United States Patent [19]

Schrepferman

[11] **3,908,884**

[45] **Sept. 30, 1975**

[54] **NAIL AND POWERED NAILER**

[75] Inventor: **John R. Schrepferman,** Merriam, Kans.

[73] Assignee: **Bliss & Laughlin Ind., Inc.,** Oak Brook, Ill.

[22] Filed: **Oct. 11, 1974**

[21] Appl. No.: **514,328**

Related U.S. Application Data

[62] Division of Ser. No. 352,243, April 18, 1973.

[52] **U.S. Cl.** **227/130;** 227/120

[51] **Int. Cl.²** **B25C 1/04**

[58] **Field of Search** 227/95, 120, 125, 126, 227/127, 128, 130, 136, 139

[56] **References Cited**

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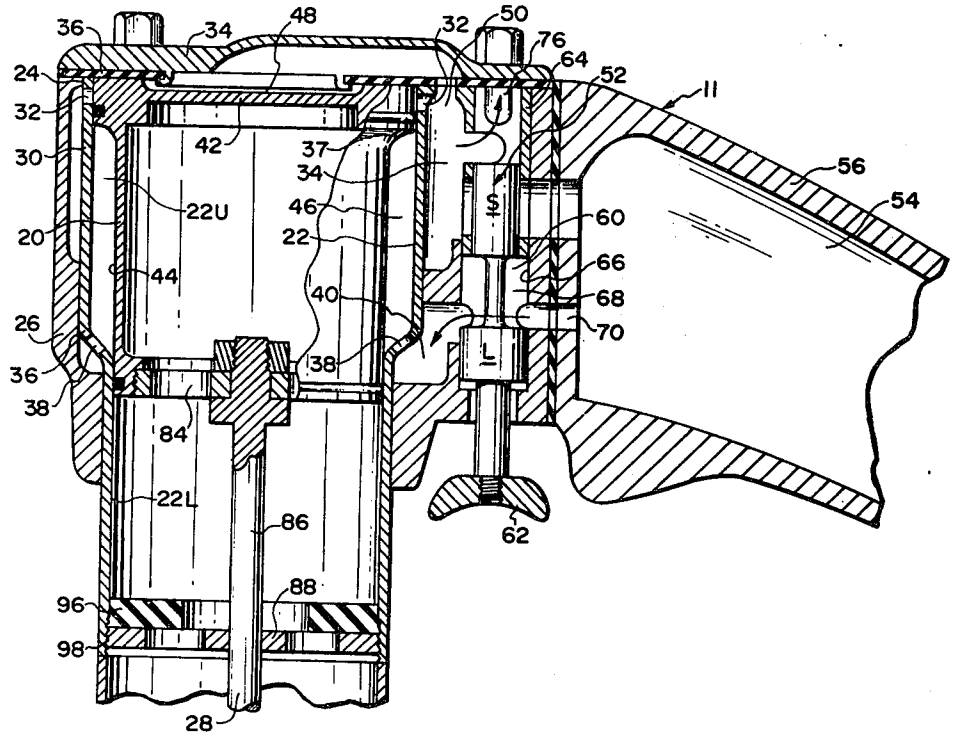
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Primary Examiner—Granville Y. Custer, Jr.
Attorney, Agent, or Firm—Watson D. Harbaugh

[57] **ABSTRACT**

A nail and nail clip arrangement in which so-called common nails may have their shanks grit-blasted and the edge of their heads flattened along equal parallel planes to provide a minor diametral dimension of the nail head that is approximately twice the diameter of the nail shank. The heads are alternately offset laterally in contact with each other in two rows and with the heads of the two rows alternately cross-engaging and the shanks of the nails interdigitate at an acute angle adjacent their points. The end nail at the feed end of one row extends beyond the next adjacent nail of the other row far enough for a powered driver to nip off and drive the lead nail upon actuation of the power mechanism.

