This invention relates to fastener driving apparatus and more particularly to apparatus for driving fasteners fed from a magazine into a workpiece.

Fastener driving apparatus of the type in which fasteners are fed to the driving passage of a workpiece are finding increasing use in the construction industry. For example, apparatus of this type may be used in the laying of hardwood floors. Such an apparatus is equipped with a magazine that contains a substantial supply of nails. A nail is withdrawn from the magazine and fed to a nail-delivery passage, from which it is driven downwardly into a workpiece by a nail-driving blade carried by a plunger. In manually operated devices the downward movement of the plunger conventionally is effected by striking the plunger with a hammer or mallet.

It is an object of this invention to provide a novel and improved fastener driving apparatus which includes a magazine for storing a quantity of fasteners and which functions to successively deliver fasteners from the magazine to the nail-delivery passage for driving by the plunger.

Still another object of the invention is to provide novel and improved fastener-feeding mechanism for efficiently delivering fasteners to the driving passage in response to the resetting of the plunger after completion of a fastener driving operation.

A further object of the invention is to provide a novel and improved manually operated heavy duty fastener driving apparatus of the type particularly adapted for use in the nailing of hardwood flooring.

Another object of the invention is to provide a novel and improved fastener driving apparatus in which the feeding and driving of fasteners are coordinated so as to avoid the possibilities of jamming a fastener in the drive track.

Apparatus constructed in accordance with the invention includes a body having an upwardly extending head portion formed with a fastener driving passage. Structure defining a fastener feeding passage extends away from the body portion for connection to a magazine which holds a supply of fasteners. In the particular embodiment described hereinafter in detail, these fasteners are full heading nails which are secured together in serially spaced arrangement by a frangible connector so that the nails may be cilled into a compact cylindrical configuration. A plunger is slidably mounted in the head portion and has a depending fastener driving blade disposed for movement downwardly through the driving passage upon downward movement of the plunger to drive a fastener disposed in the driving passage through that passage into a workpiece. Also, mounted in the body is a feed cam which is responsive to the downward movement of the plunger. Coupled to this feed cam in the fastener feeding passage is a feed pawl which is arranged to engage a fastener and advance the fastener from the feed passage to the driving passage. Also disposed adjacent to the feed passage is a holding pawl which engages a fastener in the feed passage and prevents movement of that engaged fastener away from the driving passage. The feed cam, in response to the downward movement of the plunger moves the feed pawl to a cocked position and the feed pawl is then secured in cocked position by a latch. A latch release, also disposed in the body, is actuated upon return of the plunger to its full "up" position to release the feed pawl latch so that the feed pawl advances a fastener from the feed passage into the driving passage.

Also included in the apparatus is a plunger control which prevents upward movement of the plunger after a fastener driving operation has started until the plunger reaches its full "down" position. This interlock prevents resetting of the plunger after only partial driving of a fastener thus avoiding the feeding of more than one fastener into the driving passage at one time so that a cause of potential jamming of the apparatus is eliminated.

The apparatus provides a simple and reliable fastener-driving apparatus which may be incorporated in a manual type of nail driver in which the plunger is actuated by being struck by a hammer or mallet.

Other objects, features and advantages of the invention will be seen as the following description of a particular embodiment thereof progresses, in conjunction with the drawings in which:

FIGURE 1 is a side elevational view of a manually actuated fastener driving apparatus constructed in accordance with the invention;

FIGURE 2 is a front elevational view of the fastener driving apparatus shown in FIGURE 1;

FIGURE 3 is an enlarged view of the nose portion of the fastener-driving apparatus shown in FIGURE 1 showing the side of the nose piece opposite that shown in FIGURE 1;

FIGURE 4 is a front elevational view similar to FIGURE 2 with a portion of the nose piece broken away to show details of the fastener-feeding passage;

FIGURE 5 is a sectional view of the body portion of the fastener-driving apparatus, showing details of the plunger and feed cam;

FIGURE 6 is a sectional view of the plunger-control pawl showing its position during a downward stroke of the plunger;

FIGURE 7 is a sectional view similar to FIGURE 5 showing the plunger in its down position at the completion of the driving of a fastener into a workpiece;

FIGURES 8, 9, and 10 are sectional views taken along the lines 8—9, 9—9, and 10—10 respectively of FIGURE 5; and

FIGURE 11 is a sectional view similar to FIGURE 10 taken along the line 11—11 of FIGURE 7.

