This invention relates to power nail-driving devices by which a plurality of nails may be successively fed and delivered and driven automatically with the application of the tools to the work.

It is an object of our invention to provide a relatively light, portable and highly efficient power nailing device or tool wherein the delivery of nails successively to a reciprocating driving head may be timed automatically and precisely with the application of the tool to the work and under the control of the operator.

A further object is the provision of a power nail-driving device of the class described wherein novel and highly efficient multiple nail-holding mechanism is provided in close cooperative relationship with simplified and highly efficient nail delivery means to the nail driving barrel.

A further object of the invention is to provide a device of the class described which is extremely simple, light and practical in construction, strong and reliable in use, inexpensive to manufacture, assemble and service.

A still further object is the provision of a highly improved nail driving tool of the class described which may be readily and conveniently employed with a minimum of skill and effort on the part of the operator and which may be quickly and easily loaded without jamming and which is positive in action without reliance upon gravity feed and is adapted to be used at any convenient angle and in otherwise inaccessible corners and places where manual hammering is impractical.

Still another object is the provision in a tool of the class described, of novel and highly efficient multiple nail clips and feeding means positively providing for easy loading of a nail magazine and precise and accurate successive feeding of the nails to a power hammer under the control of the operator.

It is a still further object to provide structure of the class described which is well adapted for complete manufacture as a complete portable unit and which is equally applicable for manufacture as an attachment to conventional pneumatic hammers and other reciprocating type power portable tools.

These and other objects and advantages of our invention will more fully appear from the following description made in connection with the accompanying drawings wherein like reference characters refer to similar parts throughout the several views and in which:

Fig. 1 is a top elevation view of an embodiment of our invention applied as an attachment to a conventional type of a pneumatic hammer, some portions being broken away and others shown in full;

Fig. 2 is a view mostly in vertical section showing the device of Fig. 1, with some portions of the handle and sleeve being shown in full;

Fig. 3 is a detail view taken at the outer end of the muzzle of the barrel and showing the improved nail-holding and centering mechanism;

Fig. 4 is a cross section taken approximately along the line 4—4 of Fig. 1 and showing the nail-delivery passage and feeding mechanism in the forward end of the barrel;

Fig. 5 is a cross section taken along the line 5—5 of Fig. 2 and showing the manner in which the barrel is connected through the intermediary of the outward sleeve to the handle of the tool and the means for urging the barrel forwardly relatively to the sleeve, the sleeve being in the embodiment illustrated, rigidly connected with the handle of the pneumatic hammer;

Fig. 6 is a cross section looking in the direction of the arrow, taken substantially along the line 6—6 of Fig. 2;

Fig. 7 is a view mostly in side elevation with some portions broken away and others in section and illustrating an alternative form of the invention wherein certain novel features are present which are not included in the first form of Figs. 1 to 6 inclusive;

Fig. 8 is a fragmentary top plan view showing an alternative form of a multiple tier nail magazine attached to the top of the sleeve of the hammer.

Fig. 9 is a side elevation showing a novel and preferred form of nail assembly in the form of a clip; and

Fig. 10, in perspective, shows another form of nail clip. Referring now to the form of the invention illustrated in Figs. 1 to 6 inclusive, our improved structure is built around and combined with a conventional type of pneumatic hammer such as is made by Skil Corporation of Chicago, Illinois. It will of course be understood that the entire unit as a portable tool, including the source of power, may be manufactured and sold independently rather than the sale of our device as an attachment and that furthermore, any reciprocating, compact and portable source of power may be utilized with the cooperating elements of our invention.

As shown, a pneumatic hammer designated as an entirety by the letter H is employed as a source of power. The pneumatic hammer H is of conventional type, having a heavy casing constituting a hand grip G acting as the housing for circulatory paths of the source of fluid under pressure as well as the mounting means for the conventional hammer X which is slidably mounted within the sleeve S integrally formed or rigidly secured to the upper portion of the handle or grip G and extending laterally therefrom. A trigger T controls through its depression, the operation of the pneumatic hammer and the reciprocating of the hammer proper X. In conventional manner, a strong, tapered coil spring C surrounds at its outer end, the short hammer of the tool proper X and has its enlarged and inner end secured to the sleeve S or other parts in order that it may return or retract the hammer X after the hammer has been protracted in reciprocation by the fluid under pressure.