5 Claims, 29 Drawing Figures



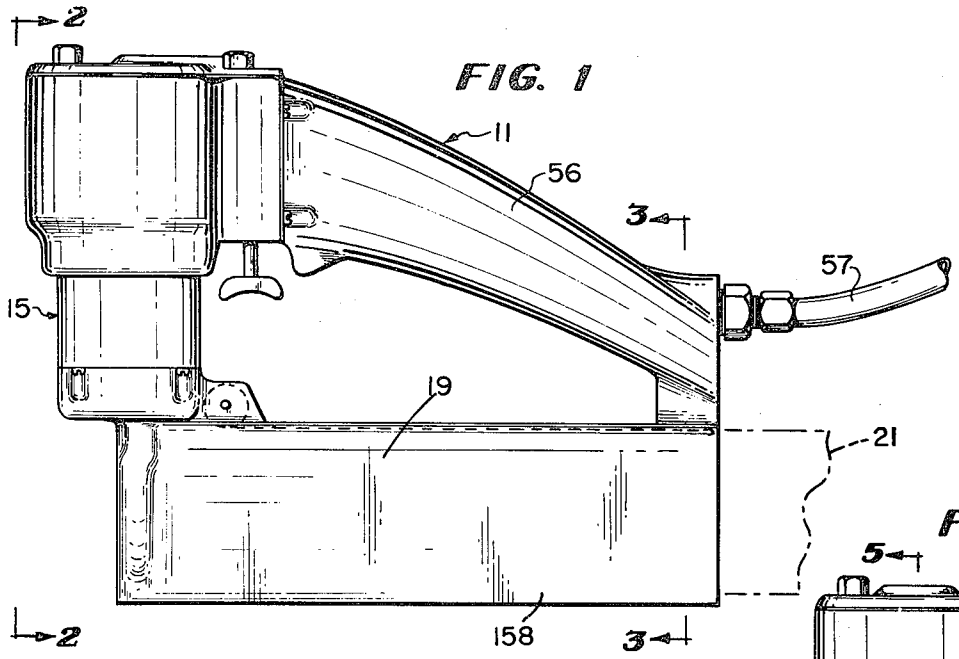


FIG. 1

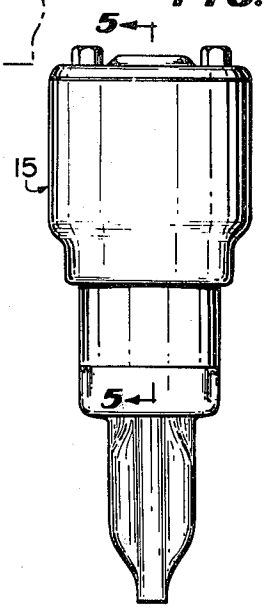


FIG. 2

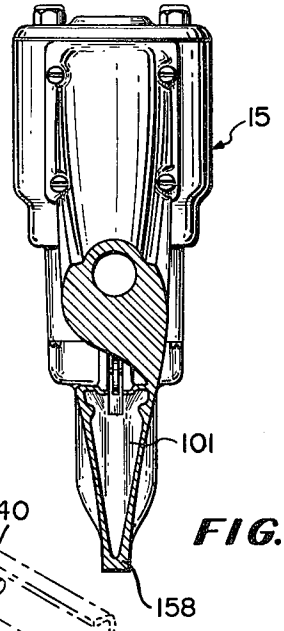


FIG. 3

FIG. 4

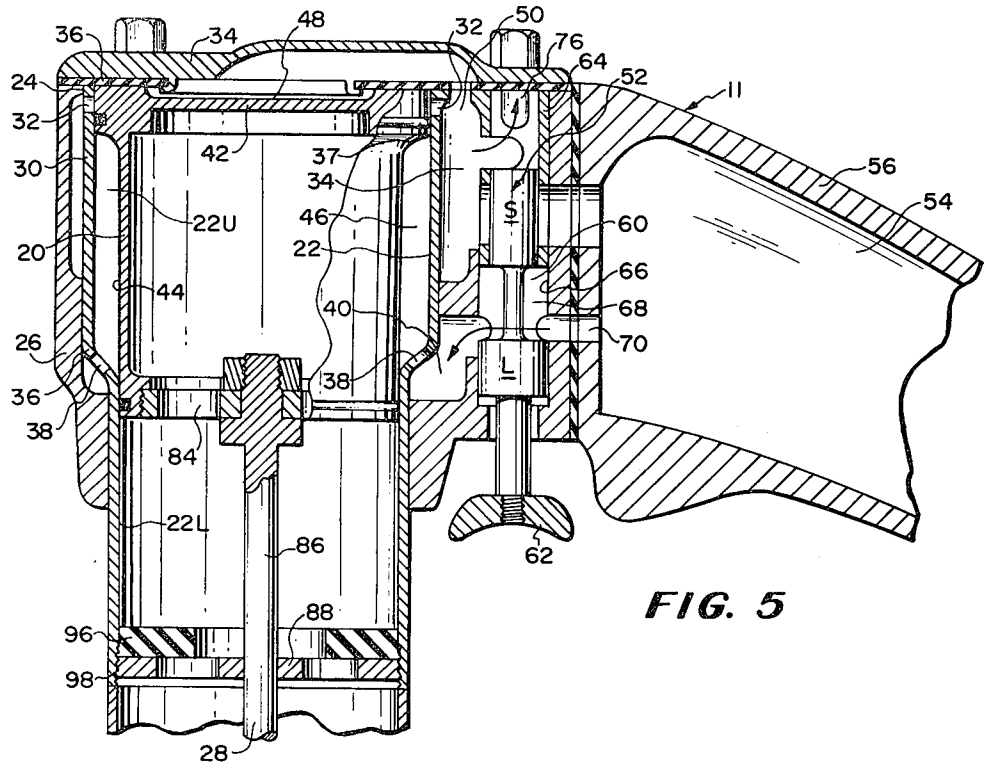

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FIG. 5

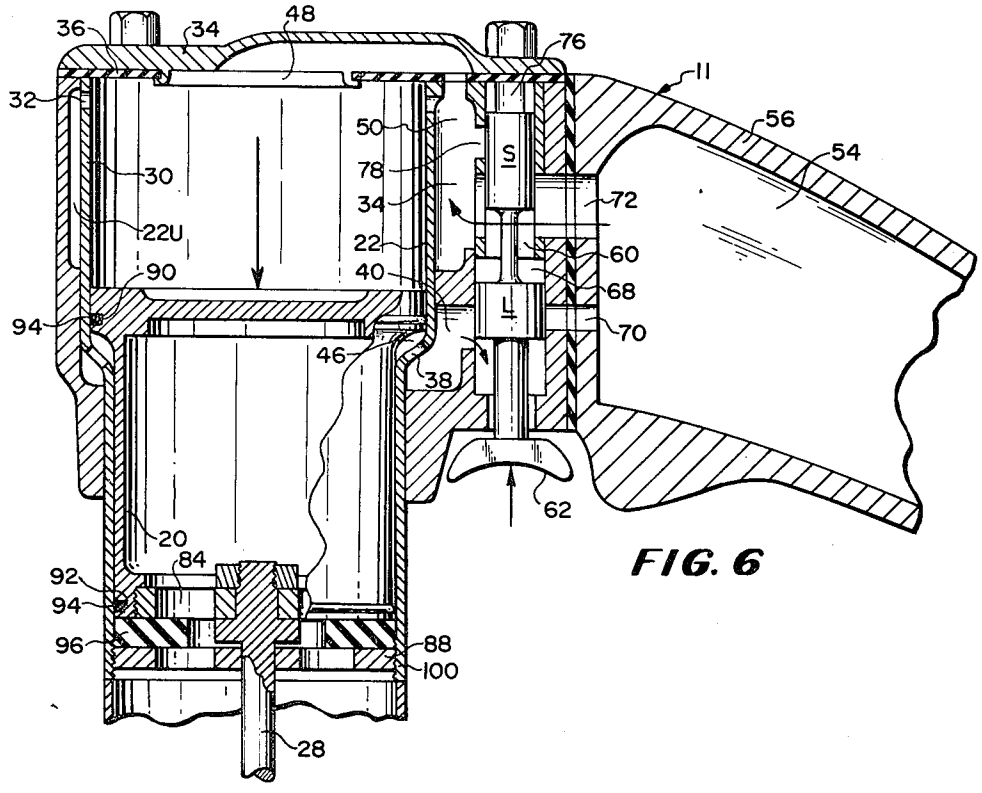

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FIG. 6

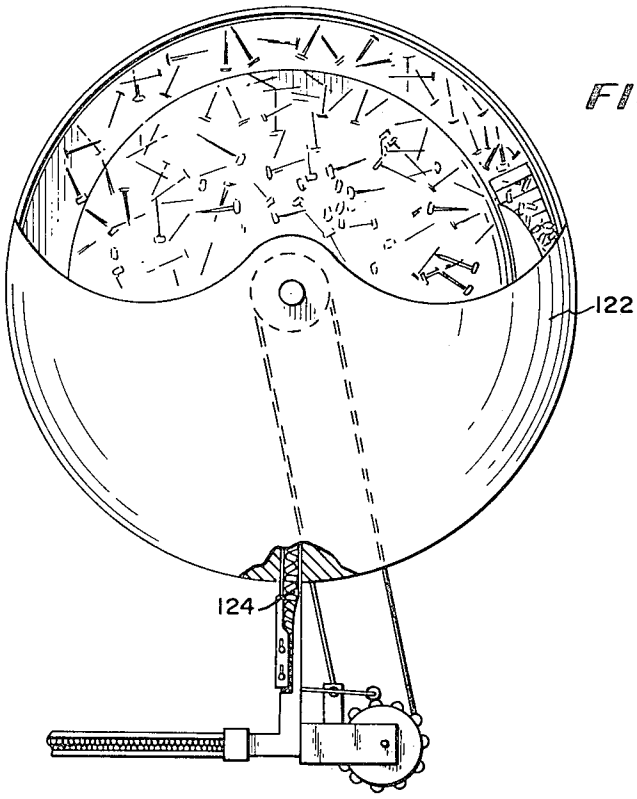


FIG. 7

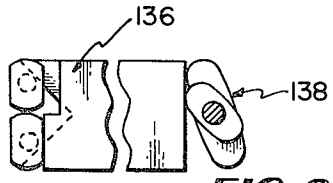


FIG. 9

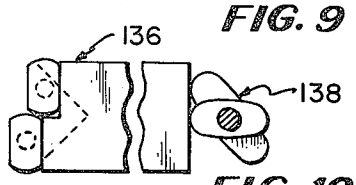


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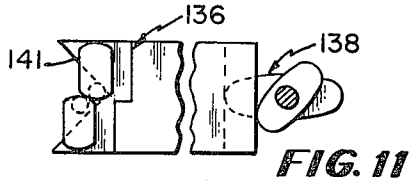


