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[33] **Germany**

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ABSTRACT: A fastener-inserting machine such as a nail gun, screw driving gun, or the like with a driving channel for the drive rod and a feed channel for a fastener strip carrying a row of fasteners on one lateral side of a carrier strip. The feed channel extends to and through the driving channel and has a lateral wall recessed from the wall of the driving channel so that during the strokes of the drive rod in the driving channel or its rotation therein when serving as a screw driver, the drive rod will not engage with the carrier strip. For severing headed fasteners such as nails or screws one at a time from the carrier strip and shifting at least the fastener head laterally into the driving channel, a groove in the wall of the driving channel in which the head is at first located has an inclined guide surface, whereby when in a nail gun the fastener is moved forwardly directly by the drive rod or—either in a nail gun or in a screw driving gun—the fastener is so moved by a separate shifting member which is driven by the drive rod only during a first part of its forward stroke and before the drive rod itself engages with the fastener, the fastener head is laterally deflected by the inclined guide surface into the driving channel.

[54] **FASTENER-INSERTING MACHINE**
17 Claims, 12 Drawing Figs.

[52] U.S. Cl. 227/136,
 227/114

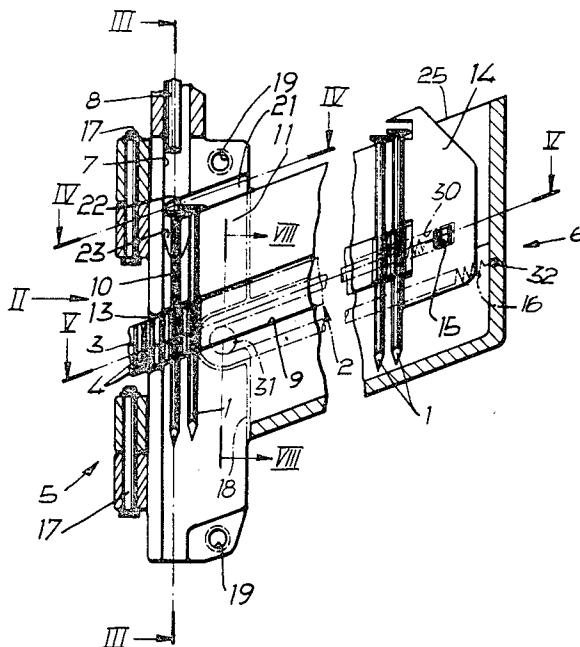
[51] Int. Cl. B25c 1/00

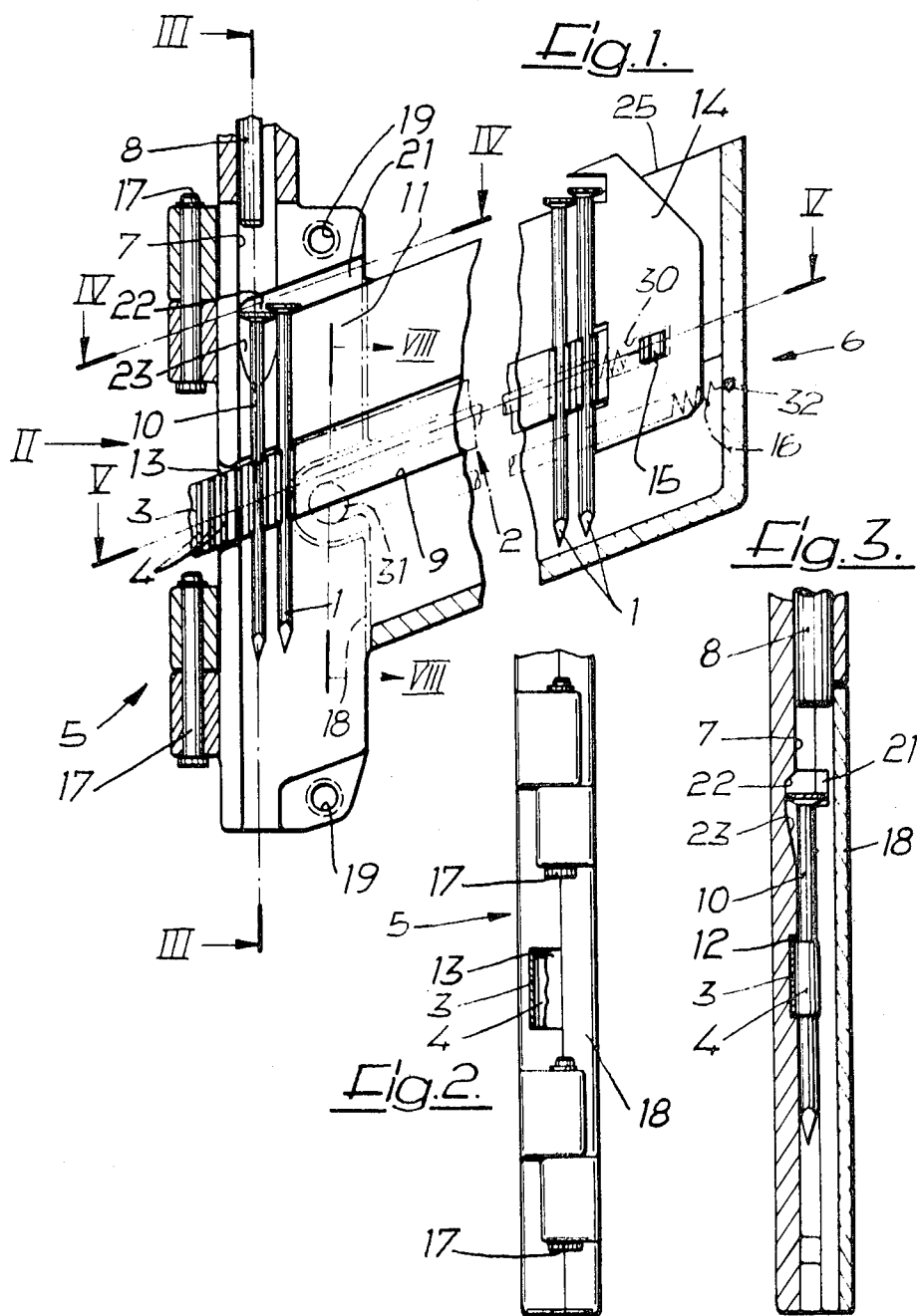
[50] Field of Search. 227/114,
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SHEET 2 OF 4

Fig. 4.

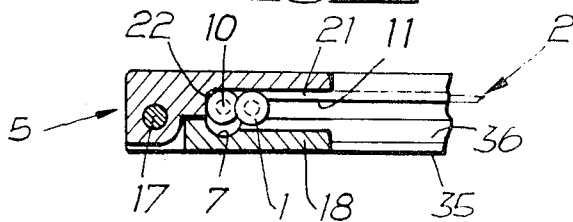


Fig. 5.