With reference to FIGURE 1, the fastener driving apparatus there shown is a nailer particularly arranged for driving nails 10 at an angle into a workpiece, which in this case is a series of hardwood flooring boards 12. The nailer structure includes a body portion 14 having a carrying handle 16 secured to it. Protruding from the upper end of the body portion is a plunger head 18, which may be struck one or more blows by a hammer in a nail-driving operation. At the lower end of the body portion is formed a nose-piece structure 20 and secured to the lower surface of the nose piece is a guide structure 22 adapted to be positioned against the tongue 23 of the hardwood board 12 to be nailed and a shoe 24 which lies on the surface of the board as indicated in FIGURE 1.

A magazine 26 is secured to the nose piece by a structure 28 which defines a nail-feeding passage. Mounted on one side of structure 28 is a holding-pawl structure 30 (indicated in FIGURE 1) and on the opposite side of structure 28 is mounted a feeding-pawl structure 32 (indicated in FIGURE 3). The feeding pawl is normally
biased forwardly towards the front of the nose piece by a spring 34 which is secured between the feeding pawl and a plate 36 mounted at the front of the nose-piece structure.

The magazine 26 is a cylindrical canister of the type disclosed in greater detail in a pending application, Serial No. 396,841, filed September 16, 1964, entitled Fastener Driving Apparatus and assigned to the same assignee as this application, which receives a coil of nails 10 which are arranged in a flexible belt coiled into a compact cylindrical configuration for convenience in handling. The nails are rounded headed nails secured together by a pair of, frangible wires in the manner disclosed in the Peterson Patent No. 3,083,369 or other suitable frangible connecting links, for example, plastic strips.

In loading the canister magazine 26, a coil of nails is placed therein and the leading end of the belt is disposed within the feed passage in structure 28. As best indicated in FIGURE 4, this feed passage has two parallel vertical walls 38 that define a channel which receives the shank of the nail, and at the upper end of each wall 38 is a horizontal surface 40 on which a portion of the nail head 42 rests. Disposed in this feed passage, as indicated above, are two paws, a holding pawl 30 and a feeding pawl 32. The holding pawl is generally of U shaped configuration, as indicated in FIGURE 4, and each leg has two opposed grooves or recesses 44 (FIGURE 10) which engage the shank 46 of two successive nails in the belt. The two paws are vertically offset from one another so that they do not interfere with each other. As indicated in FIGURES 4 and 10, holding pawl 30 is pivoted secured on pin 48 which passes through hole 50 that project outwardly from the wall of structure 28. A spring 52 normally biases the holding pawl and its nail shank receiving grooves 44 into engagement with the nail shanks. The holding pawl is designed to prevent movement of nails in the feed passage 54 away from the drive passage 56. The holding pawl 30 also has inclined surfaces 58 along which the nail shanks ride and force the pawl outwardly as the nails are advanced through channel 54.

The feeding pawl 32 is coupled to a feed-cam structure 60 which extends upwardly from the feed cam into the body portion of the driving apparatus. In configuration the feed pawl is similar to the holding pawl, having nail shank receiving grooves 44 and inclined surfaces 58. It is also biased, however, to allow withdrawal movement of the pawl and forward feeding of the nails. To this end pawl 32 is mounted for front and back motion. Also mounted within the body portion is a plunger 62 to which is secured a depending nail-driving blade 64, which is aligned with nail-driving passage 56 for downward movement therethrough. The plunger 62 includes a sleeve 66 which surrounds the nail-driving blade 64.

Housed within the sleeve and surrounding the nail-driving blade is a return spring 68 which acts between a stop 70 in the lower portion of the body and the plunger head to return the plunger to an "up" position. A key-like projection 72 protruding from the side of the sleeve 66 rides in a slot 74 in the body wall and functions to guide and limit the motion of the sleeve.

On the opposite outer wall of the sleeve are formed two depressions 76 and 78, which are arranged to cooperate with a pivotally-mounted pawl 80. The pawl 80 is pivotally mounted on shaft 82 and is biased in the clock-wise direction by a push rod 84 and a spring 86, and in the counterclock-wise direction by a spring 88. The length of the pawl is such that it engages the surface 89 of the plunger sleeve 66 except when the plunger is either in its full "up" position (at which time the pawl is in groove 76) or in its full "down" position (at which time the pawl is in groove 78). When the plunger is intermediate its "up" and "down" positions, sleeve surface 89 is engaged by the pawl 80, and that pawl acts to prevent reverse movement of the plunger.