FIG. 11

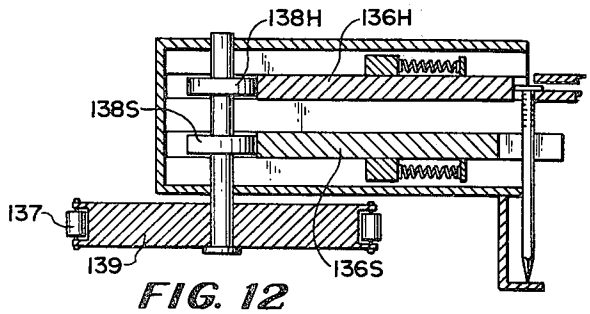


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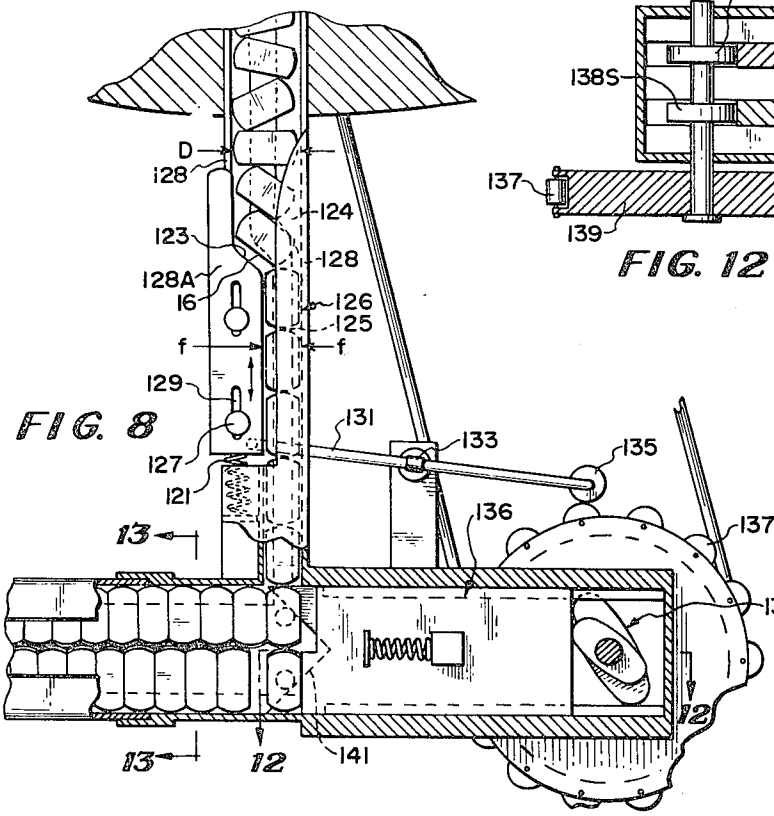


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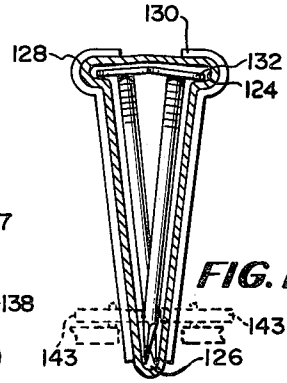


FIG. 13

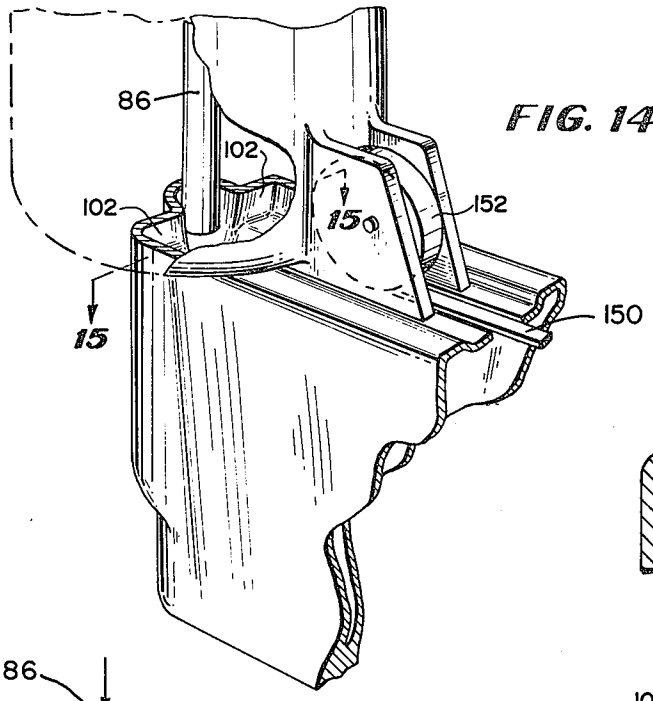


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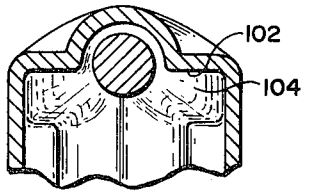


FIG. 15

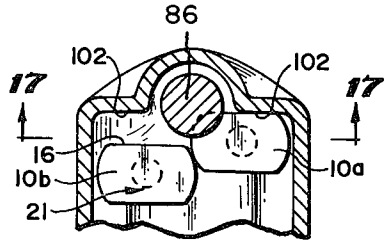


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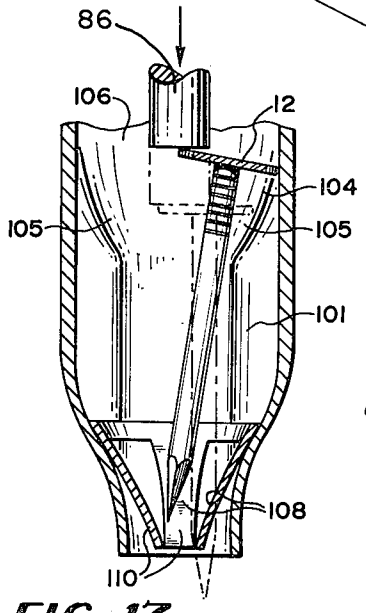