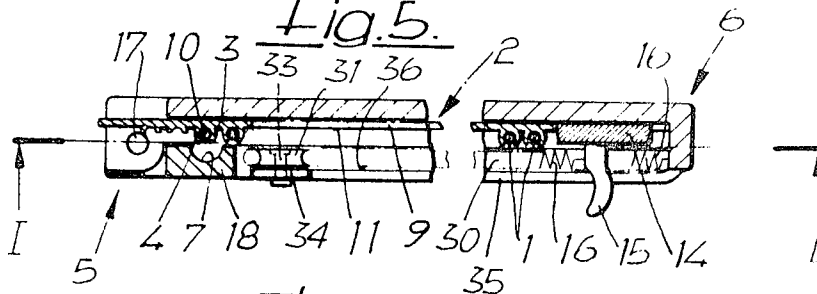


Fig. 6.

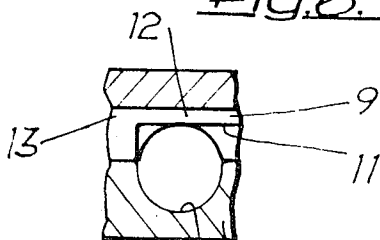


Fig. 7.

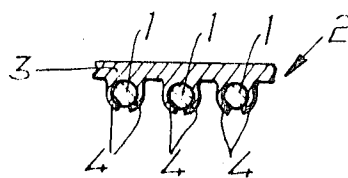
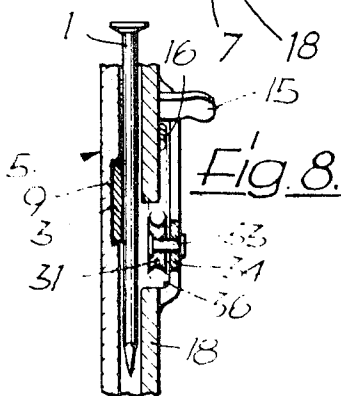


Fig. 8.



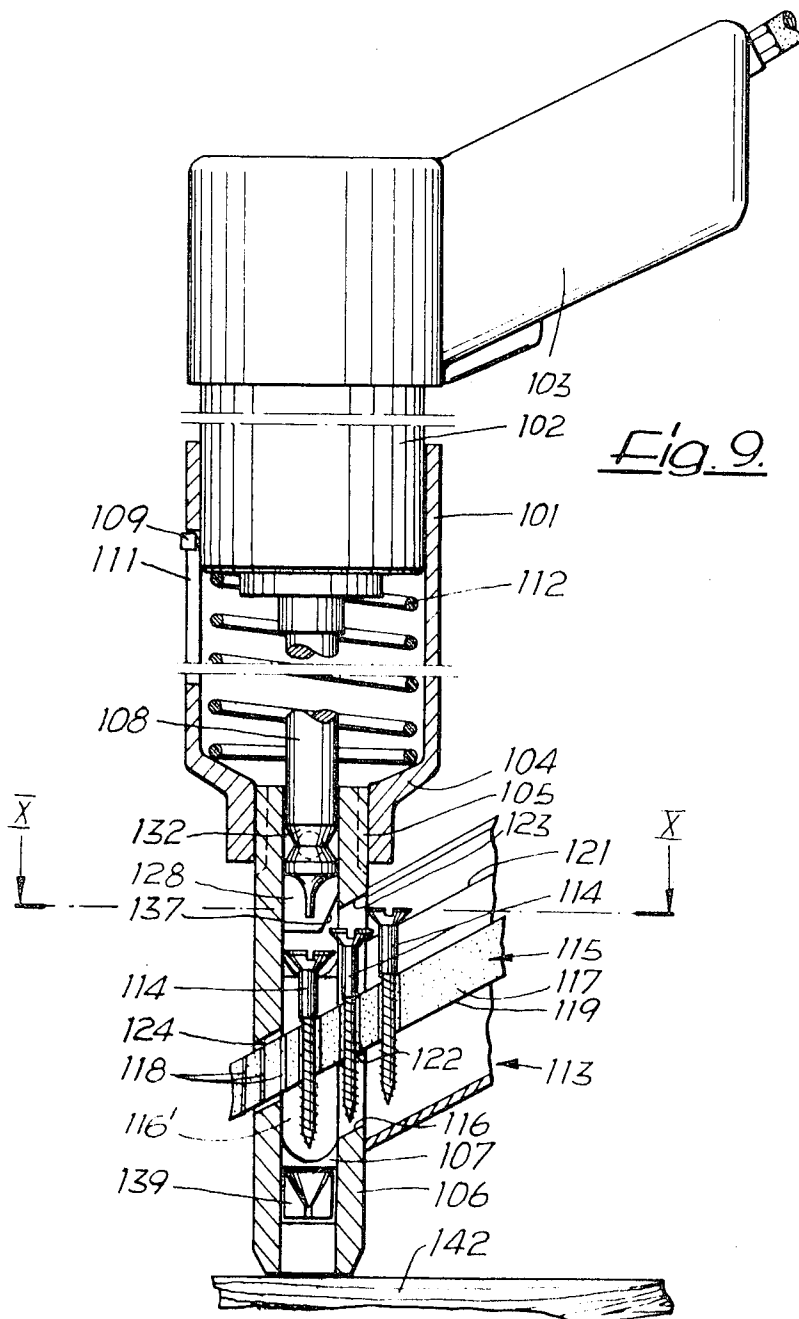
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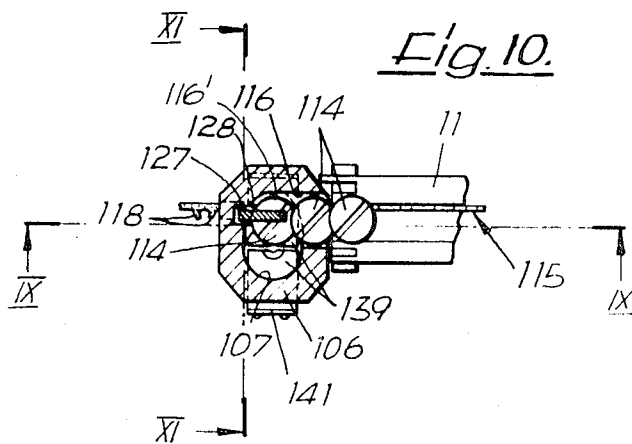
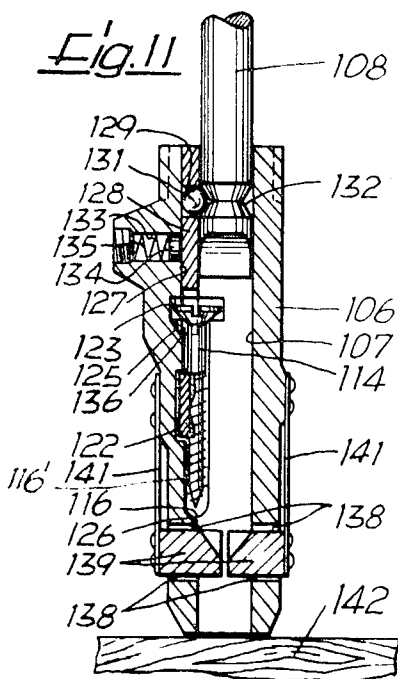
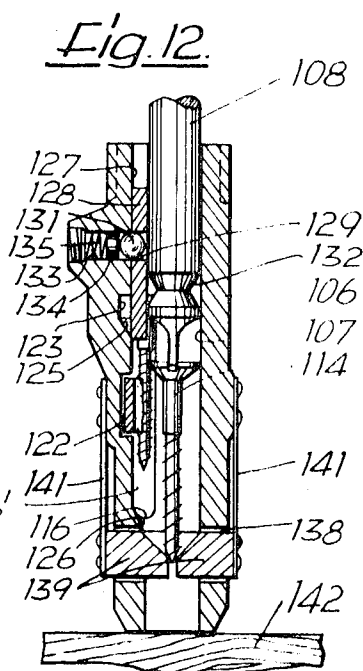
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FASTENER-INSERTING MACHINE

This application is a continuation-in-part of our copending application, Ser. No. 718,676, filed on Apr. 4, 1968 now abandoned.

