

[54] FASTENER FEEDING APPARATUS

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221/160, 225, 210, 278, 258

[51] Int. Cl.....B239 7/00

[58] Field of Search.....221/11,
221/12, 14, 159, 160, 225, 236, 158,
221/263, 210, 278, 10, 13; 10/165

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Attorney—E. F. Wenderoth et al.

[57] ABSTRACT

A fastener feeding apparatus for use in an operative association with a power operated fastening tool such as a screw driver or rivetting tool, which comprises a chute section including a rotary drum and a fastener receiving funnel, a drive section including an electrically operated motor for rotating the drum to scoop a plurality of fasteners upwardly from the bottom of the funnel, a chute section including a pair of spaced rails providing a track along which the scooped fasteners are downwardly guided, either rail being provided with a pair of spaced electrodes electrically connected with the drive section for controlling the supply of fasteners in response to the presence of the row of fasteners on the track, and an escapement section for successively transferring each of the fasteners from the track onto the power operated fastening tool.

15 Claims, 22 Drawing Figures

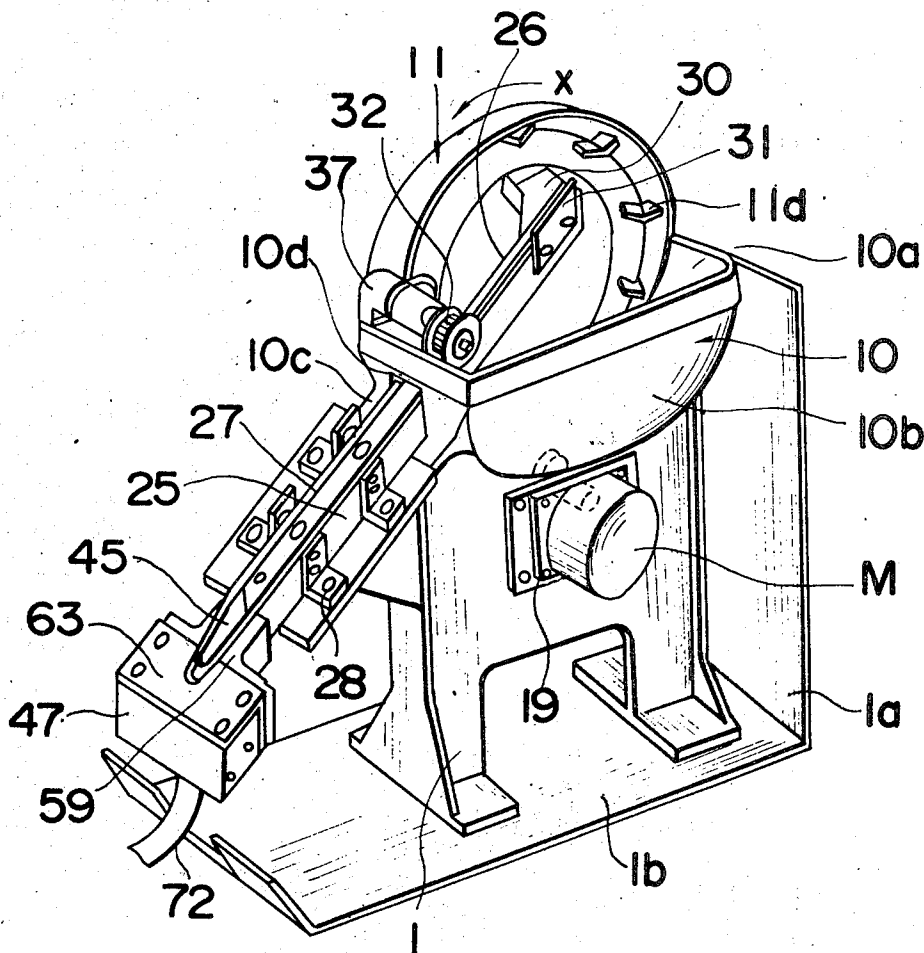


FIG. 1

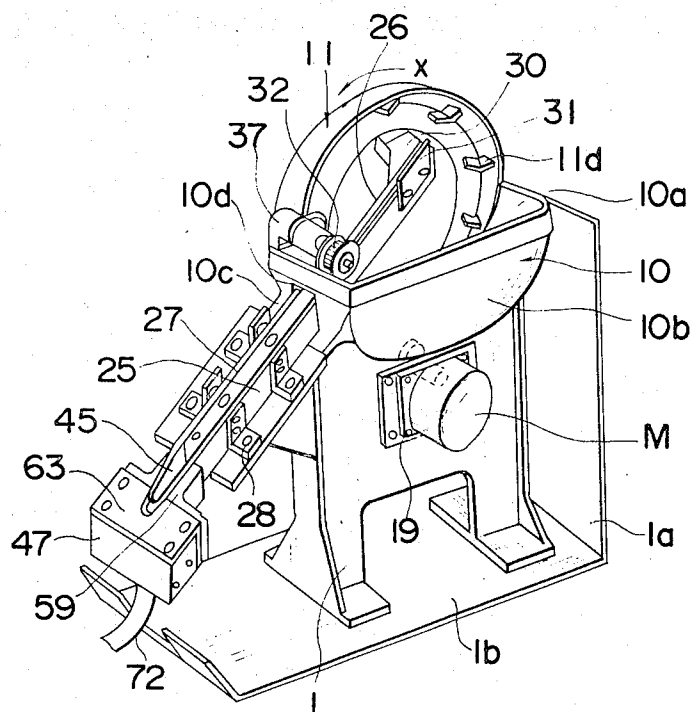


FIG. 2

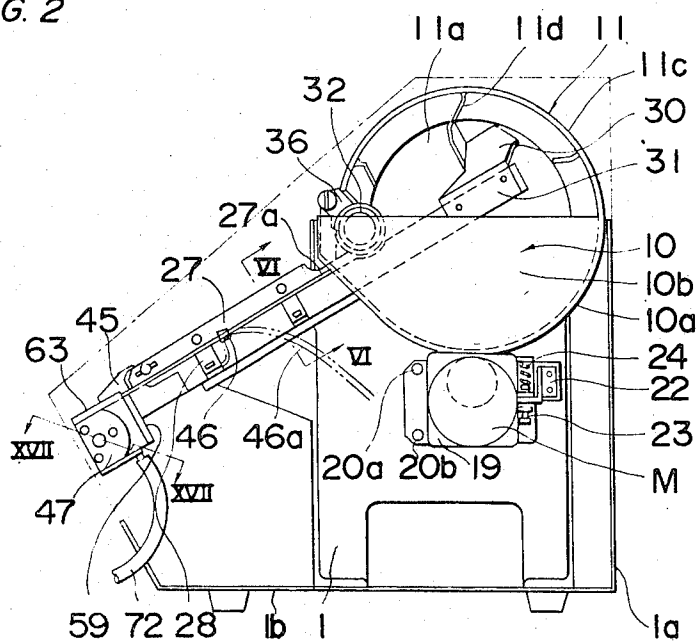


FIG. 3

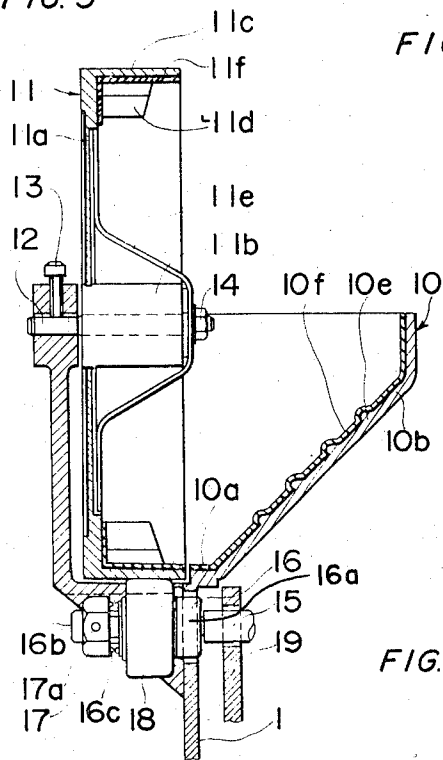


FIG. 5

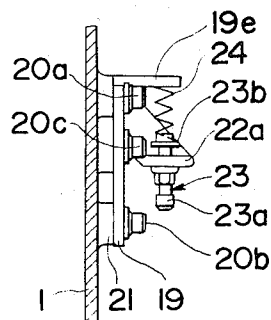


FIG. 6

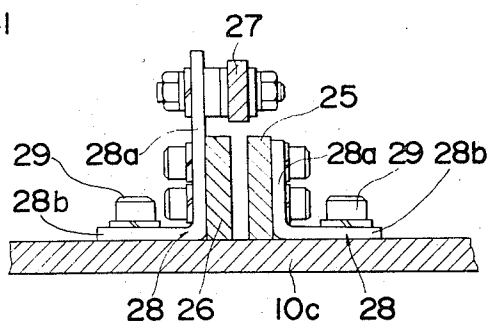
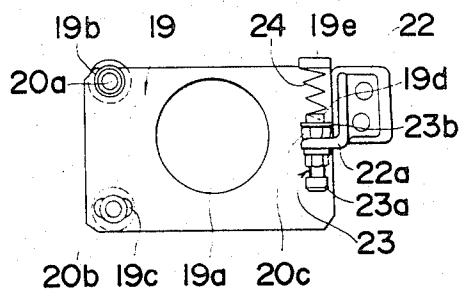