FIG. 17

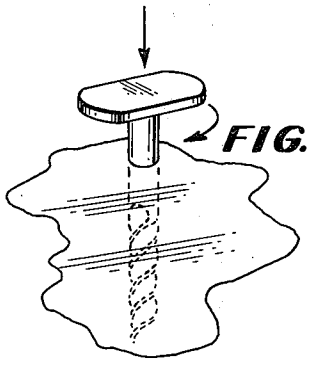


FIG. 18

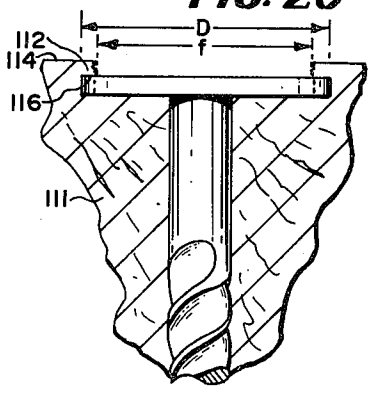


FIG. 20

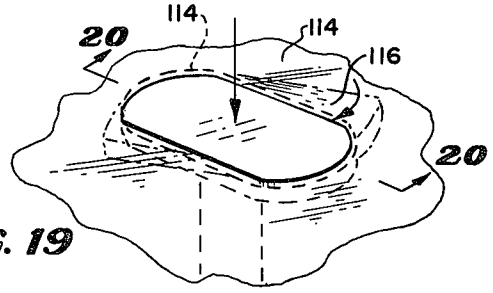


FIG. 19

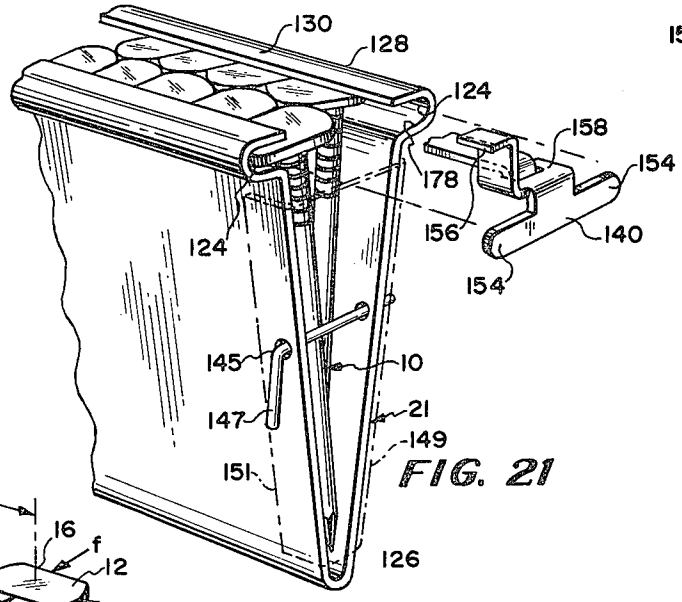


FIG. 21

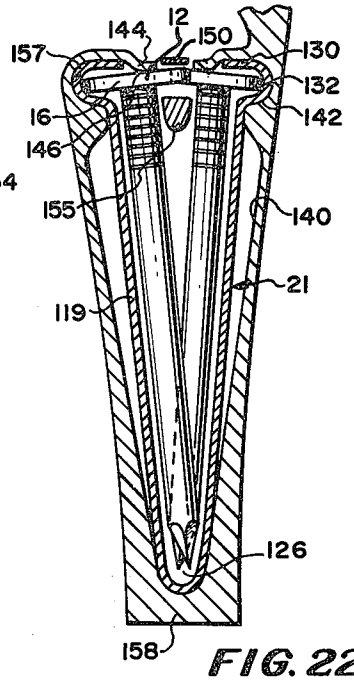


FIG. 22

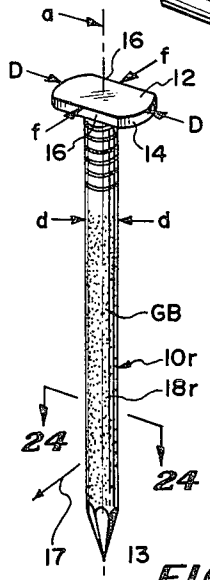


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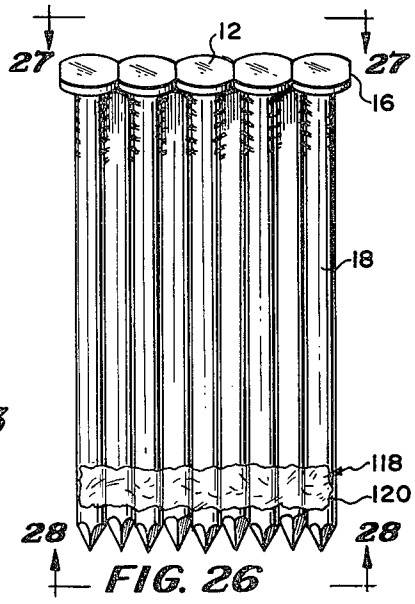


FIG. 26

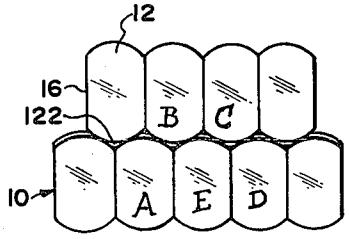


FIG. 27

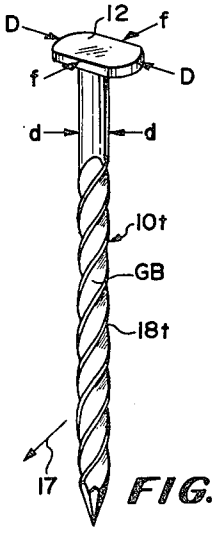


FIG. 25

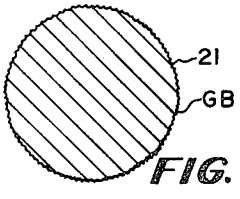


FIG. 24

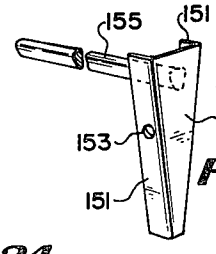


FIG. 29

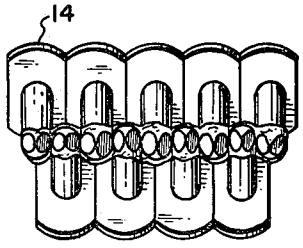


FIG. 28

NAIL AND POWERED NAILER

BACKGROUND OF THE INVENTION

This is a division of application Ser. No. 352,243, filed Apr. 18, 1973.

Powered nail drivers utilizing nail feed clips and pneumatic feed tubes are old in the art for feeding a high volume of nails classified as common nails, as where the diameter of circular flat heads are generally more than twice the diameter of the shanks. In feeding such conventional nails progressively to a powered driver, the heads of the nails either are coplanar and spaced, or are disposed edge-to-edge in a transport train, or are axially offset enough to overlap vertically with the head of the lead nail contacting the adjacent shank on the next nail head above it. In most cases, however, unless supported in an inclined clip member the nails are carried on a feed tape means or a frangible adhesive that supports the nails as a stick unit.

In feeding a train of nail heads in edge-to-edge contact by a resilient force under working conditions, the contacting edges of the heads can become overlapped and cause malfunctions because there is only a critical single point of contact between adjacent nail whose naail head edges are rounded in two directions. In feeding overlapping heads there are theoretically two contact points, but they are critically and contiguously arranged at one end of the nails.

The feeding can be done by gravity, if the nails are loose, or by mechanical means engaging the nail heads and shanks at the level of the contact points to provide clip-forming supports such as adhesive tape or frangible mastics, etc. Moreover, a lot of available clip storage space for nails is not utilized because of the wide spaces between the nail shanks. The spacing is at least the radial distance of the head overhanging the shank.

Where a supporting means for spaced shanks is used, waste material has to be disposed of as the lead nail is stripped free each time for driving, and, although heads have been provided having the same width as the nail shank, the holding power of the reduced head area is greatly reduced to a fraction of what may be desired of a common nail having a shank of the rated diameter involved.

SUMMARY OF INVENTION

In the present invention, the nail emboyding the invention is characterized by having a flat head that is edge flattened along equal parallel lines spaced a distance twice the diameter of the nail shank. Such nails not only serve as a standard nail in conventional ways with conventional equipment but further fosters a shape and clip arrangement for power nailers in which utmost space economy is attained in a clip of large head area nails. The shanks are contiguous and the heads are arranged alternately contiguous for extensive contact engagement and the nails contact at opposite ends for clip stability. The nails can be fed by hand, by gravity or by spring. Also, the nails are easily handled because they will not roll on a flat surface and can be collated in either one of two orientations by flat edge portions on radially opposite sides of the rim of the head.