BACKGROUND OF THE INVENTION

This application concerns an invention in a fastener-inserting machine preferably of the type to which a magazine is directly attached which contains a row of fasteners connected to each other to form a strip, and which comprises a drive rod for driving the individual fasteners in the order in which they are supplied from the fastener strip, a driving channel within the foot of the machine for guiding the drive rod and the fastener which is to be driven thereby, and a feed channel for feeding the fastener strip from the magazine into the driving channel.

Fastener-inserting machines of the above-mentioned type which may be driven pneumatically, hydraulically or by mechanical means are known for a long time. It is also well known in this art to provide fastener strips by connecting fasteners of various types, for example, nails, pins, staples or the like, by different means to each other. Such fastener strips are inserted into a magazine of a fastener-inserting machine of the above-mentioned type and are fed through a feed channel into the driving channel so that always the first fastener of the fastener strip will engage into the driving channel. When the trigger of such a machine is pulled, the drive rod carries out a driving stroke, tears the first fastener off the fastener strip and drives it into a workpiece. When the fastener is being torn off the fastener strip, the means which connect the fasteners to each other are torn apart and thrown upon the surface of the workpiece where they might interfere with the fastening operation, for example, by passing underneath the head of the fastener which is to be driven into the workpiece.

There is another known type of fastener strips for magazines in which the fasteners are held together by a connecting strip of steel. These fastener strips cannot be employed for inserting machines of the type to which the present invention relates since they require special devices for removing the fasteners from the connecting strip before being passed into the driving channel. These additional devices render also the construction of the fastener inserting machine rather complicated.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a fastener-inserting machine of a type of construction which is as simple as possible and is designed so that a part of each forward stroke of the drive rod of the machine will be employed so as to remove one of the fasteners from the fastener-connecting strip without damaging this connecting strip at all or only to such a small extent that the amount of material which might be severed from this connecting strip will be so small as not to interfere with the proper operation of the machine itself or with its action upon the workpiece.

According to the present invention this object is attained in a fastener-inserting machine of the type as first mentioned above by designing it so that at least a part of the feed channel for the fastener strip which extends from the magazine through the wall of the foot of the machine in a direction transverse to the driving channel for the drive rod is laterally offset relative to a plane extending through the axis of the driving channel and thereby forms a recess in one side of the wall of the driving channel in which the strip is guided which connects and carries the fasteners. Due to this offset position at least of the fastener connecting or carrier strip relative to the driving channel for the drive rod, at least the main part of this strip will be moved past the driving channel without interfering with the movement of the drive rod. Depending upon the depth of this recess in the wall of the driving channel, the drive rod will therefore either not engage at all with the means which connect the respective fastener to the connecting strip or if it does engage with these means during its forward stroke, it will damage them only very slightly so that very little, if any, broken parts thereof may fall upon the workpiece.

According to one preferred embodiment of the invention, the fasteners which are fed to the machine by means of a connecting or carrier strip are provided with heads and both sides of the feed channel which extends through the wall of the foot of the machine and through one side of the driving channel in which the recess for the carrier strip is provided are further provided with second recesses for receiving the heads of the fasteners. One important feature of the invention which is applicable to this embodiment consists in extending the backwall of this second recess in one side of the wall of the driving channel in the form of an inclined guide surface in the direction toward the first recess for the connecting strip so as to taper from the maximum depth of this second recess in the direction toward the normal unrecessed part of the driving channel. When a fastener the head of which is located within this second recess in the wall of the driving channel is struck either directly by the drive rod or when in accordance with another feature of the invention as subsequently described this fastener is moved forwardly within the driving channel by the action of a separate shifting member which, in turn is moved by the drive rod, this head by sliding along the inclined guide surface is deflected and guided by the latter in a lateral direction toward and into the driving channel, whereby the fastener will be torn off the connecting strip which is held in the first recess or off the means which connect the fastener to this strip.

While for operating a nailing or similar machine which is designed in accordance with the invention, the number of headed fasteners, for example, nails, which a carrier strip of a certain length may carry, is dependent upon the distance between the adjacent fasteners, which ordinarily should be at least slightly larger than the diameter of the drive rod of the machine, it is another object of the invention to modify such a machine so as to permit such a carrier strip to carry a much larger number of headed fasteners by connecting the fasteners to the strip at such a short distance from each other that the heads of the adjacent fasteners will partly overlap each other and the head of one fastener on the strip may even abut against the shank of the next following fastener.

Since a normal drive rod of a circular cross section which substantially fills out the driving channel may in this case hit not only upon the head of the fastener which is supposed to be hit within the driving channel but also upon the overlapping head portion of the next following fastener which would result at least in a breakdown of the operation of the machine, the invention provides that the side of the drive rod which faces the head of this following fastener be ground off to such an extent that the remainder of the drive rod will only hit upon a part of the head of the fastener which is supposed to be driven but will not touch the overlapping part of the head of the following fastener.

Of course, if such a drive rod which is ground off at one side and is therefore of a reduced strength and poorly guided by the wall of the driving channel is subjected to very high stresses in the operation of the machine, it has the disadvantage over a drive rod of a full circular cross section the entire peripheral surface of which is guided by the wall of the driving channel that it may bend or jam in the driving channel. If, on the other hand, the drive rod is made of a full circular cross section, and the adjacent headed fasteners are held on the carrier strip at least at such a distance from each other that their heads will not overlap, such carrier strips may also be employed for holding headed screws and for feeding them to the driving channel of a screwdriving machine in which the end of the drive rod is provided with a flat tip which is to be inserted during the first part of the forward stroke of the drive rod into the entire length of the slot in the head of the screw which is located centrally within the driving channel. Since during its forward stroke such a drive rod of a screwdriving machine also rotates about its axis, the flat tip of the drive rod requires practically the entire cross-sectional area of the driving channel, even though when not rotating it only forms a thick diametrical line in the driving channel. Therefore, the screws on the carrier strip must necessarily be spaced so far

from each other that at each stroke of the drive rod only one screw and no part of the head of the next following screw will be located within the driving channel.

It is a further object of the invention to provide a fastener-inserting machine which may be either a nailing or similar machine or a screw driving machine or a machine which forms a combination of these two types of machines by being adjustable so as to carry out alternately the functions of one or the other, and which, even though it is provided with a drive rod which may be fully guided by the wall of the driving channel by taking up substantially the entire cross-sectional area of this channel, permits headed fasteners, for example, nails or screws, to be fed successively to the machine without interfering therein with each other, even though these fasteners might be spaced at the shortest possible distance from each other on their carrier strip so that their heads may overlap each other and the head of one fastener may even abut against the shank of the next fastener. By simple modifications, such a fastener-inserting machine should also be capable of driving headless fasteners, for example, pins or worm screws, into a workpiece.

