nail 10a from its "ready" position intruding in the bore 62. For this purpose the outer end of the rectangular opening is plugged with a block 120 held in place by a set screw 122, is bored at 124 and internally threaded at 126 to receive an adjustable sleeve 128. The sleeve 128 has a stop 130 thereon for the slide block 104 and a spring guide for a compression spring 132 that urges the slide block towards the oncoming nails when the endmost nail 10a has been discharged from the delivery portal 86a. A push rod 134 threaded to the slide block 104 carries the button 118 on the end thereof and thereby further serves as a telltale as to whether or not a nail 10a is in delivery position. The slide block is milled out along the contour 136 to clear the drive piston 100 regardless of the position of the slide block 104.

It will be observed that while a nail 10a is being driven, the piston 100 wall holds back the next nail 10 until the piston is retracted. During this time the slide block 104 moves towards the incoming nail under the mild influence of the spring 132 and tool vibration and makes contact with the head 18 thereof so that it is somewhat guided and constrained in attaining and remaining in delivery position after the piston is retracted. Adjustment of the sleeve 128 and stop 130 assists in positioning the end nail 10a. In this connection it will also be observed with nails having different head sizes that the tangency of the nail advance is such that a portion of the shank 14 diameter also intrudes into the bore 62, as seen in FIG. 1, thereby assuring by this adjustment that nails having the smallest of heads for a given shank size can be driven.

Furthermore, it is to be noted that merely by changing the block 104 and the track 44 in the magazine 56 any nail smaller can be handled by the device described.

In the event the operator permits the piston 100 to return to a position above the next nail head 18 and he desires to finish driving the previous nail, the slide block 110 and stop 96 are moved as controlled by a button 118 to drive the endmost nail head back out of the path of movement of the piston thereby permitting the piston to be lowered to resume driving the previous nail, or, to permit merely a pounding action without movement of any nails being involved. Release of the button 118 permits resumption of the successive driving of further nails from the magazine.

Considering now the driving of the nail, the piston 100 is reciprocable in the barrel 60, preferably by hand, and is concavely shaped on the lower end at 137 (FIG. 5) to assist in centering the nail head 18a. Furthermore, in the preferred embodiment the piston is bored to receive a nail setting stem 138 which in resting position does not engage a flat nail head, but when the handle 180 is ro-

tated a quarter turn the nail set pin 138 does engage the nail head as will shortly be described in connection with relative rotation between the piston 100 and nail set 138.

In providing this, a windowed housing 140 (FIG. 1) is threaded in the flange 64 and has an inwardly directed radial flange 142 which serves as a stop. Slidable in the radial flange 142 and the housing 140 is the head 144 of a power cylinder 148 which is spring pressed outwardly, i.e., to a retracted position, by a conical compression spring 146.

The lower face of the power cylinder 148 has a spring 153 receiving socket 150 whose side walls 152 serve as a stop engaging a washer 154 on the drive piston 100 above which the piston 100 is cylindrical, as at 156, to permit relative rotation between the piston 100 and the power cylinder 148. The corners of the hexagonal contour therebelow provide shoulders supporting the washer 154. Thus, the spring 153 urges the piston 100 downwardly while the main spring 146 holds the power cylinder upwardly. The piston 100 however becomes captive to manual downward movement by the handle 180 and cylinder 148 when the washer 154 bottoms on the side walls 152.

This arrangement provides several novel results, the piston 100 can be manually disposed in an interference path for the endmost nail 10a if desired by merely moving the head 144 a short way away from the flange by a cam at 155 or preferably moving it clear down where a bayonet lock between lugs 160 at the bottom of the housing 140 and slots 162 in the head 144 can hold them. Either or both, however, can be used. Once the cam 155 or lock 160 is released the piston 100 is spring raised to clear the nail head 18a and thereafter downward pressure on the power cylinder frees the endmost nail 10a and maintains contact therewith while actuation of the hammer drives the nail. Concomitant therewith the arrangement provides the operator not only with a visual perception of progress through windows 158, but also tactual perception of the driven movement of the nail.