The flat edge portions are radially spaced in each nail a distance twice the diameter of the nail shank so that the shanks of two rectilineal rows of nail heads contact at points adjacent to their pointed ends, and alternate heads contact at the nail head ends whereby clip stability is improved by each intermediate nail engaging two nails on each side. Each end nail of a clip extends at its

head beyond the next adjacent nail far enough to be nipped from the nail assembly by the powered driver regardless of which side the head is on of the double row of centrally interdigitating transversely contiguous heads.

Moreover, in the feeding of nails progressively into the driver striking position the driver of the power unit can serve as a feed stop in a low retracted resting position during idle conditions, or, if the driver is raised to a poised resting position above the head of the lead nail a feed stop is preferably employed on each side of the path of the driver below the end of the driver to locate the nail in its drive position. The driver then operates to nip or strip and drive the lead nail. When struck by the driver the head and shank of the nail are both cammed into substantial alignment with the driver. The head is cammed by a fixed cam and the nail point is cammed by a resilient finger or fingers at the feed end of the clip, the fingers yielding to the downward passage of the nail head, yet clearing the driver so that it can strike the nail with one blow or transmit plural blows if the driver is repeatedly struck by a repeating hammer.

Where nails are fed pneumatically by a tube each nail head on its driven movement preferably passes through a throat cross-sectionally shaped to mate with the shape of the nail head which helically turns the nail shank during its initial penetration of the nailed material for easing the penetration without damage to the workpiece or to the holding strength of the nail. If the nail is a threaded nail, the helical lead starts the threading rotation with a thread lead equalling that of the nail, preferably, approximately 65°.

The nails also are particularly easy to collate into compact strips. Although this can be accomplished with two moving converging lines of nails, with the heads oriented flat-to-flat and the shanks depending, it is preferred to utilize a single line of nails arranged with the flat edges aligned in parallel planes. The line is advanced lengthwise to a station where the lead nails are pushed laterally in pairs to form a double row with head edges flat-to-flat and the shanks are positively displaced to interdigitate. Thereupon the next step can be either to apply a quick drying frangible mastic to the contact lines of the heads and the interdigitating shanks, or, the assembly with or without any mastic securement of the nails, can be fed into a V-shaped sheet metal clip that centers the nail points and carries the weight of nails along two outside facing channels that engage the outside edge portions of the contacting heads.

Preferably, for ease in using the clip, the clip is longitudinally open along the top and an L-shaped spring drawn pusher carried by the power unit is manually drawn out the length of the clip and lodged against the head of the outermost end nail to feed the nails towards the drive station.

Objects of the invention are to provide an improved common or threaded nail which lends itself to economical packaging and use in power nailers; which enables a power controlled twisting of the nail as it enters the workpiece, or, as it comes to rest in the workpiece; whose head can interlock with the workpiece when deeply set; and which is easy to collate compactly in a nail feed or shipping package.

A further object is to provide a nail shape that is easy to form and readily identified in place as to source and physical characteristics including the size of the shank embedded in a workpiece.

The invention also contemplates an improved collating apparatus and process for compactly packaging common nails in a storable feed unit for power nailers.

Another object of the invention is to provide a flat headed nail of approximately a 12 gauge size that has over a third greater holding strength of a comparable shaped 11 gauge nail bright.

Other and further objects and advantages will appear from the following description and claims relating to the drawing in which:

FIG. 1 is a side elevation of a nail gun embodying and utilizing the invention;

FIGS. 2 and 3 are sectional views taken on lines 2—2 and 3—3 respectively in FIG. 1;

FIG. 4 is an enlarged perspective view of a portion of the sectional view of FIG. 3;

FIG. 5 is an enlarged sectional view taken on line 5—5 of FIG. 3 with the working parts poised for operation;

FIG. 6 is a view like FIG. 5 showing the working parts in their operated, nail-driven position;

FIG. 7 is a diagrammatic top plan view of a conventional collating drum in which the collated nails move radially from the collation discharge opening;

FIG. 8 is an enlarged top plan view partly in section of the formation of collated nails into clips for use with the gun;

FIGS. 9, 10 and 11 are schematic illustrations of the steps taken forming a double line of interdigitated nails from a single line orientation;

FIG. 12 is a diagrammatic vertical section through the oscillating and reciprocating mechanism shown in FIGS. 9, 10 and 11;

FIG. 13 is an enlarged sectional view taken on line 13—13 in FIG. 8;

FIG. 14 is a close-up perspective, partly in section illustrating the nose portion of the gun for feeding and driving nails from a clip;

FIG. 15 is a sectional view taken on line 15—15 of FIG. 14;

FIG. 16 is a sectional view similar to FIG. 15 showing the cooperating locations of the nails and driven for nipping and driving a lead nail each time;

FIG. 17 is a vertical sectional view taken on line 17—17 of FIG. 16 of the driving barrel with the lead nail nipped and being guided into full drive position;

FIG. 18 is a perspective view of a threaded nail head rotation being driven into a wooden workpiece;

FIG. 19 is a perspective view similar to FIG. 18 showing the nail head recessed and interlocking with the wood fibers;

FIG. 20 is a section taken on line 20—20 of FIG. 19;

FIG. 21 is a perspective end view of the nail feed clip as related to the nails and the resilient nail feeder;

FIG. 22 is an enlarged sectional view through the clip and the gun support magazine for the clip;

FIG. 23 is a dimensioned perspective view of a nail embodying the invention whose shank is grit-blasted;

FIG. 24 is an enlarged sectional view taken on line 24—24 of FIG. 23 illustrating the surface derived from grit-blasting;

FIG. 25 is a perspective view similar to FIG. 23 showing a threaded nail with a grit-blasted shank;

FIG. 26 is a side elevation of a stick of nails in which the nails are held together by frangible mastic;

FIGS. 27 and 28 are top and bottom views taken on lines 27—27 and 28—28 respectively in FIG. 26;

FIG. 29 is a perspective view of a clip end cap carrying a nail shank spacing rod.

NAIL

Referring to the drawings, the nails 10 illustrating the invention can be classified as common, flat-headed, 12 gauge tempered wire nails having the usual dimensions for making pallets. The have flat heads 12 and shanks 18. The numerals without a suffix are used generically while suffixes *r* (FIG. 23) or *t* (FIG. 25) indicate the round or threaded character of the shanks, respectively.

The rated diameter D of the heads 12 are substantially more than twice the diameter *d* of the shanks 18, thus $D>2d$. Furthermore, the heads 12 are flattened at their edges 14 as at 16 along equal, parallel planes or lines, spaced *f*—*f* a distance that is twice the diameter *d* of the shanks, thus $f—f=2d$ for reasons later explained.

Preferably, the flattening at 16 is accomplished by radially directed compression or swaging dies which work the metal, increase the axial width of the resulting faces 16 and thereby provides flat surfaces that engage one another as between collated nails in a stabilizing relationship by substantial engaging surfaces which permit appreciable relative movement without overlapping when being collated and stored, or used loosely.

Also, preferably, the shanks, whether threaded or not, are grit-blasted as indicated at GB with size 80 aluminum oxide grit to remove the "bright" surface of the nail and provide small pits 21 with minute sharply shaped walls. This is particularly true with tempered nail shanks. With this inexpensive treatment 2 inches of the shank of a 65° threaded 12 gauge nail thus treated provides a holding strength against withdrawal that is substantially greater than a like nail shank sand-blasted with the same size conventional sand particles. Such is also much greater than a conventional 11 gauge nail and much greater than with any 12 or 11 gauge coated nail tested. The harder the grit and the smaller the grain size above 40, namely, 70 to 90, 80 is optimum, the greater the holding power of the nail and the more important become the advantages that it is capable of collation in a dispensing clip without the expense, necessity or waste of coatings and adhering material on the shanks.