FIG. 4



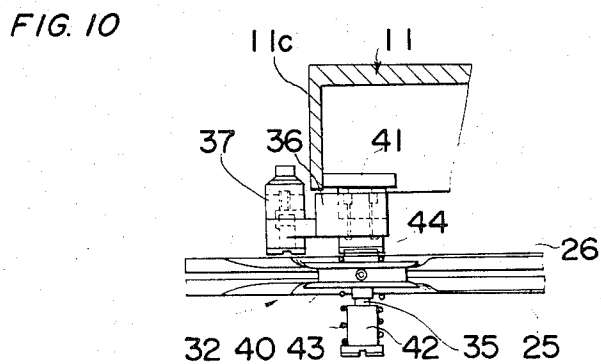
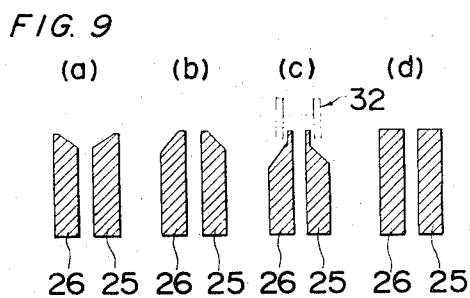
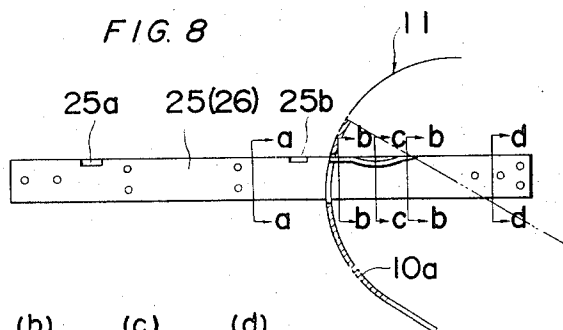
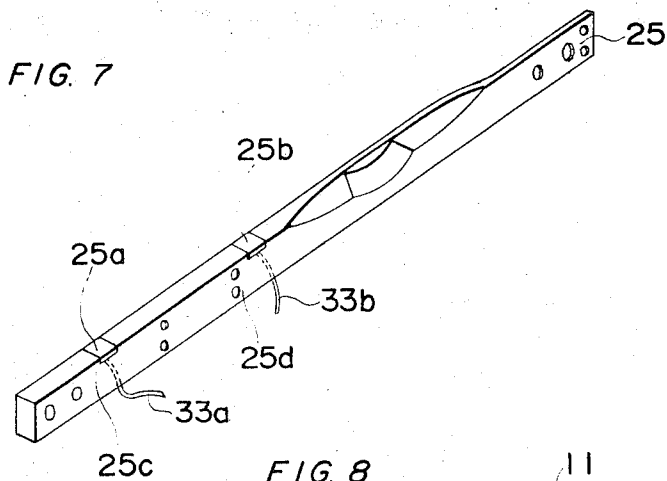