In the embodiment of our invention illustrated which is in the form of an attachment for the conventional power pneumatic hammer H, we provide an extended feeding sleeve 10 which is rigidly affixed at its inner end as by threads 10a with the protruding sleeve S of the pneumatic hammer and which is coaxial with the short, reciprocating hammer element X of the tool.

An extension hammer rod 11 is positioned with the rear end thereof disposed just forwardly of reciprocating hammer or piston X having an enlargement collar 11a disposed some distance forwardly of the rear end; and said rod extends concentrically through sleeve 10 and being slidably mounted at its forward portion in the rear portion of a hammering barrel 12, the barrel 12 being slidably mounted for reciprocating movement within the sleeve 10 and connected to said sleeve for such movement by a very durable and secure means to facilitate free sliding of the barrel relative to the sleeve.

To this end, as shown in Figs. 5 and 6, the sleeve 10 on opposite sides thereof has elongated, horizontal or longi-
tudinal slots 10b formed therein which receive slide members 13 which extend laterally or radially from diametrical portions of the barrel 12 and are secur to the barrel by suitable means such as the screws 13a. The barrel 12 is urged to and normally held in forwardly projected position as shown in Figs. 1 and 2 by a suitable medium such as the coil springs 14 disposed above sleeve 10 and having as shown, their forward ends 14a connected to the forward portion of the sleeve 10 while the rear ends thereof 14b are connected to the rear portion of a rigid saddle member 15 of inverted U-shape structure, said saddle member being connected with the barrel 12 through the intermediary of the four screws 13a which extend through the laterally disposed four slide members 13, working in the slots 10b of the sleeve.

An upstanding nail magazine 16 is rigidly affixed to and supported from the top of the saddle member 15 comprising as shown, a forward, elongated, nail-receiving channel 16a of segmental configuration which has rigidly attached base flanges and parallel side walls and which is open at both upper and lower ends. Channel 16a is adapted to accommodate the forward portions of a plurality of nails N disposed in tier formation, one above the other, the heads successively overlapping.

The nail magazine 16, for the most part of channel form has straight slots formed in the opposing channel walls thereof near the extreme rear edge for accommodating a pin 20 of a follower member later to be described, leaving the opposing marginal strip portions 18 which at their rearward upstanding edges define guiding means for the heads of nails in a clip or otherwise disposed within the magazine in preferably the tier formation with the successive heads overlapped from the lowermost nail outwardly. A rearwardly swingable gate member 17 comprising as shown, a pair of parallel strips pivoted at their lower ends to small brackets to the rear portion of the saddle member 15, is provided for facilitating feeding of nail clips into the magazine. The swingable gate member 17, as shown, carries forwardly extending spring arms 17a which are adapted to engage the upper end of the marginal strip portion 18 to retain the gate in closed position as shown in the full lines in Figs. 2 and 7.

The heads of the nails in successive overlapping relation are received and guided in the space between the strip 17 of the gate member and the rearward edges of the marginal strip portions 18 of the channel.

When the open end of the channel 16 comprising the parts described, is in open communication with a nail-shaped elongated slot 15a formed in the top plate of the saddle and of dimensions to accommodate a small variety of sizes of nails varying somewhat in length and slightly in diameter, said saddle-slot 15a having a nail head-receiving portion at the rear end thereof. Sleeve 10, at its forward portion has a similarly shaped nail-receiving slot 10b which when the barrel is protracted to full extended position, as shown in Figs. 1 and 2 relatively to the sleeve, is in precise alignment below the slot 15a of the saddle member (see Figs. 2 and 6).

Means are provided for urging a clip or a series of nails disposed one above the other in the overlapped head relationship, downwardly to urge the lowestmost nail into and through the slots 15a and 10b. As shown, such means comprise (see Figs. 1 and 6) a follower member 19 connected with a cross pin 20, the outer ends of which are urged downwardly by two coil springs 21 disposed at the respective sides of the magazine and having their lower ends anchored to the saddle 15. The cross pin 20 is accommodated in the space or slots produced between the rear edge of the channel member 16a of the magazine and the marginal strip portion 18 thereof.