By way of example, with respect to helically threaded pallet nails actual exploratory holding strength tests have shown the following results with nails identified as follows:

Nail identification	Length	Wire diameter	Threaded body outside diameter	Head diameter	Length of diamond point	Number of flutes	Thread angle	Withdrawal load		
								Minimum	Maximum	Average
	In.	In.	In.	In.	In.		Degrees	Lb.	Lb.	
2 1/2×11 No coat	2–17/32	0.121	0.133	9/32	5/32	4	64	290	340	315

—Continued

Nail identification	Length	Wire diameter	Threaded body outside diameter	Head diameter	Length of diamond point	Number of flutes	Thread angle	Withdrawal load Minimum	Withdrawal load Maximum	Withdrawal load Average
	In.	In.	In.	In.	In.		Degrees	Lb.	Lb.	
2 1/2×11 TN25° No coat	2–1/2	.121	.127	9/32	5/32	5	65	305	340	320
2 1/2×12 25° T No coat Sand	2–9/16	.106	.119	1/4	1/8	4	63	325	410	355
2 1/2×12 25° Coated	2–17/32	.105	.123	1/4	1/8	4	63	270	360	330
2 1/2×12 25° Grit	2–9/16	.105	.124	1/4	1/8	5	67	355	465	390

Tentative conclusions:

1. 2½ inches × 12 nails have greater holding strength (HS) than 2½ inches × 11 nails.
2. 2½ inches × 12 nails, not coated, have holding strength greater than coated nails.
3. 2½ inches × 12 grit-blasted nails (size 80 grit) have the greatest holding strength.
4. The minimum HS of grit-blasted shanks is approximately equal to maximum HS of coated nail.

Moreover, during withdrawal it was noticed that the high holding strength persists, and renailing in the same nail hole retains approximately the same high holding strength.

In some respects I am not able to account fully for these improved and unexpected results which are obtained by the invention described, and it should be understood that any attempt to analyze the theory which is believed to be responsible for these results is to be construed not as defining a mode of operation, but merely as a possible explanation of certain physical phenomena which have been observed.

Wood fiber displacement is involved in both axial directions of nail movement and, if not split, reamed or torn, their resiliency has maximum resistance up to the point just before splitting occurs. Under these conditions they provide a firm reaction which can be referred to as a heavy clamping frictional contact that is maintained substantially high and constant. Also, the wood fibers at any transversely severed ends can be bent, displaced or end compacted at the nail interface without a tearing action as part of the clamping action.

It also appears that sand-blasting or grit-blasting with large size grit flattens or slicks the nail shank surface, particularly if the metal is untempered, whereas the small hard grit "pits" the surface, which the small size sand does not, with many minute upstanding edges that augment the friction without tearing the wood fibers, going in or coming out, particularly with a 12 gauge size nail which is of a size that does not split the wood fibers.

Fixed protrusions provided sometimes on axially driven wood nail shanks operate to "oversize" or "ream" the wood fibers at the interface. This constitutes damage to the wood fibers, and very little frictional engagement remains. Moreover, the fibers broken in one direction will yield more readily in the other direction and once withdrawal begins, even slightly, any holding strength drops rapidly. Renailing in whole or in part in the same hole under these conditions entails a false expectancy of reestablishing the original holding strength.

NAIL GUN, Shape

In driving the nail 10 GB embodying the invention it may be noted that a heavier driving force proportional to the nail's increased holding strength is required.

Preferably, for high speed nailing, the nails are pneumatically fed singly by tube directly from storage, otherwise either from a collator or clip, to the driving compartment **101** (FIG. **3**) of a pneumatic gun **15** (FIG. **1**).

Also, in absence of special applications it is highly desirable that a nail **10** of the invention, rated as a common nail, be disposed axially in its driving direction **13** (FIG. **23**), and be advanced laterally in a direction **17** (FIGS. **23** and **25**) oriented normal to the axis of movement **13** of the nail so that a magazine **19** (FIG. **4**) can be arranged to provide a support squaring the drive direction normal to the nailing surface. Furthermore, the magazine itself should be narrow enough that the gun can be inclined laterally to the vertical to toe-nail in narrow spaces. This is distinguished from conventional nailers handling loose common nails or nails fed by magazine in an inclined direction which require auxiliary attachments, or fed from reel housings that are too wide horizontally to permit inclining the gun to toe-nail with common nails.

Accordingly, as noted in FIG. **1**, the magazine is at a right angle to the power drive housing **26**, the lower edge permits lateral leaning for toe-nailing, and the nailer is compacted also vertically for a low handle that is manipulated quite easily.

NAIL GUN CONSTRUCTION

As already noted the nails embodying the invention illustrated in FIG. **23** comprise a construction in which their flat heads **12** have two flat edges **16** of equal length defining for each nail **10** two parallel planes **16** of substantial area-of-contact on opposite sides of the shank **18** and spaced apart a distance equal to twice the diameter of the nail shanks (f—f=2d).

Briefly, the versatility of the present invention for nailing is illustrated with a pneumatic gun **11** shown generally in FIGS. **1–6** having a piston **20** and cylinder arrangement **22** received in the front portion of a body housing **26** for relative vertical movement in reciprocating a driver **28**. A liner **30**, castellated or apertured, around its upper end **24** to provide ports **32**, is mounted in the housing for durability and ease of manufacturing, and the housing **26** is radially enlarged therearound to provide a large flow passage **34** for the ports **32**. Part way down its length the liner **30** is provided with a re-

duced diameter as at shoulder **36**, and ports **38** are provided therethrough by which the periphery of the upper cylinder **22** is connected to a valve through passage **40** for alternately venting and applying pressure thereto.

The piston **20** is reciprocably mounted in the cylinder **22** and has an axially predetermined thin head portion **42** at the top received in the larger upper cylinder portion **22U** where it marginally closes the castellate ports **32** in its uppermost position as limited by a cylinder head **34** removably bolted thereon and carrying a resilient bumper **36** which serves also as a sealing means for the housing and the piston. The remaining major length of the piston is reduced in size as at **44** to slide in the reduced lower cylinder portion **22L** in sealing relationship below the shoulder **37.** The shoulder provides an offset to define with the overhang of the head portion **42** a secondary cylinder **46** to power the return stroke of the piston. Thus the cylinders and pistons for the work and return strokes compactly overlap and thereby minimize the overall height of the gun.

A recess **48** in the piston head **42** had access to a passage **50** leading through the cylinder head **34** to a high flow capacity spool valve **52** to control fluid pressure that initiates downward movement of the piston. An appreciable downward movement of the piston would nip the lead nail and open the ports **32** rapidly for a full thrust of the piston without any waste of power occurring with any parts first moving in an opposite direction. All air pressure is effective in a downward direction against the piston with all spaces below the piston head **42** vented to atmosphere.

Air pressure is taken from a large collection chamber **54** in the handle **56** supplied by an air hose **57** and is controlled by the spool valve **52** which handles large volumes of air under pressure quickly through a large flow area **60** located between the spool valve heads S and L that are vented to atmosphere at opposite ends. The valve may be finger actuated by trigger **62** with minimal effort since a slight pressure differential on the heads that is provided by relative diameters of the spool heads S and L establishes a continuous differential force normally urging the valve to a "closed" position. For this purpose the valve has a sleeve liner **64** for the spool valve which is open to atmosphere at its upper end and provides a step up size at the lower end to a diameter at **66** that provides a larger diameter cylinder portion **68** and valve head L whereby air pressure which is continuous in the piston chamber **60** between the differential valve heads S and L continuously urges the larger area valve piston L downwardly to a closed position.