Referring now to the relative manual rotation between the piston 100 and nail set 138 the piston is preferably hexagonally shaped externally at its lower end for non-rotational guidance by the hexagonal bore 62. Thus, relative rotation is established for manual control between the power cylinder 148 and the head 100a on the piston 100 in the cylinder 148. The head 100a is held against rotation when the handle 180 rotates the cylinder 148. Means are then provided whereby the nail set stem 138 can be rotated by rotary movement of the power cylinder so that the nail set is activated for setting nails driven by the piston 100. For this purpose the nail set stem has quarter segments 164 matable with but not normally resting on top of quarter segments 168 on the head 100a carried by the piston 100. As thus disposed, nail driving effort is transmitted through the segments to the piston and thereby to the nail head without the nail seat protruding. However, with a quarter turn of the power cylinder, the segments of both elements interdigitate to drop the nail set stem 138 downwardly to protrude and deliver a final driving blow to the nail head through the nail set stem. This rotation of the nail set 138 by the cylinder 148 is accomplished through the construction of the upper face of a rubber bumper 166 that is provided to cushion any blow not transmitted in full to a nail head. The bumper 166 is fit tightly in the cylinder 148 at its base and the cushion portion has upstanding guide ways 189 receiving in rotary engagement radial ears 170 on the nail set stem head. Thus, relative rotation between the nail set stem and piston 100 can be accomplished by rotation of the cylinder 100 when desired. It will be observed that if desired the piston 100 can be cylindrical throughout instead of hexagonal and then moved manually by a shaft driven cam insteam of the power cylinder rotating the nail set pin, but this requires two-handed operation and is not shown. Such a shaft would extend

laterally through a window 158 to accommodate axial and rotary movement at any particular level. The nail set feature can be omitted or removed at any time or in any construction merely by omitting the nail set stem.

The power unit and piston are removable at the threaded joint on flange 64, the spring 146 being retained therewith as bottoming on a C-flange spring retained by 172 resting in groove 174. Thus, an electrical or pneumatic hammer means can be interchangeably used with the magazine shown or interchangeable with a series of magazines similarly constructed to take different nail size ranges merely by unthreading at the joint.

Preferably the upper end of the power unit has a pistol grip handle 180 and actuation of the device is by trigger 182, in any suitable manner, accompanied by downward force on the handle 180. In this connection downward force on the handle raises the piston head 100a off of the bumper 166 against the action of the spring 153 so that the full blow of the hammer is transmitted to the nail. The distance of this movement can be manually varied depending on the power of each hammer blow desired for the ranges of nails to be handled and the final blows. Letting up on the handle until some of the blow is cushioned by the bumper lightens the blow delivered. It is desirable to strike eight to twelve blows before the final blows in order for the operator to have time to react to let-up and lighten the final few blows if desired. It was noted that initial downward thrust on the power cylinder severs and moves the nail into driving position, if desired, before moving the trigger to apply the first hammer blow. This is particularly desirable for shorter nails to place the nail and hammer into operating relationship before a power stroke blow is induced. Thus, operation of the device is versatile for operation by differently skilled workmen and different sizes of nails. A hammer 184 conventionally reciprocated by compressed electricity is shown, as by way of example but not to exclude pneumatic hammers.

Considering further the action and control of driving the nails, indicator marks 185 (FIG. 1) encircling either cylinders 140 or 148 serve as references between them to indicate the remaining position of the nail as seen from any direction. This is true of and is a constant for all nail lengths.

As the head of the endmost nail 10a is severed from the clip and moved downwardly, it clears the shank of the next nail 10 by the cams described but preferably before the point 24a of the nail contacts the work the downwardly inclined spring fingers 70 center the point. As the nail is driven home the head 18a thereof cleans the fingers and the lower end of the piston 100 holds them outwardly until the piston is retracted for the next nail. Anytime a nail head requires a few more driving blows to seat it the piston is moved down through the spring fingers to engage the nail and strike the blows without damage to the spring fingers because one of the features of the invention is that the piston during the driving operation is held in contact with the nail head being driven all the way down.