For example, in the position shown in FIGURE 5, pawl 80 is resting in groove 76 and the plunger sleeve 66 is free to move in either direction. However, it is in its "up" position as is limited by key 72. When the plunger head 18 is struck a mallet blow, it is driven downwardly and surface 89 engages pawl 80, cocking that pawl in counter-clock-wise direction against the force of spring 88. The pawl, in that cocked position, prevents upward movement of the plunger and holds it in the position to which it was driven by the mallet. Further mallet blows, as necessary, drive the plunger downward until the pawl engages groove 76, at which time the upward restraining force of the pawl is removed. In this position 80 is then effective to immediately move the plunger upwardly. As the plunger sleeve moves upwardly, surface 89 again contacts pawl 80, but in this case it cocks the pawl in the clock-wise direction (against the tension of spring 88), so that the pawl 80 does not impede the return of the plunger to its "up" or initial position. Thus, pawl 80 acts to insure the movement of the plunger from its "up" position fully to its "down" before the plunger can return to its "up" position. This travel in the driving stroke of the nail-driving blade 64 is necessary to move the nail disposed in the driving passage fully into the workpiece 12, as indicated in FIGURE 7.

Feed cam 60 has a cam surface 90 that is engaged by the lower end 92 of plunger sleeve 66 as the plunger is moved down in a driving operation. The cam surface 90 is inclined slightly forward, as indicated in FIGURE 5, and as the plunger moves down, the cam 60 is moved rearwardly (pivoting about the shaft 82 on which it is supported). As the cam moves rearwardly, it carries the forward pawl 32 back towards the menacing position. In this operation, the feed pawl 32 rides out (on inclined surfaces 58) through transverse flexure of the cam 60 as it moves rearwardly past the nail shanks 46 that are held in position by the surfaces 44 of the holding pawl 30.

There is also provided in the body 14 about halfway down the plunger channel, a latch 96 which is pivotally mounted on pin 98 and urged downwardly by spring 100. This latch normally rests on upper ledge 102 on the feed cam 60. However, as the feed cam is rocked to the right, as viewed in FIGURE 5, by the downward movement of plunger sleeve 66, the latch is moved off ledge 102 and at the end of the plunger stroke, it falls, under the influence of spring 100, onto ledge 104 in which position it holds the cam in latched position, as indicated in FIGURE 7. In this position, as shown in FIGURE 11, the feed pawl 32 has been moved rearwardly from engagement with the first and second nails in the series into engagement with the second and third nails in the series (the same nails that are being held by the holding pawl 30).

Also, in this position, where the feed cam 60 has just been latched, control pawl 80 is disposed in groove 78 so that upward movement of the plunger 66 is now permitted. The plunger then moves upwardly rapidly under the influence of spring 68 to return to its "up" position. Carried on the lower end of the plunger sleeve 66 is a latch release tag 110, which is offset laterally from the cam 60. As the plunger returns to its "up" position, the latch release tag 110 rises until it engages latch 96 and lifts that latch off of ledge 104 and up to ledge surface 102 so that the feed cam 60 is free to move forward. Spring 34 then moves the feed cam and feed pawl 32 forwardly to advance the second and third nails, placing the second nail in the drive passage 56, during which movement holding pawl 30 engages the surface 89 of the plunger sleeve 66 except when the plunger is either in its full "up" position (at which time the pawl is in groove 76) or in its full "down" position (at which time the pawl is in groove 78). When the plunger is intermediate its "up" and "down" positions, sleeve surface 89 is engaged by the pawl 80, and that pawl acts to prevent reverse movement of the plunger.