In its closed position shown in FIG. **6**, pressure from the handle chamber **54** enters through passage **70** and passes through the valve chamber **60**, through passage **40** and through openings **38** into cylinder **46** to hold the drive piston **20** in its poised or retracted position with minimum use of compressed air volume. When triggered against the mild valve closing pressure (FIG. **6**), the lower head L is moved upwardly to vent the return chamber **46** through openings **38** and passage **40** while the spool chamber **60** advances to interconnect the passages **72** and **50** to apply driving pressure to the space **48** while the upper head S closes the vent passage **76** from the space **34.** The piston is driven downwardly. Then when the trigger **62** is released, the pressure present in the spool chamber **60** dominates the valve by acting against the larger spool head L exposed to atmosphere on the other side and drives the spool valve downwardly venting the drive chamber **22** to atmosphere through the port **78** and the laterally extending exhaust passage **76** for a controlled return of the piston to its poised position against bumper **36.**

Preferably, as viewed in FIG. **1**, for the sake of gun compactness, the closeness of the operators hand to the axis of the nail driver and to the nailing surface for improved manipulation of the gun it will be observed the spool valve thereby forms part of the handle, or is present in the handle.

The piston **20** is lightly but ruggedly constructed to reduce its inertia and rely essentially upon the air pressure to drive the nails. The driver is the rod **28**, has a shoulder flange **83** that extends through a spider **84**, and is terminally threaded for nut **85** or welded to the spider to transmit the driving force of air pressure on the piston through the spider to the head of a nail. A spider **88** centers and guides the intermediate portion **86** of the driver **28** with respect to the smaller cylindrical surface **22L.** Grooves **90** and **92** are provided around the head and spider **84** to receive suitable O-ring seals **94** lubricated by lubricant conventionally supplied to the air pressure supply line.

The depth to which a nail is driven is adjustably determined by a resilient bumper **96** adjustably supported at the lower end of the power cylinder as at **98** by a threaded relationship of the spider **88** at **100.**

In operation, the driver **28** on the initial movement of the piston on its driving stroke nips the lead nail (FIGS. **16** and **17**) to move it towards its drive position and by this movement the ports **72** and **32** are opened for a strong, quick and full driving thrust with the compressed air entering through all driving ports **32** while the air present in the peripheral cylinder space **44** below the piston head is vented to atmosphere. Thereafter the piston is returned to its starting position upon release of the valve by air pressure being admitted to the differential area **46** under the piston head **42** while air pressure is vented from above the piston through the exhaust **76.** This is accomplished without undue bounce of the gun in the hand of the operator as the piston closes the ports **32** and contacts the combination head seal and bumper **36.**

NAIL DRIVING

In the driving compartment or barrel **101** (FIG. **17**) the driver **28** attached to the piston **26** travels a predetermined axial path. On the opposite sides of this path nail head engaging stops **102** are provided on the wall of the barrel against which the exposed flat portion **16** of the head **12** of the lead nail **10***a* of a lateral feed clip **21** is contacted at a point where the driver overhangs a substantial portion of the head without touching the secondmost nail head **10***b*. The stops **102** (FIG. **15**) are contoured as at **104** to follow the round portion of the nail heads **12** laterally of the axial path of the driver. Below the initial contact level at **106**, the contours **104** are arranged to define converging cam chutes **105** that alternately move the lead nail heads to a position coaxial with the driver within the distance of approximately three diameters of the nail head. This is done with an initial rapid radial displacement which occurs at the initial slower movement of the accelerating driver **28.** The nail points are also cammed inwardly at **108** to pass through centering spring fingers **110** that accept the head of the nail as it is driven from the driving barrel.

Where the nails **10** are supplied one-by-one by a pneumatic tube (not shown) the nails are delivered endwise to the driving chamber through the same end

receiving the driver. As each nail settles into place in the chamber, its head rotatively orients itself to the contour thereof that mates with the shape of the head. Thereafter as the nail is moved through the barrel the nail is rotated by the mating contour that is spiralled at an angle of 65° corresponding with the lead of a threaded nail **10***t*. Thus whether threaded or not the nail enters the wood with a turning action that assists in avoiding a splitting of the wood fibers so that the greatest possible holding strength is provided for both smooth and threaded nail shanks.

It is to be noted (FIGS. **19** and **20**) that when threaded nails **10***t* embodying the invention are dispensed and the heads are counter sunk into the wood fibers **112** of a workpiece **111**, the head **12** will take a twist in the wood fibers **112** below the surface **114** thereof and provide a locking relation as at **116** with wood fibers located between it and the surface through which it was driven. This provides a desirable keying action.

Any frangible adhesive that may be used on the heads to secure the collated nails together as a stick will be sufficiently shattered by the driver that the remains will easily fall out of the barrel for a clean drive that establishes great holding strength.

NAIL COLLATION

For purposes of rapidly collating the nails for gun use a conventional rotating hopper **122** is provided rotated an axis inclined to the vertical. The nails are dropped in a trough having a slot in the bottom where the shanks of nails drop through to be supported by their heads and move outwardly on parallel rail channel members **124** defining tracks **126.** The tracks are subject to vibration longitudinally and are slightly inclined for the nails to slide away from the drum. As the nails enter the tracks, they slide below flanges **125** overhanging the nail heads to hold the heads marginally in a fixed plane and provide convergence of the sides **128** to contact the edges of the nail heads loosely. Adjacent the hopper the sides **128** are spaced the distance D and converge to the distance *f*—*f* (FIG. **8**). One of the sides **128A** is independently mounted as a slider by headed pins **127** in slots **129** and oscillated longitudinally against spring **121** by a lever **131** pivoted at **133** engaging the slider **128A** at one end and actuated at the other end by a roller **135** engaged by gear teeth **137** on wheel **139.** The slider **128A** has a counter current shoulder **123** that engages the advancing nail heads at their major dimension to agitate and turn them until they turn enough for the flat edges **16** to pass between the converged side guides to dispose the flat edges in alignment and carry them in that alignment to a collection station where an advancing means **136** is provided to move the nails laterally two-by-two into a final collation assembly line. For this purpose, as illustrated in FIG. **12,** each successive pair of adjacent nails are engaged by followers **136** driven by cams **138** on the wheel **139.** Follower **136H** has offset shoulders spaced the distance *d* of the nail shank diameter that engage the flat edges **16** to offset them that distance and push them into the clip form shown in FIG. **13.** The follower **136S** is synchronized by the cams **138H** and **138S** as shown in FIGS. **9, 10** and **11** to engage the shanks of each pair of nails after they are offset and has a V-shape **141** to bring the points of the nails into overlapping interdigitating relation at the nail points.

Thus the collation provides shank and head contacts for each nail which are offset horizontally whereby the lead nail of the pair is pushed off ahead of the companion nail a distance equal to *d* with a stroke distance of at least 2*d*. As so moved, the points of the shanks are cammed by a V-form **141** to overlap in contact with each other in interdigitating relation in the final assembly.

In this relation, the nails move along either to receive a frangible mastic adhesive **120** covering the overlapping inner portions of the heads (not shown) or the points as applied by rollers **143** (FIG. **13**), or both, in mutually supporting relationship, or they are fed into or picked up in clips of the shape and form shown in FIGS. **1** and **2,** for shipment and use in a gun magazine of like shape.