FIG. 11

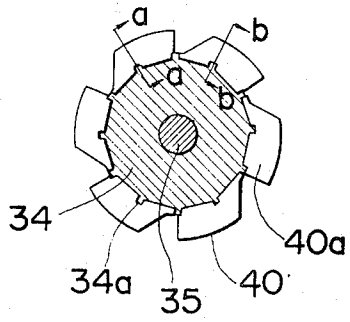


FIG. 12

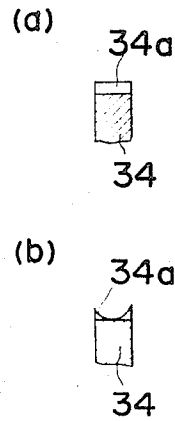


FIG. 13

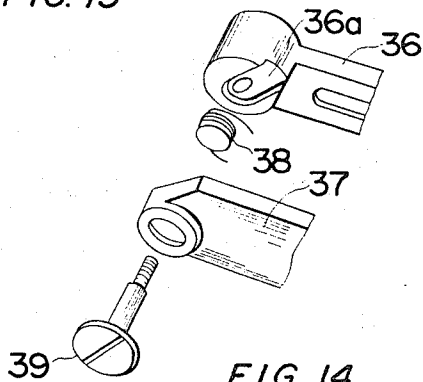


FIG. 14

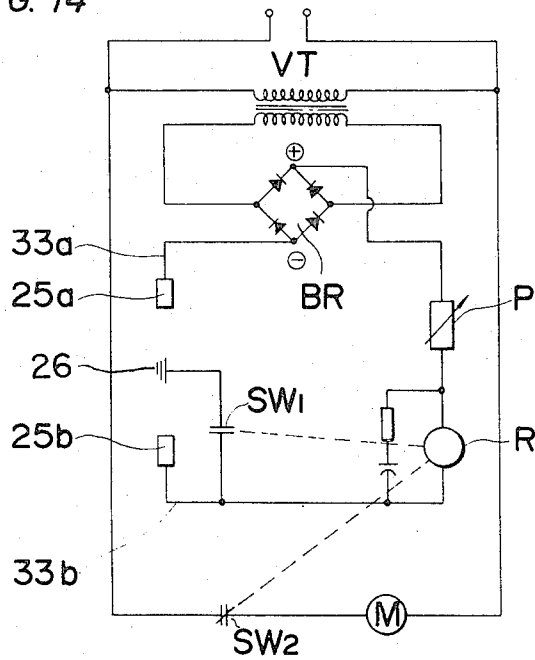


FIG. 15

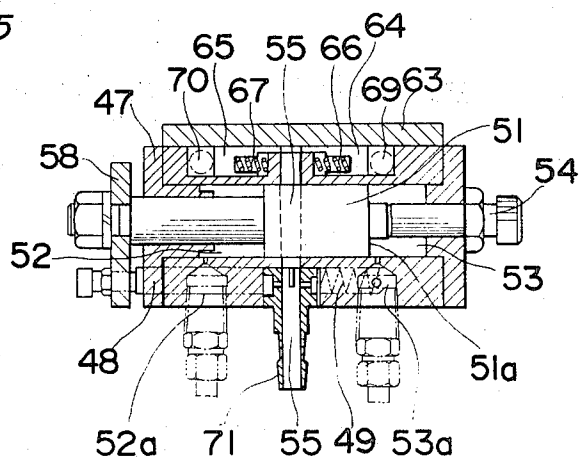


FIG. 16

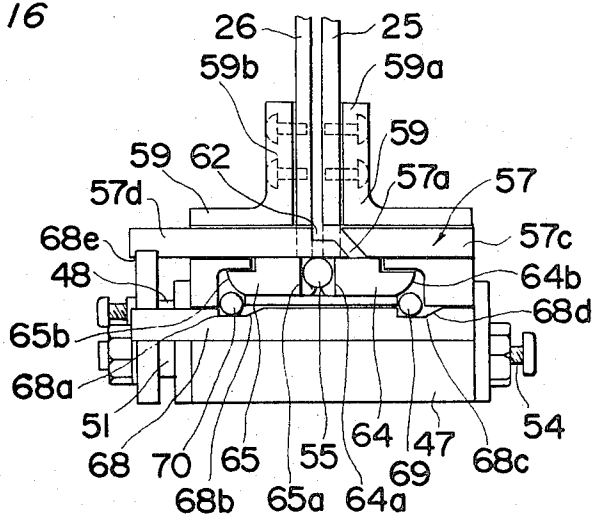


FIG. 17

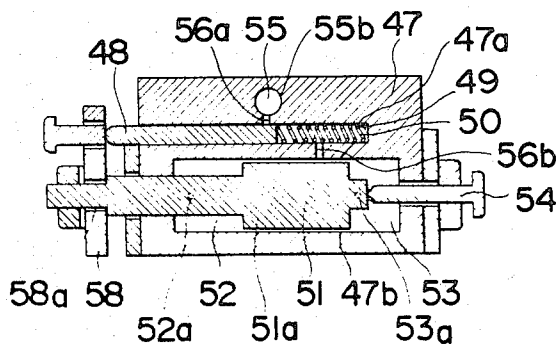


FIG. 18

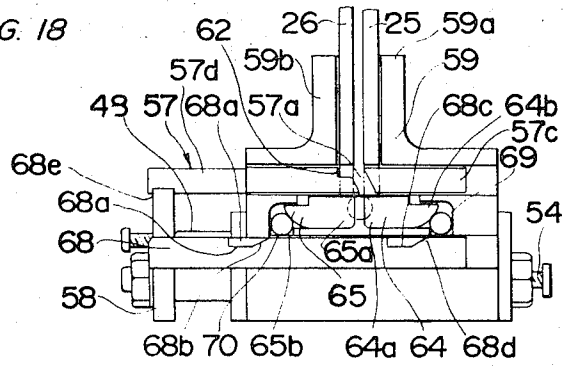


FIG. 19

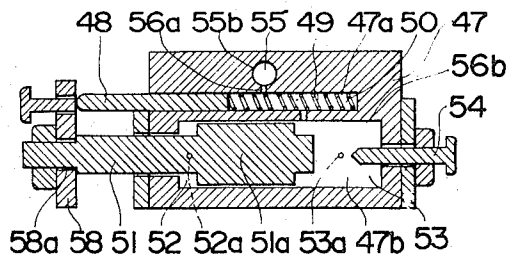


FIG. 20

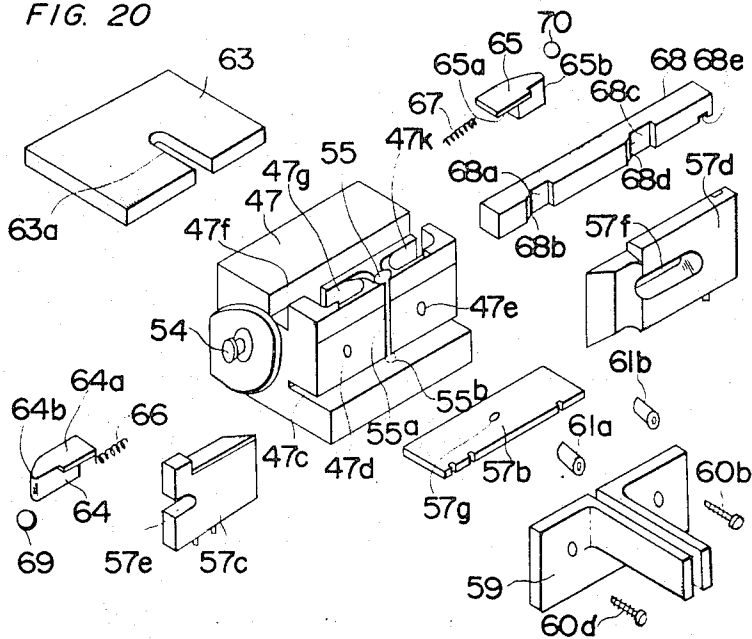