For attaining these objects, it is one feature of the invention that the feed channel which is formed by the inlet and outlet slots in opposite wall portions of the foot part of the machine is laterally offset for such a distance relative to the axis of the driving channel that the intermediate recess in the wall of the driving channel has a length at least equal to the length of the fasteners and such a depth that a fastener while held in this recess on the carrier strip will, if at all, only project partly into the driving channel. If the inlet slot is sufficiently offset from the driving channel and the recess for a headed fastener in the inner wall of this channel is made of a sufficient depth, there is no possibility that the head of the next following fastener might project into the driving channel, even if the adjacent fasteners on the carrier strip overlap each other.

Another feature of the invention for attaining these last mentioned objects consists in the provision of suitable means which are actuated by the drive rod during a first part of its forward stroke so as first to shift the fastener which is located within the recess in the wall of the driving channel in a lateral direction so as to be partly or entirely removed from this recess and separated from the carrier strip, and to move this fastener entirely or at least its upper end or head into the driving channel before it is acted upon by the drive rod itself during its further forward movement.

These shifting means may be of various designs and may consist, for example, of a shifting member which is slidable in a direction parallel to the axis of the drive rod within a further recess which is provided in the wall of the driving channel and which during a first part of the forward stroke of the drive rod will be taken along by the latter so as to engage upon the upper end or head of a fastener and to move the same forwardly and also laterally and thereby to push the fastener laterally out of the carrier strip and at least its upper end or head into the path of the subsequent travel of the drive rod within the driving channel. Although the shifting member preferably consists of a slide member, it may also consist, for example, of a pivotable lever. The required lateral component of the movement of the fastener may also be produced in different manners. For headed fasteners, this lateral movement may be produced by the same means as earlier described, namely, by providing the recess for the head of the fastener in the driving channel at the side facing the recess for the projecting part of the carrier strip with a tapering surface along which the fastener head slides when it is moved forwardly by the shifting member. For headless fasteners, a part of the surface of the shifting member, for example, its end surface, may be inclined relative to its direction of movement so as to push the upper end of the fastener by a cam action away from the backwall of the recess in the wall of the driving channel in which the entire fastener is located, or the shifting member may be moved at an inclined angle or even horizontally against the fastener, for example, by an intermediate transmitting member which is moved by the drive rod during a first part of its forward stroke.

While in a nailing machine for headed nails the shifting member which is movable parallel to the axis of the drive rod may be automatically disconnected from the drive rod when it has carried out its required action upon the fastener, it may in certain cases also be positively secured to the drive rod in which event the driving channel must be provided with a groove which extends parallel to the axis of the drive rod and has a length which is at least equal to the length of the stroke of the shifting member. In a screwdriving machine, however, in which the drive rod which is provided with a flat tip for engaging into the slot of the screw is to be rotated about its axis so as to turn the screw, the shifting member must be connected in such a manner to the drive rod during the first part of the driving stroke of the latter that the drive rod may rotate relative to the shifting member.

Another feature of the invention consists in the provision of a very simple and very reliably operating clutch which connects the shifting member with the drive rod during a first part of the forward stroke of the drive rod and automatically disconnects the shifting member from the drive rod and simultaneously stops any further movement of the shifting member when this member has been moved by the drive rod to a position in which it has severed the fastener from the carrier strip or has also moved at least the upper end or head of the fastener partly or fully into the driving channel before the drive rod itself acts upon the fastener during the further part of its forward stroke. This clutch therefore limits the movement of the shifting member to the distance which it requires for attaining the desired result, and in a screwdriving machine this clutch is designed so as to connect the shifting member to the drive rod during the required length of its shifting movement without interfering with the rotation of the drive rod which is required for turning the screw and screwing it into a workpiece.

The clutch for connecting the shifting the shifting member to the drive rod and for disconnecting it therefrom and stopping its further movement may be of various designs which only need to have further in common that, during a first part of the forward stroke of the drive rod, the respective clutch employed will insure that the shifting member will be taken along by the drive rod with a force which suffices at least for severing the next fastener from the carrier strip before it is driven by the drive rod. Such a clutch may, for example, also be of a magnetic type.

Still another feature of the invention consists in designing the shifting member so as either to prevent the next following fastener from entering the driving channel and even the recess in the inner wall of this channel or at least to deflect the following fastener from this channel and recess until the previous fastener has been driven into a workpiece and the drive rod has been retracted to its original position. Thus, if the recess in the wall of the driving channel is not made of such a depth that the entire fastener, while still connected to the carrier strip, will be held therein but will partly project into the driving channel, the drive rod can only act upon this fastener and cannot collide with the next following fastener which might result in a breakdown of the operation or even into a damage of the machine.

BRIEF DESCRIPTION OF THE DRAWING

The above mentioned as well as numerous other features and advantages of the present invention will become further apparent from the following detailed description thereof, which is to be read with reference to the accompanying drawings, in which:

FIG. 1 shows a cross section of the foot and parts of the magazine of a nailing machine according to the invention, said section being taken along a plane indicated by the line I—I in FIG. 5 and extending substantially through the longitudinal axes of the driving and feed channels;

FIG. 2 shows a view of the foot of the nailing machine as seen in the direction of the arrow II in FIG. 1;

FIGS 3, 4, and 5 show cross sections which are taken along the lines III—III, IV—IV, and V—V, respectively, of FIG. 1;

FIG. 6 shows an enlarged view of a part of FIG. 5, but without a nail strip;

FIG. 7 shows an enlarged cross section of a part of the nail strip as shown in FIG. 5;

FIG. 8 shows a cross section which is taken along the line VIII—VIII of FIG. 1;

FIG. 9 shows a side view of a screwdriving machine according to the invention, the lower part of which is illustrated by a cross section which is taken along the line IX—IX of FIG. 10;

FIG. 10 shows a cross section which is taken along the line X—X of FIG. 9; while

FIGS. 11 and 12 show cross sections which are taken along the line XI—XI of FIG. 10 and respectively illustrate the screwdriving rod in its retracted position and in a position during its forward stroke after engaging into the slot in the head of a screw

DETAILED DESCRIPTION

In FIGS. 1 to 8 of the drawings, the present invention is illustrated by way of example in the form of a nailing machine, a so-called magazine nailer, of which only the lower or foot part 5 and the nail magazine 6 are shown since the other parts of the machine may be of a conventional construction. The nails 1 which are to be driven into workpieces are supplied to the machine in the form of a nail strip 2 which is inserted into the magazine 6 which is rigidly or integrally connected to the foot 5 of the machine. Each of these nail strips 2 is made of a certain length and combines a certain number of nails 1 into a unit. It comprises a carrier strip 3 from which resilient pairs of clips 4, which are parallel to and spaced at equal distances from each other, project toward one side. Each pair of these clips 4 forms a socket which is adapted to hold one nail and has an inner diameter slightly smaller than the shank of a nail 1 before the latter is inserted therein. As indicated particularly in FIGS. 1 and 4, the axes of the adjacent sockets are spaced from each other at such a distance that the outer edge of the head of each nail 1 engages upon the shank of the adjacent nail and the heads of the adjacent nails therefore partly overlap each other. The carrier strip 3 and the clips 4 form an integral element which is made of an inexpensive plastic which may be of a brittle but slightly elastic consistency, for example, polystyrene or polyvinyl chloride.