A longitudinal feed slot and channel 22 is provided in the upper portion of the barrel 12 extending longitudinally thereof and at its forward portion, forming a nail-receiving aperture or slot 22a which is in communication with the interior of the outer portion of the barrel and of a length and size to nicely accommodate nails varying somewhat in length and section with slots 10b, causing the nails to be fed longitudinally and downwardly through slot 22 of the barrel and into the sleeve when the sleeve 10 is projected forward slidably on barrel 12. It is clearly shown in Figs. 2 and 6 that the receiving portion or rear portion of the channel and feed slot 22 is of a depth to just accommodate one nail, the portion at the head of that one nail projecting slightly above the important abutment edge 10c at the end of the said receiving slot in the barrel.

From the structure described, including the swingable end 17 of the nail magazine, it will be apparent that the magazine may be hand operated and that the nails are arranged in tier formation with overlapping heads, as shown in Fig. 2.

However, we prefer to utilize a novel and highly efficient clip construction for quickly loading the magazine with the multiplicity of nails in proper overlapped head relationship for successive feeding.

An embodiment of such structure constituting an important part of our invention is illustrated in Fig. 9. Such a clip would be formed by nail manufacturers, consisting in its simplest form indicated as an entirety by the letter Y in Fig. 9, in a multiplicity of the nails N interconnected substantially rigidly and bonded together by cements, adhesives or other materials of the nature. As shown in Fig. 9 the bonding material is applied between adjacent nails, at two or more points only being adequate to retain the nails in clip formation but of such fragile nature that when the lower nail is pushed forwardly by abutment with the end 10c of the slot 10b, the bond is broken and the nail is released from the clip.

To assist in the successive feeding of nails from slot 10b of the feeding sleeve along the feeding channel 22 in the top forward portion of the channel, we provide a resilient, nail-engaging roller device comprising a diagonally disposed bifurcated arm 23 intermediate between the forward portions and at the upper end of the upstanding forward channel 16a of the nail magazine and pivotally carrying at its lower end, the thin roller 23a (see Figs. 2 and 4), which applies pressure to the top of a nail in longitudinal feeding channel 22.

We provide nail-retaining and centering mechanism within the forward or muzzle portion of the barrel of suitable structure. As shown, such mechanism comprises a pair of elongated leaf springs 24 (see Figs. 1, 2 and 4), anchored at their rear ends as by screws 24a in external and oppositely disposed, longitudinal grooves provided in the sides of the forward portion of barrel 12. These grooves taper inwardly, increasing in depth and communicate with square cut apertures 12c at the muzzle end of the barrel, said apertures accommodating with clearance, a pair of cooperatively expansible retaining blocks 25 which are affixed to the forward extremities of springs 24 by suitable means such as the rivets 25a. The blocks 25 are provided with cooperating, axially disposed grooves of semi-funnel shape as shown in Fig. 2, being urged together for centering by the two leaf springs 24 and permissive of course of spreading for ultimate driving of the head of a nail in place in a board.

We prefer to provide the muzzle end of the barrel 12 with a plurality of longitudinally and forwardly extending teeth 26, terminating as shown, in points for pressure engagement and retention of the barrel to the work wherein nails are being hammered. As shown, one series
of said teeth 26 are provided at the top and a second series at the bottom of the muzzle end.

In Fig. 7, another form of the invention is illustrated which is shown in the form first disclosed in that a shorter and more compact tool assembly is provided. The feeding sleeve, reciprocable barrel, nail-guiding and feeding means and magazine are all substantially identical with those parts of the first form of the invention and will accordingly be numbered consistently with said first form.

Likewise, the mounting, grip handle, attachment sleeve and trigger of the pneumatic power tool or hammer II are similar to the power hammer described previously and are accordingly numbered similarly.

However, in the form of Fig. 7, a special hammer rod 30 is employed and the sleeve 10 of that structure is upwardly offset from the attachment sleeve S of the power tool and suitably and rigidly secured thereto by a rugged clamping strap 31, having its lower and free edges tightly clamped together by suitable means as the clamping screws 32.