Thus, this driving apparatus enables the driving of a nail by repeated blows into an embedded position in
the workpiece, and when the nail reaches that embedded position, the driving apparatus recycles automatically to reset the plunger and the nail-driving blade and then to advance another nail automatically into position for the next nail-driving operation. The apparatus is useful with a belt of full-headed nails which are secured tightly against movement by large number of nails may be driven without the necessity to reload the magazine. The particular embodiment described in detail is particularly adaptable for nailing operations in conjunction with the laying of hardwood floors. While this particular embodiment has been described in detail, modifications thereof will be obvious to those skilled in the art and therefore, it is not intended that the invention be limited to the disclosed embodiment or to details thereof, and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

What is claimed is:

1. Apparatus for driving fasteners into a work piece comprising:
   a body defining a fastener delivery passage,
   a magazine structure for holding a fastener package including a multiplicity of parallel fasteners interconnected in series,
   a structure connecting said magazine to said body defining a fastener feed passage for guiding fasteners from said magazine to said magazine delivery passage, a plunger slidably mounted in said body between a starting position and a fastener driven position, a fastener driving blade depending from said plunger for movement through said fastener delivery passage in response to movement of said plunger from said starting position to said fastener driven position to thereby drive a fastener from said delivery passage into a work piece,
   means for effecting return movement of said plunger from said fastener driven position to said starting position,
   feed means mounted for movement from a first position through said fastener feed passage into a second position to engage said fastener package and effect movement of the leading fastener from a feed position within said feed passage into said delivery passage and the next adjacent fastener into said feed position and for movement from said second position to said first position,
   holding means operable to engage a portion of said fastener package disposed within said feed passage to prevent movement of the latter therein in a direction away from said delivery passage during the movement of said feed means from said second position to said first position but to permit movement of said fastener package within said feed passage during the movement of said feed means from said first position to said second position,
   spring means operatively connected with said feed means for effecting movement of said feed means from said first position to said second position, means operatively associated with said plunger and said feed means operable in response to the movement of said plunger from said starting position to said fastener driven position for effecting movement of said feed means from said second position into said first position against the action of said spring means,
   latch means engageable between said body and said feed means in response to the movement of said feed means into said first position to retain the latter against movement out of said first position by said spring means and releasable to permit such movement, and
   means operatively associated with said plunger operable in response to the return movement of said plunger to said starting position for releasing said

2. Apparatus as defined in claim 1 wherein said feed means comprises a feed member mounted for movement between said first and second positions within slot means formed in said fastener delivery passage defining structure and extending in the direction of movement of said fasteners therein, said feed member being normally biased in a direction transversely away from a fastener within said fastener feed passage to engage such fastener and effect movement thereof during the movement of said feed member from said first position to said second position and being yieldable in a direction transversely away from a fastener in said fastener feed passage to ride over such fastener during the movement of said feed member from said second position to said first position.

3. Apparatus as defined in claim 2 wherein said feed member includes a pair of spaced fastener engaging portions having aligned pairs of fastener engaging notches formed therein for engaging the leading and next adjacent fasteners.

4. Apparatus as defined in claim 2 wherein said feed means further comprises an elongated member pivotally carried by said body and operatively connected with said feed member, and said feed means moving means comprises a first cam surface fixed with respect to said plunger for movement therewith, said elongated member having a second cam surface extending longitudinally thereof for engagement with said first cam surface throughout substantially the entire movement of the latter during the movement of said plunger between said starting and fastener driven positions.

5. Apparatus as defined in claim 4 wherein said latch means comprises a latch member carried by said body for normally biased movement into a latching position and for movement out of such latching position into a release position, said elongated member having latch engaging surface means adjacent one end of the cam surface thereon for retaining said latch member in said release position when said feed member is out of said first position and for permitting biased movement of said latch member into said latching position when said feed member is moved into said first position by said elongated member and wherein said latch means comprises a release tab fixed with respect to said plunger for movement therewith in a position to engage said latch member and effect movement thereof from said latching position to said release position during the movement of said plunger into said starting position.

6. Apparatus as defined in claim 1 wherein said plunger includes a head portion disposed outwardly of said body adapted to receive impact blows by a mallet to affect movement of said plunger from said starting position to said fastener driven position.

7. Apparatus as defined in claim 6 wherein said means for effecting return movement of said plunger comprises return spring means, and means operatively engageable with said plunger to retain the latter in any position into which it is moved by an impact blow during the movement of said plunger from said starting position to said fastener driven position and releasable in response to the movement of said plunger into said starting position to permit the return movement of said plunger by said return spring means.

8. Apparatus as defined in claim 1 wherein said magazine is generally cylindrical in shape having a central axis disposed parallel with the longitudinal extent of said fastener delivery passage for holding the fasteners of said package therein in parallel relation to said axis in coil formation thereabout, the fasteners being interconnected by a pair of parallel wires welded to the shank of each fastener.

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