FIG. 21

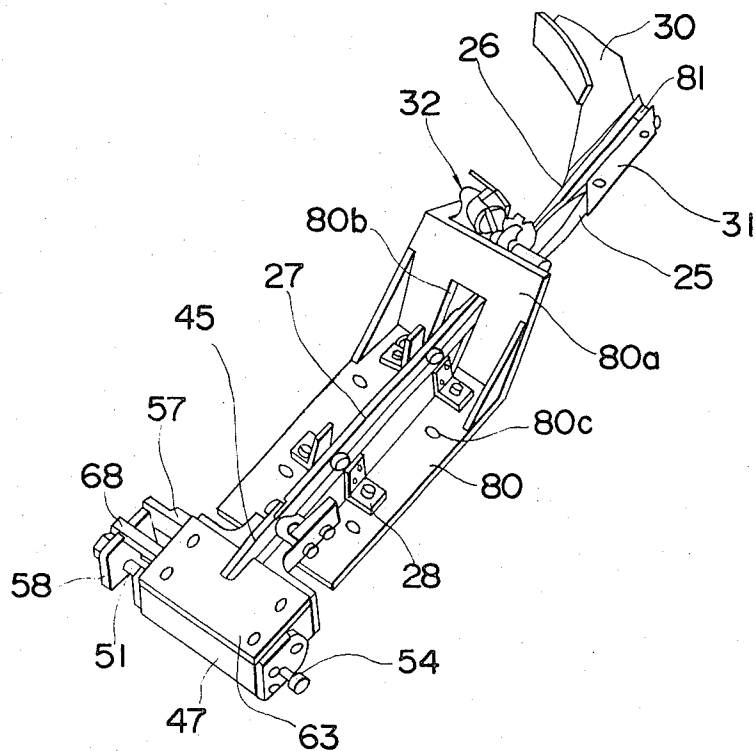
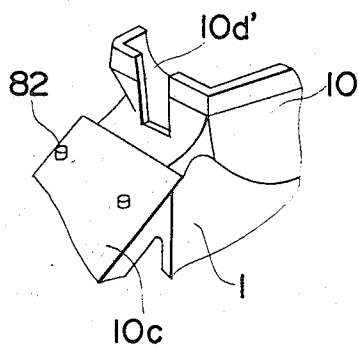


FIG. 22



FASTENER FEEDING APPARATUS

The present invention relates to a fastener feeding apparatus and, more particularly, to a fastener feeding apparatus for use in connection with a power operated fastening tool such as screw driver, rivetting tool or the like, wherein a plurality of fasteners are automatically supplied one by one to the fastening tool in a timed manner with respect to the operation of the fastening tool.