The foot 5 of the nailing machine has a driving channel 7 for a drive rod 8. This drive rod 8 is connected to a piston (not shown) which is movable within a pneumatic cylinder (likewise not shown) which is connected via conventional control means to a supply of compressed air so that, when the trigger of the machine is pulled, compressed air will be supplied to the cylinder and effect a driving stroke of the piston and the drive rod 8 thereon. The side of drive rod 8 facing the magazine 6 is offset from the wall of driving channel 7 by being provided with a flat surface. Drive rod 8 therefore takes up only slightly more than one-half of the diameter of driving channel 7 which has the result that, even though the heads of the nails in the nail strip 2 overlap each other, drive rod 8 will only hit upon the head of the nail 10 which is located in the driving channel 7.

Magazine 6 forms a housing of a U-shaped cross section which is integrally connected to the foot 5 and provided with a recess 9 in its rear side wall in which the carrier strip 3 of nail strip 2 is guided. The magazine chamber terminates into a feed channel 11 in the machine foot 5 which, in turn, extends into the driving channel 7. Recess 9 in magazine 6 is continued through the feed channel 11 and also transversely through the driving channel 7, in which it forms a recess 12 in its sidewall, and it terminates into an aperture 13 in the wall of driving channel 7 opposite to the magazine 6. For feeding the nail strip 2 into the driving channel 7, a slide member 14 is provided which acts upon the rear end of nail strip 2 and has a handle 15 which projects through a slot 30 to the outside of magazine 6 and is acted upon by a tension spring 16 which, when the magazine is charged, draws the slide member 14 in the direction toward the driving channel 7 so that the nail strip will be pushed continuously into the driving channel 7.

Driving channel 7 and feed channel 11 are open at the side opposite to the groove 9, recess 12 and aperture 13. This opening may be closed by a cover 18 which is pivotable about pins 17 and normally held in its closed position by screws, not shown. This cover 18 is merely provided for permitting access to the inside of a driving channel 7 and feed channel 11 in the event of an interference in the nail supply. As illustrated in FIGS. 1, 5 and 8, spring 16 extending around a roller 31, and its end opposite to that which is connected to the handle 15 is connected at 32 to the rear wall of the magazine. Roller 31 is rotatably mounted on a pin 33 which is secured to a strip 34 which extends from the front wall of the magazine 6 through an aperture in the cover 10 which is provided for receiving the roller 31. The part of spring 16 which leads from roller 31 to its place of connection 32 is provided within a recess 36 in the wall 35 of magazine 6.

The heads of the nails 1 of the nail strip 2 which is inserted into the magazine 6 project upwardly from the magazine. For receiving the nail heads, the upper end of feed channel 11 is enlarged by a part 21 which also extends into a recess 22 in the wall of driving channel 7. The lower part of the sidewall of this recess 22, which extends in the direction toward the recess 12 which is an extension of recess 9 forms an inclined surface 23 which, as shown in FIG. 3, merges gradually into the corresponding sidewall of driving channel 7. The rear part of recess 9 extends from its lower edge to the edge of the upper opening 25 of the magazine and forms a chamber of a length greater than that of one nail strip. Magazine 6 preferably has a length sufficient to take up at least two nail strips 2 which are inserted successively through the opening 25 into the mentioned chamber from which they are then passed into the feed channel 11. The mode of operation of the device is evident from the above description of its structural features. As soon as at least one nail strip 2 has been inserted into the magazine 6 through its upper opening 25, slide member 14 actuated by spring 16 will push this nail strip through the feed channel 11 and so far into the machine foot 5 that the most forward nail 10 will engage into the driving channel 7. The part of the head of the adjacent nail which also projects at this time into the driving channel 7 will not interfere in the next driving stroke of drive rod 8 since the flat side of the latter is sufficiently offset from the side of driving channel 7 facing the magazine so that the drive rod will only hit upon the head of nail 10 but not upon the overlapping part of the head of the adjacent nail. The carrier strip 3 then engages into groove 9 and recess 12, while the head of nail 10 engages into the recess 22 in driving channel 7. When drive rod 8 carries out its next driving stroke, it will drive the nail 10 downwardly along driving channel 7 and from the mouth of the latter into a workpiece. During this movement of nail 10 in its axial direction within guide channel 7, the nail head will be pressed by the inclined surface 23 of aperture 22 toward the center of driving channel 7, and the nail 10 will thereby be pushed off the carrier strip 3. Drive rod 8 then comes into engagement only with the ends of the clips 4 on the carrier strip 3 and will break off these ends which are so small that only a very small amount of waste material might fall upon the workpiece.

After the first nail 10 has been driven into the workpiece and drive rod 8 has moved back to its inactive position, spring 16 will feed the nail strip 2 so that the next nail on this strip will pass into the driving channel 7. At the same time, the bare front end of the carrier strip 2 passes into the aperture 13 in the wall of driving channel 7. When the next driving stroke of drive rod 8 occurs, the same operations will again occur as have been described above. The bare carrier strip 3 will then move at every driving stroke one step further through the aperture 13 to the outside of the machine foot 5.

While according to the first embodiment of the invention as previously described and illustrated in FIGS. 1 to 8 the drive rod itself has to remove the next nail from the carrier strip which is located within a groove in the inner wall of the driving channel by striking at first only upon a part of the nail head which projects from a second groove into the driving channel and by thereby sliding this head along an inclined extension of

the back wall of this second groove and thus forwardly and at the same time laterally into the driving channel, whereby the nail is separated from the carrier strip and is then further driven through and out of the nailing channel, a second embodiment of the invention which will now be described provides that before the drive rod during its forward stroke engages directly upon the upper end or head of a fastener so as to drive the same forwardly, the fastener has already been disconnected from the carrier strip by a separate shifting member which is driven by the drive rod, and has also moved at least the upper end or head of the fastener fully into the driving channel.

This second embodiment of the invention is illustrated in FIGS. 9 to 12 as being applied to a screwdriving machine for headed screws, although by suitable modifications it may also be employed for driving screws without heads, for example, worm screws, into a workpiece. It may, however, also be applied to a nailing machine or the like for driving headed nails into workpieces or to a similar machine for driving other fasteners without heads, for example, pins, staples, or the like, into workpieces.

The screwdriving machine as illustrated in FIGS. 9 to 12 comprises a cylindrical casing 101 in which a cylindrical housing 102 of an electric or pneumatic motor is axially slidable, the rear outer end of which is provided with a grip 103 like that of a handgun. Casing 101 is provided with a frustum-shaped bottom 104 which has a central tapped bore 105 into which a tubular foot 106 of the machine is screwed. The axial bore of this foot 106 forms a guide or driving channel 107 in which a drive rod 108 is movable in its longitudinal direction and also rotatable about its axis by the motor 102. This drive rod 108 serves as a screwdriver and its free end is therefore provided with a flat tip which is adapted to be inserted into the slot in the head of a screw. The motor housing 102 carries a radially projecting pin 109 which engages into and is slidable along a longitudinal slot 111 in the wall of casing 101 and prevents the housing 102 and the casing 101 from turning relative to each other. Casing 101 contains a coil spring 112 which is interposed between the motor housing 102 and the bottom 104 and tends to press the housing 102 away from the bottom 104 to a position in which pin 109 abuts against the upper end of slot 111.