The elongated hammer rod 30 is journaled at its rear portion for sliding action in a suitable slide bearing 33 secured within the rear portion of sleeve 10 and the forward portion of hammer rod 30 is slidably mounted within the barrel 12. A downwardly offset actually integrally formed or rigidly secured to the hammer rod 30, extending parallel therewith and having a rear abutment end which is positioned just forwardly and/or connected to the forward end of the reciprocating hammer element X of the power tool proper. The coil spring C is utilized as in the form first described, to retract the hammer in its reciprocating stroke.

In Fig. 8, a different and alternative form of nail magazine is shown, in top plan view, with the nail followers and actuating springs for urging the tiers of nails downwardly, removed from the structure. The tool, it will be noted, is extended in the opposite direction from the disposition of the sleeves and barrels of the tools previously described.

The magazine of the structure of Fig. 8 includes a base or mounting 35 which is secured at its forward end through the movement on a vertical anchoring pin 36 into three selective positions, whereby three vertically disposed tiers of nails in vertical compartments 37a, 37b and 37c may selectively be brought into alignment with the nail-receiving slot 10a of the sleeve 10. It is to be noted that the nails may be manually loaded in the head overlapping relation within the compartments 37a, 37b and 37c or that the preformed clips, as illustrated in Fig. 9, may be employed, one clip being inserted in each of the said magazine compartments.

In Fig. 10 another form of nail clip is illustrated which requires no bonding between the several nails employed. A channel member designated as an entire by the numeral 40 is employed, constructed of resilient or elastic material such as some of the plastics including polyethylene or from suitable rubber fabric having the ability of retaining its shape and yielding slightly.

Channel 40 is open at its two ends and as will be seen, defines a T-shaped passage having the enlarged head 40a for reception of the heads of the nails arranged in tiers and a relatively elongated passage portion 40b for receiving portions of the nail shanks. The nails utilized may be of the conventional headed structure and then arranged in successive, head-overlapping relation, as shown in Figs. 2, 7 and 9 of the drawings with the rear end of the shanks being spaced slightly apart and with the forward end of the nails in abutment or if desired, a special form of nail as illustrated in Fig. 10, positioned along side of the clip may be used whereby the heads are successively overlapped, but the entire shanks of the nails will be in abutment and the nails extend parallel, as shown in Fig. 10.

Such special nails have arcuate recesses formed in the heads thereof of similar or slightly greater diameter than the shanks thereof to accommodate the shank of an adjacent nail when the heads are overlapped, as shown in Fig. 10.

Operation

Some phases in the sequence of operation have been previously discussed in connection with the description and cooperation of our working parts.

In Figs. 1 and 2 of the drawings, the complete automatic tool is illustrated in the position to begin the driving of a nail with the barrel 12 in fully protracted position and with the magazine loaded with a multiplicity of nails in tier formation, one above the other, with the heads thereof successively overlapped rearwardly of the nail below. In such position, as will be seen from Figs. 2, 5 and 6, the slot 15a in the bottom of saddle member 15 and the feed slot 10b through the top of feed sleeve 10, are aligned and in registration and through spring pressure exerted by the follower element 19, the lowermost nail of the tier is positioned with the forward portion thereof lying in the longitudinal feeding channel 22 of the barrel and at the rear end thereof.

It will also be noted that a nail has previously been fed into and dropped within the muzzle end of the barrel 12 and upon the first hammering strokes of the hammer rod 11, will be retained and centered between the blocks 25, axially aligned with the barrel and with the pointed end thereof forward.

In power-driving a nail into a board or other piece of work, the operator supports the entire tool from the handle and grip G, pointing and positioning the muzzle of the tool at the point where nailing is desired and thereafter, presses triggers T rearwardly to reciprocate the convenient element X and with it, the hammer rod 11. At the same time, the operator pushes the tool toward the work, thereby taking up some of the slack between the forward end of the hammer rod 11 and the head of the nail being driven and of course, following the head in the successive driving action. Such action of course, causes forward sliding movement of sleeve 10 on barrel 12 and such sliding movement feeds the then lowermost nail forwardly of the barrel 12 along the feeding channel 22, the rear end of the nail being abutted by the edge of the sleeve at the rear of the slot 10b. In Fig. 7 a nail is shown partially driven into a piece of work with the barrel at least two thirds enclosed within sleeve 10. The function of the guide roller 23a will also be apparent from Fig. 7, pressing the next nail to be hammered downwardly in inclined relation to the barrel. In the position shown in Fig. 7, only the rearward portion of the nail is disposed upon the unpierced portion of channel 22, while the major and forward portion of the nail is being guided through the aperture or feeding slot 22a of channel 22. The parts are so related that only upon complete driving and seating of the forward nail with subsequent protrusion of the barrel 12 actuated by the enclosed longitudinally disposed springs 14, will the second nail be delivered within the muzzle end of barrel 12.