A prior art feeding apparatus of the kind referred to above comprises a hopper section including an elevator reciprocatingly movable between the bottom of the fastener receiving funnel and a fastener discharge opening located within the funnel. A downwardly extending track along which the fasteners are guided to an escapement device for separating each of the fasteners in the row from succeeding ones is connected with the fastener discharge opening of the funnel.

In this prior art apparatus, in order to transport a plurality of fasteners from the bottom to the discharge opening of the funnel by the operation of the elevator, a mechanism for converting the rotational force of an electrically operated motor into the reciprocal movement has been required. This increases the size of the apparatus proper and requires various movable parts for such mechanisms which are susceptible to wear.

Furthermore, even after the fastener guiding track is filled with fasteners, elevator operating motor continues to operate thus unnecessarily wasting electric power.

In addition to the above mentioned disadvantages, other disadvantages can be found in the escapement device. The escapement device used in the prior art fastener feeding apparatus of the kind referred to above is designed such that the first fastener in the row of fasteners which are downwardly guided by the guiding track from the hopper is supported, above the opening of a passage leading to the power operated fastening tool, in such a way that a slidable finger member included therein engages the undersurface of the head portion of the first fastener from one direction. This results in the fastener sometimes being supported in a displaced manner which may result in blockage of the passage leading to the fastening tool.

Moreover, the escapement device used in the prior art apparatus of the kind above referred to is very complicated with the various movable elements arranged so as to move in different directions with respect to the direction of movement of a plunger which operates such movable elements.

Accordingly, an essential object of the present invention is to provide a fastener feeding apparatus of the kind referred to above which substantially eliminates the above mentioned disadvantages inherent in the prior art apparatus of the same kind.

Another important object of the present invention is to provide a fastener feeding apparatus of the kind referred to above wherein an improvement is made to reliably ensure a supply of fasteners are provided from within the supply funnel onto the downwardly extending guide track.

A further object of the present invention is to provide a fastener feeding apparatus of the operation of

the motor and consequently the kind above referred to wherein means is provided for controlling the supply of fasteners from the funnel to the track and then to an escapement section in response to the presence of the fasteners on the track in a row whereby any wastage of the electrical power required to operate a continuously operating motor can be advantageously eliminated.

A still further object of the present invention is to provide a fastener feeding apparatus of the kind above referred to wherein an impeller is provided for positively removing the incorrectly mounted or displaced fasteners from the track prior to the arrival of each one of the fasteners at the escapement section whereby a smooth sliding movement of the fasteners along the track is advantageously ensured and the probability of blockage of the track is minimized.

A still further object of the present invention is to provide a fastener feeding apparatus of the kind above referred to wherein the escapement section is of simple construction and is highly reliable in performance and can be easily assembled.

A still further object of the present invention is to provide a fastener feeding apparatus of the kind referred to above wherein the escapement section comprises various movable elements arranged so as to move in parallel relation with respect to each other resulting in a substantially advantageous reduction of portions of the escapement section susceptible to wear.

A still further object of the present invention is to provide a fastener feeding apparatus of the kind above referred to wherein the chute section and the escapement section are built into a single unit whereby the necessity of purchasing a separate apparatus for employment with each different type of fastener can be advantageously eliminated, because such single unit may be replaced with another one while using a common hopper section.

According to one preferred embodiment of the present invention, the fastener feeding apparatus comprises a hopper section including a rotary drum and a fastener receiving funnel, a drive section including an electrically operated motor for rotating the rotary drum, a chute section including a pair of rails forming the track along which fasteners supplied from the funnel to said track can be guided downwardly by gravity, and an escapement section for successively separating the first of the fasteners in the track to supply them one at a time to the power operated fastening tool in synchronism with the operation of the fastening tool.

In the arrangement as hereinbefore described, an essential feature of the present invention resides in the provision of a pair of upper and lower electrodes on either of the spaced rails which are operatively associated with the motor through an electrical circuit. These electrodes are arranged such that when they are both shortcircuited through a ground consisting of the other rail by a row of fasteners on the track the operation of the motor and the rotary drum is halted and, only when the short-circuit between the lower electrode and the other of the spaced rails is released does the motor commence to run and drive the rotary drum.