Rigidly connected to the foot 106 is a magazine 113 which may be similar to the magazine 6 of the nailing machine according to FIGS. 1 to 8 but instead of a nail strip contains a screw strip 115 which carries a row of screws 114 at equal distances from each other. Magazine 113 forms a housing of a U-shaped cross section which is open at its upper side, as shown in FIG. 9, into which the screw strip 115 may be inserted. The longitudinal chamber containing the screw strip 115 between the front and rear walls of magazine 113 forms a feed channel which is continued through the wall of foot 106 in the form of an inlet slot 116 and through a recess 116' which is provided in one side of the inner wall of driving channel 107 and the backwall of which is in alignment with the backwall of slot 116. The entire feed channel including the inlet slot 116 and the recess 116' does not extend radially to the driving channel 107 but substantially tangentially thereto and its longitudinal axis is disposed within a plane which is laterally offset relative to the axis of driving channel 107 and drive rod 108, as may be seen especially in FIG. 10.

For holding the screws 114 on the screw strip 115 the latter comprises a connecting or carrier strip 117 of plastic which has a width considerably smaller than the length of the screws 114 and which is provided at one side with pairs of elastic clips or projections 118, each pair of which grips one of the screws 114.

The inner surface of the backwall of magazine 113 which, as previously described, is laterally offset relative to the corresponding side of the inner wall of driving channel 107 is recessed relative to its lower part for receiving the carrier strip 117 and so as to form a shoulder 119 for guiding the lower edge of this strip. This shoulder 119 is continued in the

backwall of the inlet slot 116 and also in the backwall of the recess 116' in the inner wall of the driving channel 107 in which it forms the lower edge of a guide groove 122 of a width slightly larger than the width of the carrier strip 117 and of a depth substantially equal to the thickness of the carrier strip without the clips 118. If the screws 114 are headed as illustrated in the drawings, at least the backwall of magazine 113 is provided with another recess which forms another shoulder 121 above the first shoulder 119 for guiding the heads of the screws 114. Corresponding to this shoulder 121 each side wall of the inlet slot 116 is provided with a groove 123 of a sufficient depth for the passage of the screwheads, and the backwall of the recess 116' in driving channel 107 corresponding to the backwall of the inlet slot 116 is likewise provided with such a groove 123 for receiving the part of the head of a screw which projects from one side of its shank. For passing the carrier strip 117 without screws from the guide groove 122 in the inner wall of driving channel 107 to the outside after the previous screw 114 has been removed from the clips 118 of strip 117 and manner as will be subsequently described or at least after this screw has also been screwed into a workpiece by the rotating drive rod and after the latter has been retracted, the wall of the foot 106 is further provided with an outlet slot 124 the backwall of which is in alignment with the backwall of the grooves 122. This outlet slot has a length equal to that of grooves 122 and a width slightly larger than the entire thickness of the carrier strip 117 including the clips 118.

The means for feeding the screw strip 115 from the magazine 113 toward and through the inlet slot 116, so that a new screw will be inserted into the recess 116' in the inner wall of the driving channel at least when the previous screw has been driven into a workpiece and the drive rod has been retracted, may be of the same type as illustrated and described with reference to FIGS. 1 to 8 and comprise a slide member 14 which acts upon the rear end of the fastener strip—here the screw slot 116 is likewise provided with such a groove 123 for receiving the part of the head of a screw which projects from one side of its shank. For passing the carrier strip 117 without screws from the guide groove 122 in the inner wall of driving channel 107 to the outside after the previous screw 114 has been removed from the clips 118 of strip 117 in a manner as will be subsequently described or at least after this screw has also been screwed into a workpiece by the rotating drive rod and after the latter has been retracted, the wall of the foot 106 is further provided with an outlet slot 124 the backwall of which is in alignment with the backwall of the grooves 122. This outlet slot has a length equal to that of grooves 122 and a width slightly larger than the entire thickness of the carrier strip 117 including the clips 118.

The means for feeding the screw strip 115 from the magazine 113 toward and through the inlet slot 116, so that a new screw will be inserted into the recess 116' in the inner wall of the driving channel at least when the previous screw has been driven into a workpiece and the drive rod has been retracted, may be of the same type as illustrated and described with reference to FIGS. 1 to 8 and comprise a slide member 14 which acts upon the rear end of the fastener strip—here the screw strip 115—and is drawn by a tension spring 16 in the direction toward the foot 106 of the machine.

For severing the screw 114 which is located within the recess 116' from the carrier strip 117 in groove 122 and for also shifting this screw fully into the driving channel before the drive rod 108 during its forward stroke is moved so far that its flat tip reaches the screwhead and engages into the slot thereof, the lower wall of groove 123 in the backwall of the recess 116' in driving channel 107 is provided similarly as in the nailing machine according to FIGS. 1 to 8 with an inclined surface 125 which tapers forwardly and toward the inside of the driving channel 107, and in addition, the lower end of recess 116' adjacent to the tip of screw 114 is likewise provided with an inclined surface 126. Thus, when a pressure is exerted in the axial direction upon the head of screw 114, this

head will slide along the inclined surface 125 and the tip of the screw along the inclined surface 126 and the entire screw will thus be moved forwardly and laterally into the driving channel 107 to a position in which the screw will be separated entirely from the holding clips 118 on the carrier strip 117 and at least the head of the screw will be located centrally within the driving channel so that during the further forward movement of drive rod 108 its flat tip may engage into the slot in the screw head. For effecting this forward movement of screw 114, the invention provides a separate shifting member 128 which is slidable within another groove 127 in the wall of driving channel 107 in a direction parallel to drive rod 108 toward a part of the upper surface of the head of screw 114. For connecting this shifting member 128 to the drive rod 108 only during the first part of the forward stroke of the latter, a suitable clutch is to be provided which should be as simple and reliable as possible. As illustrated especially in FIGS. 11 and 12, one preferred embodiment of this clutch consists of a ball 131 which is slidable within a transverse bore 129 and has a diameter larger than the thickness of the shifting member 128 so that, when the ball engages upon the bottom or sidewall groove 127 along which the shifting member 128 is slidable, it projects from the opposite side of the shifting member into an annular groove 132 in the shank of drive rod 108 and thus locks the shifting member to the drive rod so as to be taken along by the latter during the first part of its forward stroke. The wall of groove 127 along which the shifting member 128 is slidable is provided with a bore 133 which contains a small piston 134 which is pressed by a spring 135 against the shifting member 128 until the two bores 129 and 133 are in alignment with each other. When during the first part of the forward stroke of drive rod 108 and before its flat tip engages with the head of screw 114 the drive rod has moved the shifting member 128 into engagement with the head of screw 114 and has moved the latter so far forwardly that, by the sliding engagement of the screwhead with the inclined surface 125 and of the screw tip with the inclined surface 126, the screw is pushed laterally out of the clips 118 on the carrier strip 117 and at least the screw head is moved fully into the driving channel 107, the two bores 129 and 133 will be in axial alignment with each other. At the same time, due to the cam action of the surface of the annular groove 132 in the forwardly moving drive rod, ball 131 will be pushed out of groove 132 and pressed instead into bore 133 against the spring-supported piston 134 and will thereby lock the shifting member 128 in a fixed position. For absolutely preventing the ball 131 from being accidentally taken along by drive rod 108 past the point where it should slip into bore 133 and thus prevent the shifting member 128 from being moved beyond the required position the invention provides an additional stop member against which the front end of the shifting member may then abut and which may consist of the front end 136 of groove 127 in which the shifting member has previously moved.