The combination of the feeding sleeve with its registering nail slot 10b, the reciprocable mounting of the barrel and sleeve and the forwardly declined nail-feeding channel 22 and associated parts, ensures a precise and positive successive feeding of the nails for positioning to be driven into the work under instant control of the operator.

With such mechanism, the tool is nicely adapted to break off the bonding between successive nails in the clip structure shown in Fig. 9 and the feeding of such nails from clip structure is as positive and efficient as when the nails are manually loaded in the magazine into a vertical tier.

The successively overlapped head relationship of the nails in the magazine (overlapping rearwardly from
the bottom nail up) is a feature of importance in its combinative relationship with the feeding mechanism of our power hammering nailing machine. This provides not only for maximum compactness of the nails in the magazine but also assures the lowermost nail of being in slightly declined relation to the top of barrel 12 which is very important to the proper and positive forcing of the nail forwardly and ultimately into the muzzle of the barrel. It will be noticed that in all instances forward ends of the nails in a tier abut.

With our structure, including the positive feed mechanism and the means within the muzzle of the barrel 12 for yieldably holding and centering a nail, the tool may be directed downwardly, upwardly, horizontally or vertically without danger of the nail to be driven or being driven becoming displaced or getting out of proper aligned relationship with the hammering rod 11. It will be seen that with our structure, nails may be automatically driven in relatively inaccessible spaces where hand-hammering cannot be carried on.

Assuming that the hammer rod 11 is power reciprocated 3200 times per minute and that the effective driving stroke thereof is approximately one half inch, a nail may be completely driven to place within less than 4 seconds and such has been amply demonstrated through actual operation and reduction to practice of our device.

From the foregoing description, it will be seen that our invention is well adapted as an attachment to power-reciprocated tools of conventional structure whether electrically or pneumatically or hydraulically driven, but is equally well adapted for manufacture and sale as a complete automatic power tool in itself.

It will of course be understood that various changes may be made in the details, arrangement of parts and design of our invention, without departing from the scope thereof.

What is claimed is:

1. In a power nail-driving device, a feeding sleeve, a barrel mounted within said sleeve for slidable telescoping relation therein and a handle extension extending at its forward end some distance beyond the forward end of said sleeve, an elongated hammer rod axially mounted within said barrel and also extending into said sleeve, a magazine extending laterally and exteriorly of said sleeve and secured to said barrel, said magazine having an open lower end through which the lowermost nails of a tier of nails pass inwardly, said feeding sleeve having a longitudinal nail-receiving slot therethrough, over-riding said barrel and positioned to receive a nail from the lower end of said magazine when said barrel is protruded outwardly from said sleeve to a predetermined position, means for urging said barrel outwardly into said protracted position, said slot having a depth to accommodate the thickness of one nail only, said barrel near its forward end having a longitudinal nail channel declining forwardly from its rear end, the rear end of said nail-receiving slot of the sleeve having a nail abutment for engaging and pushing forward a received nail along the interior of said barrel and along said channel during relative slideable retraction of said sleeve and barrel, said longitudinal nail channel in said barrel communicating at its forward portion with an aligned nail passage communicating with the interior of said barrel.

2. The structure set forth in claim 1 and said last mentioned member in which a reciprocating element is mounted, a feeding sleeve extending outwardly from said handle and secured thereto, a barrel mounted for slideable reciprocation in said feeding sleeve and extension thereof, an elongated hammer rod axially mounted within said barrel and also extending into said sleeve, said slot having a depth to accommodate the thickness of one nail only, said barrel near its forward end having a longitudinal nail channel declining forwardly from its rear end, the rear end of said nail-receiving slot of the sleeve having a nail abutment for engaging and pushing forward a received nail along the interior of said barrel and along said channel during relative slideable retraction of said sleeve and barrel, said longitudinal nail channel in said barrel communicating at its forward portion with an aligned nail passage communicating with the interior of said barrel.