Another feature of the present invention resides in the provision of the impeller for positively removing

fasteners from the track which are incorrectly mounted or displaced from the track, as well as the provision of a particular configuration on the upper edge of the rails forming the track which also acts to remove improperly aligned fasteners.

Furthermore, according to the present invention, the escapement assembly can be easily and cheaply manufactured with a minimum of parts and without any substantial reduction of the performance thereof.

According to another preferred embodiment of the present invention, the chute section and the escapement section are built into a single unit and, therefore, if a plurality of these single units are available, the hopper section including its associated drive section can be utilized in common with various types of fasteners, thus eliminating the necessity of purchasing a plurality of fastener feeding apparatus for different types of fasteners used.

These and other objects and features of the present invention will become apparent to those skilled in the art from the following description taken in conjunction with the preferred embodiments thereof shown in the accompanying drawings, in which;

FIG. 1 is a schematic perspective view of a fastener feeding apparatus embodying the present invention,

FIG. 2 is a partially sectional side view of the apparatus shown in FIG. 1,

FIG. 3 is a schematic cross-sectional view of a hopper section, on an enlarged scale, employed in the apparatus of FIG. 1,

FIG. 4 is a schematic elevational view of a drive section employed in the apparatus of FIG. 1,

FIG. 5 is a lateral side view of FIG. 4,

FIG. 6 is a schematic cross-sectional view, on an enlarged scale, taken along the line VI-VI in FIG. 2,

FIG. 7 is a schematic perspective view, on an enlarged scale of one of a pair of rails employed in the apparatus of FIG. 1 for providing the track,

FIG. 8 is a schematic side view of the chute section for illustrating the particular configuration of the rails,

FIG. 9(a) to (d) are cross-sectional diagrams showing respective portions of the rails taken along the lines a-a, b-b, c-c and d-d in FIG. 8,

FIG. 10 is a schematic top plan view of a portion of the apparatus of FIG. 1, showing the position of an impeller,

FIG. 11 is a schematic sectional view of the impeller employed in the apparatus of FIG. 1,

FIG. 12(a) and (b) are diagrams showing cross-sections taken along the line a-a and b-b in FIG. 11, respectively,

FIG. 13 is a schematically exploded view of a supporting structure for connecting the funnel with the impeller,

FIG. 14 is an electrical circuit diagram associated with the drive section,

FIG. 15 is a sectional front view of an escapement section employed,

FIG. 16 is a sectional top plan view of the escapement section showing a plunger in a retracted position,

FIG. 17 is a cross-sectional view taken along the line XVII-XVII in FIG. 2, with the plunger in the retracted position,

FIG. 18 is a similar view to FIG. 16, showing the plunger in an extended position,

FIG. 19 is a similar view to FIG. 17, showing the plunger in the extended position,

FIG. 20 is an exploded view of the escapement section employed in the apparatus of FIG. 1,

FIG. 21 is a schematic diagram showing the chute section and the escapement section incorporated in a single unit according to another preferred embodiment of the present invention, and

FIG. 22 is a schematic diagram of a portion of the funnel modified to accommodate the unit of FIG. 21.

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the several views of the accompanying drawings.

A fastener feeding apparatus including an escapement assembly, which is operatively associated with a power operated screw driver (not shown) of any known construction, is accommodated in a compact box of substantially triangular shape such that the unit is of portable size. Rear upright and bottom walls of said box are shown in FIGS. 1 and 2 at 1a and 1b, respectively. The fastener feeding apparatus herein disclosed generally comprises a hopper section, a drive section, a chute section and the escapement assembly, all of these components being respectively supported by a framework generally indicated by 1 and substantially upwardly extending from the bottom wall 1b as shown.

For facilitating the understanding of the construction of the fastener feeding apparatus herein disclosed, each one of the above mentioned components will be now described individually in the order given above.

HOPPER SECTION

Referring to FIGS. 1 to 3, the hopper section comprises a fastener receiving funnel 10 formed with a substantially semicircularly arched member 10a, one lengthwise edge of which is inwardly recessed and the other is straight, and an inclined wall member 10b secured to or integrally connected to the inwardly recessed edge of said arched member 10a. This fastener receiving funnel 10 is also formed with an elongated platform 10c integrally extending from a front end portion of the arched member 10a in a downward direction at an angle of, for example, 30°, and with an opening 10d of suitable size provided in the front end portion of the arched member 10a and having a lower edge lying in the same plane as the upper surface of said platform 10c.