In the event, as illustrated in FIGS. 9 to 12, that the feed channel in the magazine 113, the inlet slot 116, and the backwall of recess 116' in the wall of the driving channel including the grooves 122 and 123 are laterally offset from the driving channel only so far that the head of a screw 114 in recess 116' projects into the driving channel 107 before it is acted upon by the shifting member 128, and if the adjacent screws 114 on the carrier strip 117 are spaced at such a short distance from each other that their heads at least partly overlap each other, care must be taken that the head of the next following screw in the inlet slot 116 will not also project into the driving channel in which it would collide with the drive rod 108 during its forward stroke. This may be attained in a very simple manner as shown in FIG. 9 by providing the side of the shifting member 128 which faces the projecting head of this next following screw with an inclined surface 137 which would push the projecting head of this screw from the driving channel together with the screw strip 115 a short distance toward the magazine 113 while the shifting member carries out its forward stroke.

For preventing the screw after it has been disconnected from the clips 118 of the carrier strip from dropping out of the driving channel 107 and for also centering the screw within the driving channel so as to permit it to be properly screwed into a workpiece by the rotating drive rod 108, two clamping jaws 139 are mounted by leaf springs 141 on the outer wall of the foot 106 and project through a pair of diametrically opposite apertures 138 through this wall into the driving channel 107.

The operation of the screwdriving machine according to FIGS. 9 to 12 is as follows: After a screw strip 115 has been inserted into the magazine 113 and advanced therein so that the first screw 114 is located in the recess 116' in the wall of the driving channel 107, the motor for rotating the drive rod 108 about its axis is started and the end of the foot 106 of the machine is applied upon a position on a workpiece 142 into which this screw 114 is to be screwed. The motor housing 102 which is held by the grip 103 is then pressed forwardly in the cylindrical casing 101 against the action of spring 112 and during the first part of the corresponding forward movement of drive rod 108 this drive rod, by being connected by the ball 131 to the shifting member 128, takes along the latter toward the head of the screw 114, which is located in the recess 116' of the wall of the driving channel 107, and pushes this screw forwardly so that the head and the tip of the screw slide along the inclined surfaces 125 and 126 and the screw is thus pushed into the driving channel 107. Since the carrier strip 117 is guided at one side of this screw 114 in recess 116' by the opposite walls of the inlet slot 116 and at the other side of the screw by the opposite walls of the outlet slot 124, the lateral movement of this screw toward the inside of driving channel 107 causes the screw to be pushed out of the clips 118 and thus to be separated entirely from the carrier strip 117. As soon as this occurs, shifting member 128 engages with its front end against the stop surface 136 and can therefore no longer follow the forward movement of drive rod 108. Since at the same time the two bores 129 and 133 are in axial alignment with each other, the cam action of the surface of the annular groove 132 in drive rod 108 will expel the ball 131 from this groove and push the same to the same extent into the bore 133. During the further forward movement of the rotating drive rod 108 its flat tip will then engage upon the head of screw 114 and enter the screw slot and press the screw between the centering clamping jaws 139 and through the latter against the workpiece 142 into which the screw is then screwed by the rotating drive rod. When the forward pressure on the grip 103 on the motor housing 102 is then released, spring 112 will move this housing together with drive rod 108 again toward the rear until the stop pin 109 abuts against the rear end of slot 111. When during this movement of drive rod 108 its annular groove 132 reaches the position in which it is in alignment with the ball 131 in the bore 129 of shifting member 128, this ball will be pressed by spring 135 out of the bore 133 in the wall of foot 106 and into the annular groove 132 so that the shifting member 128 will then be taken along by the drive rod and retracted to its original position. During the forward movement of the shifting member 128 and while it is locked in a fixed position and until it is again sufficiently retracted by drive rod 108, its stop surface 137 prevents any entry of the next screw 114 into the driving channel 107 and thus any interference of the drive rod with this screw.

While the carrier strips as previously described are preferably straight and rigid, it is also possible to make them of a flexible material and to roll up such a strip with the fasteners thereon into a coil. A suitable feeding device should then be provided which after each return stroke of the drive rod of the machine advances the fastener strip one step toward and into the foot of the machine. The fasteners should, however, in each case be connected to the carrier strip so as to be removable therefrom toward one lateral side without danger that any parts of the carrier strip might be torn or broken off and fall into the driving channel or that any parts of the connecting means between the adjacent fasteners might enter the driving

channel in which they could interfere with the drive rod. Although our invention has been illustrated and described with reference to the preferred embodiment thereof, we wish to have it understood that it is in no way limited to the details of such embodiment but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. A driving tool for driving fasteners into working pieces, each of said fasteners having an enlarged head on one end thereof, said fasteners being adapted to be fed to said tool in position parallel to and at substantially equal distances from each other and being held together in a row by a carrier strip, said carrier strip partly projecting from one lateral side of said row of fasteners, and comprising means for removably connecting said fasteners on said side of said carrier strip, said tool comprising a foot part, a driving channel in said foot part, a drive rod movable back and forth in the axial direction of said driving channel and during its forward stroke adapted to engage upon the next fastener to be driven in said driving channel so as to move said fastener through a front part of said driving channel and out of its open end, a feed channel extending through said foot part and substantially transverse to said driving channel, said feed channel being formed by an inlet slot and an outlet slot in opposite sides of the wall of said foot part, the central axis of each of said slots extending substantially parallel to, but laterally offset from the axis of said driving channel, said inlet slot having a length at least equal to the length of each of said fasteners and being adapted for feeding one of said fasteners at a time therethrough toward said driving channel, the two lateral walls of said inlet slot forming a front wall and back wall, said backwall and the inner wall surface of said driving channel at the same side as said backwall each having a recess therein in straight alignment with each other and adapted for receiving and guiding said projecting part of said carrier strip, each of said recesses having a back wall and such a depth that at least said projecting part of said carrier strip when located in said recess in said wall surface of said driving channel is disposed laterally outside of the path of travel of said drive rod, said inlet slot having a second recess in said backwall and said wall of said driving channel also having a second recess in the same side containing said first recess, said second recesses extending parallel to and spaced from said first recesses and being adapted to receive a part of the head of each of said fasteners passing through said feed channel, said outlet slot having a width substantially equal to the entire thickness of said carrier strip and having a length substantially equal to the length of said recesses, and being adapted for passing said carrier strip without fasteners to the outside of said foot part, means operatively associated with said drive rod for shifting said next fastener laterally away from said recess in said wall surface of said driving channel in a direction toward the inside of said driving channel and for thereby severing said fastener from said carrier strip, said shifting means comprising at least an inclined surface at the side of said second recess in said wall surface of said driving channel facing said first recess therein and tapering in the direction toward said first recess in said wall surface, and means for feeding said carrier strip with said fasteners thereon toward said foot part and through said inlet slot, and thereafter without said fasteners from said outlet slot to the outside of said foot part.