The lower end of the boss 60 preferably is threaded at 190 to interchangeably receive shoes. A standard shoe 92 that is rounded to prevent surface scratching is illustrated. Specially constructed shoes can be used for special application and angles and can include guides or even nail pulling teeth. The one which is "standard" for the embodiment disclosed is provided with four short ribs 194 with indicia lines 195 at right angles to each other to apprise the operator of the expected location of the nail, to better center it with respect to a particular spot or nail entrance opening when desired.

It is highly desirable that the magazine be kept free from outside contamination and for this reason it is made completely sealed except when loading. For the convenience of the operator, a nail reserve indicator 196 (FIG. 6) can be provided comprising an element glider

button 198 lightly spring pressed by spring 200 against the head 18 of the eleventh remaining nail 10b in the magazine through an opening 202 in the head portion of the track 44 at that point. When ten nails remain the slider is no longer supported and moves flush with the housing to indicate ten or less nails remaining in the magazine. This is located one-quarter turn of the track 44 away from the discharge portal 48 on the right hand side of the housing 54.

While common nails are disclosed in the drawing and the description relating thereto it will be understood that any form of nail having a head diameter larger than the shank can be handled by devices embodying the invention, including spikes, roofing nails, brads, finishing nails, etc. and further that frangible bonds other than cement can be employed including plating material, soft wires fused thereon, or tapes, provided they hold the shanks in contact with each other where they cross.

Having thus disclosed and described the invention, it will be readily apparent how the stated objects and other objects and advantages set forth are accomplished and how various and further changes can be made therein without departing from the spirit of the invention, the scope of which is commensurate with the appended claims.

What is claimed is:

1. A nail clip comprising a plurality of nails with their heads oriented in edge to edge contact in a helical path and their shank portions crossing in contact with each other at the axis of said helical path, and frangible means adhering the shanks to one another where they contact.

2. A nail clip comprising a plurality of nails with their heads oriented in a helical path defining a surface of revolution and the shank portions crossing in contact with each other at the axis of said helical path, and frangible means adhering the shanks to one another where they contact, the lead angle on said helix at the heads being approximately 35° and the turn angle of said helix at the heads being approximately 90°.

3. A package of nails comprising a plurality of clips having the heads of the nails of each clip oriented in identical helical paths with the axis of each closer to the points of the nails than to the heads of the nails, said clips being collectively nested with each other in a direction normal to their axes with their axes parallel and spaced from each other a distance greater than the diameter of the shanks of the nail and less than the diameter of their heads.

4. A nail clip comprising a group of nails with their heads oriented in edge to edge contact in a helical path and their shanks disposed in parallel planes with the shanks in crossing contact with each other along the axis of the helical path, and holding means supporting said nails in said orientation as a group for successive removal therefrom one at a time.

5. A nail clip comprising a plurality of nails with their heads oriented in a helical path defining a surface of revolution and the shank portions crossing in contact with each other at the axis of said helical path with the axis closer to the points of the nails than to the heads of the nails, and holding means supporting said nails in said orientation as a group for successive removal therefrom one at a time.

6. The clip called for in claim 4 in which said holding means comprises a frangible means holding said shanks in said contact with each other to transmit rectilinear forces along said axis from one end of the clip to the other, said frangible means fracturing when pressure is applied in a direction normal to said axis.

7. A nail clip comprising a plurality of common nails having heads approximately twice the diameter of the shanks, said shanks being disposed in parallel planes and crossing in contact with each other on an axis normal to said planes and disposed closer to the points of the nails than to the heads, said heads being disposed in a surface

of revolution centered on said axis and contacting each other in edge-to-edge relationship, and holding means supporting said nails in said disposition as a group for successive removal therefrom one at a time.

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GRANVILLE Y. CUSTER, JR., *Primary Examiner*.

FRANK E. BAILEY, *Examiner*.