NAIL CLIPS

Clips of nails collated in two rows of alternating heads and interdigitated shanks as shown and described are particularly durable. Any group of five nails, as may be marked by A, B, C, D and E for explanation purposes, present unusual geometrically strong arrangements in which three heads A, B and E are each in contact with both of the other two; any one head E is contacted by the other four heads A, B, C and D; and, their shanks form a line of contacting shanks. Thereby each nail of any three nails contact an adjacent nail at least at two spaced points of its length for bilateral support and the strength of the group, and, each group of five has at least seven head contacts and four shank contacts for stability. Moreover, the contact points of the shanks can reasonably be located anywhere within the lower half of the shanks, preferably near the point as at **118** whereby three-point support for each nail is provided for position strength in the clip and with minimum use of adhesive in a stick, if used.

If an adhesive means **120** is employed to provide nail "sticks", it can be a narrow strip along either side or both, of the nail shanks where they contact as at **118,** and along the wave-like interstice occurring centrally between the two rows of heads as indicated at **122.** Whenever it is used quantities required are small and such is shed when the nail is driven into the wood.

In both instances, the lines of contacts are normal to the nails as thus oriented and collated. For that reason they are mutually well supported. Furthermore, with both columns of loose nails or any sticks of adhered nails they can be fed horizontally to the driving chamber of the gun as supported in a gun magazine that in turn squares the nails to the plane of the work surface.

Any clip-like means **21** that supports a group of nails thus collated may be molded or fashioned of any suitable material such as metal or plastic to define at least two facing channels **124** to support the heads and preferably a stabilizing channel **126** for the nail points. As shown, the clip comprises two parallel channels forming lower rails **128** externally and upper walls **130** but inwardly opening towards each other to receive the opposite edges **132** of the collated nail heads and confine them to longitudinal movement therein. The two channels **124** preferably constitute formed edges of a sheet that is substantially V-shaped having sides **119** to protect the nails against lateral blows and strains during handling and also in the gun or during shipping. The angle of the V-shape sides holds the points of the col-

lated nail heads against the nail heads being cocked or slipping into overlapping relationship.

The clip can be bi-terminal for receiving and discharging the nails through either end. For this purpose both ends are cross-apertured as at **145** (FIG. **21**) through the sides **119** to receive a nail or bent wire **147** therethrough at one or both ends. Preferably, however, at one end a cap **149** is provided (FIG. **29**) which has its side flanges **151** dimpled at **153** to snap in the holes **145** and carries a rod-like spacer **155** (FIGS. **22** and **29**) that runs the length of the clip **21** in position to engage the nail shanks and hold the heads in place in channels **124** against possible violent handling.

NAIL FEED in NAIL GUN

Forward feed of the nails to the driving position is accomplished by a manually adjusted follower **140** (FIG. **21**) engaging the rearmost nail **10***c* in the clip for resiliently advancing the nails as a group.

For receiving a clip or stick to feed nails to their drive position, the gun is provided with an elongated chute or receiver **140** opening into the barrel **101** and the receiver is provided with parallel facing channels **157** that receive the rails **142** of the clip **21** in guided relationship. Also inwardly thereof the receiver has shoulder lands **144** (FIG. **22**) that engage the heads of the nails as at **146** in a slidably guided relationship along the top. This relation enables either the use of the clip **21** throughout the driving of the nails therein, or, the clip can be inserted to locate the nails in place, even though loosely collated, and the clip when withdrawn leaving the nails in feed position in the chute **140.**

In either event, for resiliently advancing the nails by the follower **140,** a slot **148** is provided longitudinally in the top wall of the receiver between the shoulder lands **144** to receive a flexible band or cable **150** that is attached at one end to a spring rotated wind-up drum assembly **152** (FIG. **14**) carried by the gun. At the other end the cable **150** is secured to an ear **158** on the follower **140.** The follower and cable are releasably received in the slot **148** in guided relation to engage the rear edges of the tail-end nail heads in the magazine, as at **152.** For this purpose the follower **140** is constructed to clear the upper edge of the cap and operate as a miniature walking beam having cross-arms **154** with their forward faces engaging the flat portions on the rearmost nail heads at approximately a spaced distance coincident with the transverse spacing of the two rows of shanks.

A handle **156** is carried by the follower **140** for manipulation thereof and extends through the slot **148** and laterally for finger engagement so that the follower can be backed out of the slot and reinserted each time the magazine is replenished with collated nails. Furthermore, although the lower outside edge of the magazine can have any exterior design treatment desired, as at **158,** for work engagement, the inside is conformed to guide the collated nail points, thereby making it possible to use a very thin metal or plastic clip for the nails, which are easily filled, emptied, or, serve only as a one-time or repeat use package.

When replenishing the receiver, the follower **140** can be temporarily supported out of line with the receiver opening to free one of the hands of the operator for replenishing the receiver. Also the handle tracks the nail supply and serves as a visual indicator of the number of nails remaining in the magazine.

Although cohesives can be dispensed with in order to save time, money and eliminate waste, yet the description will indicate how frangible cohesives **118** can be employed to make nail sticks, if desired. However, coatings, adhesives and surface etching cannot equal the holding power of the **12** gauge nail described, but rather detract from it. It is for that reason that the nails embodying the invention are preferably handled without any adhesives on the shanks and adhesives that may be used on the heads will break free on spiral nails so that embedding the head locks it in wood fibers as noted.

What is claimed is:

1. In a power nailer a housing forming a barrel, a driver reciprocable in said barrel, a reciprocable piston means for actuating said driver to normally support the lower end thereof at a predetermined level, nail head locating stop means on opposite sides of said driver below said predetermined level, a magazine defining a V-shaped slideway having a portal into said barrel and provided with parallel facing channels spaced a distance of approximately two diameters of a nail head for supporting the remote edges of a pair of side-by-side nails offset longitudinally of said channels a distance approximately the diameter of the shank of said nail, the offset nail heads successively engaging said stop means on opposite sides of and below said driver.

2. The power nailer defined in claim **1** in which said magazine has a longitudinal slot, and including a resiliently urged retractible follower slidable in said slot to move said nail heads into contact with said stops.

3. A power nailer comprising,

a housing having a hollow handle defining a compressed fluid reservoir,

a cylindrical sleeve secured within the housing having an enlarged upper portion at one end defining a power piston cylinder, and a lower reduced cylindrical portion therebelow,

a piston reciprocable in said lower cylindrical portion and having an enlarged head portion reciprocable in said upper portion,

said power piston cylinder having ports proximate the upper end and ports around the lower end of said enlarged portion,

said housing and sleeve defining a first passageway in communication with said upper ports and a second passageway in communication with said lower ports,

a head closing the upper open end of said cylindrical sleeve and having a third passage therethrough in communication with said first passageway,

said housing having a bore between said passages and said reservoir,

valve means in said bore movable between two positions in one of which the first and third passageways are connected to the reservoir and the second passageway is vented to atmosphere and in the other one of which the first and third passages are vented to atmosphere and the second passage is connected to the reservoir,

said piston head portion closing said upper ports in its resting position.

4. The nail driver defined in claim **3** in which said valve means includes a spool valve having ends of different sizes and a sleeve reducing the size of a portion of said bore adjacent one end to provide a differential of cylinder sizes at opposite end portions receiving said heads by which pressure present in the central portion of the spool valve urges it to its closed position.

5. The nail driver defined in claim **4** in which said head is removable for the installation and servicing of said piston and valve.

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