2. A driving tool as defined in claim 1, in which said shifting means comprise a shifting member movable within said foot part, and means connecting said drive rod with said shifting member so that during a first part of the forward stroke of said drive rod and before the free end thereof engages with the upper end of said next fastener to be driven, said drive rod moves said shifting member into engagement with said next fastener so as to shift the same laterally out of said carrier strip.

3. A driving tool as defined in claim 2, in which said feed channel is laterally offset relative to said driving channel so as to extend substantially tangentially thereto, said shifting

member also being adapted to shift at least the upper end of said next fastener member of its offset position into the path of travel of said drive rod in said driving channel during said first part of the forward stroke of said drive rod.

4. A driving tool as defined in claim 2, in which said feed channel is laterally offset relative to said driving channel so as to extend substantially tangentially thereto, said shifting member also being adapted to shift said next fastener out of its offset position fully into said driving channel to a position substantially in axial alignment with said drive rod.

5. A driving tool as defined in claim 1, in which said shifting means further comprise a shifting member movable within said foot part, and means connecting said drive rod with said shifting member so that during a first part of the forward stroke of said drive rod and before the free end thereof engages upon the head of said next fastener to be driven, said drive rod moves said shifting member toward and into engagement with said head whereby said part of said head in said second recess in the wall of said driving channel slides along said tapering surface and thereby shifts said next fastener laterally out of said carrier strip.

6. A driving tool as defined in claim 5, in which said feed channel is laterally offset relative to said driving channel so as to extend substantially tangentially thereto, said shifting member in cooperation with said tapering surface also being adapted during the first part of the forward stroke of said drive rod to shift at least said head of said next fastener out of its offset position in said second recess in said wall of said driving channel and fully into said driving channel and into the path of travel of the drive rod.

7. A driving tool as defined in claim 4, in which when at least said upper end of said next fastener has been moved by said shifting member out of its offset position to said position in said driving channel, said connecting means disengage from said drive rod so that said drive rod alone continues its forward stroke and engages upon said upper end of said next fastener to move the same toward and out of said open end of said driving channel.

8. A driving tool as defined in claim 7, in which said fasteners consist of screws each having a slot in its upper end, the lower end of said drive rod forming a flat tip adapted to engage into said slot of said next fastener in said driving channel at least when said connecting means are about to disengage from said drive rod, said drive rod also being rotatable to turn said screw.

9. A driving tool as defined in claim 3, in which due to the offset position of said feed channel relative to said driving channel said entire next fastener is at first located within a second recess in said wall of said driving channel, the bottom of said second recess containing said first recess, said shifting means further comprising an inclined surface on the end of said second recess adjacent to and tapering in the direction toward the open end of said driving channel and adapted to guide the lower end of said next fastener out of said second recess and into said driving channel when said shifting member engages upon the upper end of said fastener and moves said fastener toward said open end.

10. A driving tool as defined in claim 9, in which the side of said wall of said driving channel containing said first and second recesses contains a third recess above said first and second recesses, said shifting member being slidable in said third recess substantially parallel to said drive rod toward and into engagement with said upper end of said next fastener, said connecting means comprising clutch means connecting said drive rod to said shifting member only during said first part of said forward stroke of said drive rod so as to move said shifting member into engagement with said upper end of said next fastener in said second recess, whereby said next fastener is moved by said shifting member for a short distance in the forward direction toward said open end of said driving channel and while said upper end of said next fastener is shifted substantially at the same time with said forward movement laterally into said driving channel, the lower end of said

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fastener slides along said inclined surface and thereby also laterally into said driving channel, and means for limiting the extent of the forward movement of said shifting member by said drive rod.

11. A driving tool as defined in claim 6, in which due to the offset position of said feed channel relative to said driving channel, said entire next fastener is at first located within a third recess in said wall of said driving channel, the bottom of said third recess containing said first and second recesses, said shifting means further comprising an inclined surface on the end of said third recess adjacent to and tapering in the direction toward the open end of said driving channel and adapted to guide the lower end of said nest fastener out of said third recess and into said driving channel when said shifting member engages upon said head of said fastener and moves said fastener forwardly.

12. A driving tool as defined in claim 11, in which the side of said wall of said driving channel containing said first, second and third recesses contains above these recesses a fourth recess, said shifting member being slidable within said fourth recess substantially parallel to said drive rod toward and into engagement with said head of said next fastener, said connecting means comprising clutch means connecting said drive rod to said shifting member only during said first part of said forward stroke of said drive rod so as to move said shifting member into engagement with said head in said second recess, whereby said next fastener is moved by said shifting member for a short distance in The forward direction toward said open end of said driving channel and said head and said lower end are shifted substantially at the same time laterally by said inclined surfaces into said driving channel, and means for limiting the extent of the forward movement of said shifting member by said drive rod.

13. A driving tool as defined in claim 10, in which said shifting member has a transverse bore and said drive rod has a recess in its peripheral surface, said clutch means comprising a locking member adapted during said first part of the forward stroke of said drive rod to be located in said bore and to engage into said recess in said drive rod so as to lock said shifting member to said drive rod so that during said first part of said

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forward stroke said drive rod takes along said shifting member, said foot part also having a transverse bore terminating into the bottom surface of said third recess, said limiting means comprising a compression spring member in said last bore and engaging upon said shifting member during said first part of said forward stroke of said drive rod, said locking member being adapted to be expelled from said recess in said drive and to engage instead into said last bore against the action of said spring member at the end of said first part of said forward stroke of said drive rod.

14. A driving tool as defined in claim 13, in which said limiting means further comprise a stop member against which said shifting member engages when said two transverse bores are substantially in axial alignment with each other and said locking member can then enter said bore in said foot part.

15. A driving tool as defined in claim 13, in which said locking member consists of a ball, and said recess in the peripheral surface of said drive rod consists of an annular groove having such a cross-sectional shape that during the first part of the forward stroke of said drive rod said ball engages into said annular recess and takes along said shifting member until said two transverse bores are substantially in axial alignment with each other, while during the further forward stroke of said drive rod, said ball is expelled from said annular recess by a cam action of the surface thereof and is thereby pressed into said bore in said foot part against the action of said spring member.

16. A driving tool as defined in claim 2, in which said shifting member is provided with a stop surface which, when said shifting member is moved toward and in engagement with said next fastener prevents a following fastener from entering said driving channel.

17. A driving tool as defined in claim 2, in which said shifting member is provided with a stop surface which is inclined relative to the direction of the forward movement of said shifting member so that, if a following fastener enters for a short distance into said driving channel when said shifting member is moved toward said next fastener in said driving channel, said following fastener will be deflected by said inclined stop surface from said driving channel.

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