3. In a power nail-driving device having a source of rapidly reciprocating power and provided with a portable handle or grips member in which a reciprocating element is mounted, a feeding sleeve extending outwardly from said handle and secured thereto, a barrel mounted for slideable reciprocation in said feeding sleeve and extension thereof, an elongated hammer rod axially mounted within said barrel and also extending into said sleeve, said slot having a depth to accommodate the thickness of one nail only, said barrel near its forward end having a longitudinal nail channel declining forwardly from its rear end, the rear end of said nail-receiving slot of the sleeve having a nail abutment for engaging and pushing forward a received nail along the interior of said barrel and along said channel during relative slideable retraction of said sleeve and barrel, a magazine extending laterally and exteriorly of said sleeve and secured to said barrel, said magazine having an open lower end through which the lowermost nail of a tier of nails may pass inwardly, said magazine being provided with a longitudinal nail passage therethrough for receiving a nail delivered forwardly thereon by the slotted portion of said sleeve, and a longitudinal guiding channel formed in the exterior portion of said barrel and communicating with said nail passage at its forward end and declining in a forward direction.

4. In a power nail-driving device for successively stripping and thereafter successively driving nails from a multi-nail unit mounted in tier formation with nails therein successively outward with overlapping heads and having the forward pointed portions converging and disposed in at least very close relationship, a supporting and nail-feeding sleeve, a barrel axially mounted within said sleeve for telescoping relation therein, means connected with said sleeve and barrel for urging said barrel to outwardly protruded position relative to said sleeve, an elongated, reciprocating hammer rod axially mounted within said barrel and also extending into said sleeve, a magazine extending laterally and exteriorly of said sleeve and secured to said barrel, said magazine having an open lower end through which the lowermost nails of a tier of nails may pass inwardly, said feeding sleeve having a longitudinal nail-receiving slot therethrough, over-riding said barrel and positioned to receive from the lower end of said magazine when said barrel is protruded outwardly from said sleeve to a predetermined position, said sleeve-slot having a depth to longitudinally accommodate the thickness of one nail only, said slot defining a nail-abutment at the rear end thereof, said barrel having a longitudinal nail-guiding channel formed in the exterior thereof aligned with said sleeve-slot and declined forwardly, said slot at its forward end communicating with a longitudinal nail passage extending radially through the forward portion of said barrel and thus into the interior of said barrel, the forwardly converging relationship of the nails in said tier cooperating with the forwardly declined nail-guiding channel of said barrel to produce efficient selective stripping and forward feeding of said nails to the forward end of said barrel and then therethrough into the interior of said barrel, and means extending through the forward portion of said barrel for engaging against the longitudinal, outermost portion of said nails to exert pressure inwardly thereon to facilitate entrance of said nails successively into said barrel.

5. In a power nail-driving device, a feeding sleeve, a barrel mounted within said sleeve for slidable telescoping relation therein and normally extending at its forward end with some portion of its lateral and exterior portion protruded outwardly, an elongated hammer rod axially mounted within said barrel, a magazine extending laterally and exteriorly of said sleeve and secured to said barrel, said magazine having an open lower end through which the lowermost nail of a tier of nails may pass inwardly, said magazine being provided with a longitudinal nail passage therethrough for receiving said nail and protruded outwardly from said sleeve, said slot having a depth to accommodate the thickness of one nail only, said barrel near its forward end having a longitudinal nail channel declining forwardly from its rear end, the rear end of said nail-receiving slot of the sleeve having a nail abutment for engaging and pushing forward a received nail along the interior of said barrel and along said channel during relative slideable retraction of said sleeve and barrel, said longitudinal nail channel in said barrel communicating at its forward portion with an aligned nail passage communicating with the interior of said barrel.
a depth to accommodate the thickness of one nail only, said barrel near its forward end having a longitudinal nail passage lying generally in a common plane with the nail-receiving slot of said sleeve, the rear end of said nail-receiving slot of the sleeve having an abutment for engaging and pushing forward a received nail along the exterior of said barrel during relative slideable retraction of said sleeve and said barrel, said barrel rearwardly of said nail passage having a longitudinal groove aligned therewith for accommodating and guiding said nail forwardly through said retractive movement and the abutment of said abutment element with the head of a nail.

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