The inclined wall 10b of the funnel 10 is preferably provided on its interior surface with a plurality of spaced projections 10e each extending horizontally so that the approximate number of fasteners left within the funnel 10 can be indicated depending upon the number of projections exposed to the outside.

The fastener receiving funnel 10 may be of a one piece construction and is firmly supported in position by the framework 1 with the arched member 10a resting on the top of the framework 1 as clearly shown in FIG. 3. Preferably, the entire interior surface of the fastener receiving funnel 10 is lined with a rubber material 10f, as shown in FIG. 3, for reducing or substantially eliminating the noisy jingling sound which is produced by a plurality of fasteners moving in all directions within the funnel 10.

The hopper section further comprises a rotary drum

11 including a disc portion 11a formed with a bearing sleeve 11b having one end rigidly connected with a central portion of said disc portion 11a and the other end protruding toward the interior of the fastener receiving funnel 10, and a peripheral rim portion 11c integrally extending from the periphery of said disc portion 11a at right angles to the plane of said disc portion 11a and in parallel relationship to the bearing sleeve 11b. This rotary drum 11 is rotatably carried by a shaft member 12 having one end mounted on an arm member upwardly extending from the framework 1 and nonrotatably secured thereto by means of a locking bolt 13 threadably inserted in said arm member, and the other end extending through the bearing sleeve 11b and receiving a nut 14 fastened thereto. As shown in FIG. 3, the sleeve 11b of the rotary drum 11 is covered by a covering disc 11e having a peripheral portion rigidly secured to the inner surface of the disc portion 11a and a central portion protruding toward the interior of the funnel 10 and sandwiched between the end extremity of the sleeve 11b and the nut 14.

The interior surface of said rotary drum 11 is similarly lined with a rubber material 11f and serves the same purpose as the rubber material 10f which lines the surface of the funnel 10.

The rotary drum 11 further includes a plurality of scoop members 11d equally spaced with respect to each other, each secured to the inner surfaces of either or both the disc portion 11a and the rim portion 11c. These scoop members 11d act to scoop some of the fasteners within the funnel 10 upwardly and subsequently cause them to fall by gravity onto the chute section (as will be mentioned later) during the continuous rotation of the rotary drum 11.

In the arrangement as hereinbefore described, care should be taken to ensure that the radius of the rotary drum 11 or the peripheral rim portion 11c is equal to that of the imaginary circle corresponding to the curvature of the arched member 10a and that the rotary drum 11 is rotatably supported in such a manner that the annular edge of the rim portion 11c conforms to the straight edge of the arched member 10a without forming an unreasonable gap therebetween. This is clearly illustrated in FIG. 3.

DRIVE SECTION

Referring to FIGS. 1 to 5, the drive section comprises an electrically operated motor M having a drive shaft 15 rigidly mounted with a bushing 16 having a flanged portion 16a on one end and a threaded portion 16b on the other end to which a locking nut 17 is engaged. The drive shaft 15 together with the bushing 16 extends in parallel relation to and below the outer surface of the arched member 10a and a roller 18 of suitable width, preferably, smaller than the width of the rim portion 11c of the rotary drum 11, is loosely mounted on the bushing 16. This roller 18 is preferably coated or lined with an elastic material (not indicated) on its peripheral surface such as natural or synthetic rubber for facilitating transmission of a rotational force from said roller 18 to said rotary drum which is in frictional contact therewith.

Interposed between the nut 17 and the roller 18 is a compression spring 16c, which may be in the form of a spring washer, having such sufficient resiliency that the roller 18 is normally urged toward the flanged portion 16a to avoid loose rotation of the roller 18

on the bushing 16 and concurrently to permit a rotational force of the drive shaft 15 to be transmitted to said roller 18. Alternatively, the provision of such elements as indicated by 16, 17 and 16c may be omitted, in which case the roller 18 is rigidly mounted on the drive shaft 15. Preferably, the locking nut 17 is provided with a fastening member 17a extending therethrough at right angles to the longitudinal axis of the bushing 16 for preventing the nut 17 from working loose from the threaded portion 16b due to the effect of vibration.

The manner in which the motor M is supported by the framework 1 will now be described with particular reference to FIGS. 4 and 5. A supporting plate 19 of substantially rectangular shape is provided with a centrally disposed bore 19a and is suitably secured to the front of the motor M with the drive shaft 15 extending through said bore 19a. This supporting plate 19 has four corner portions, two of which, for example, upper left and lower left corner portions as viewed in FIG. 4, are provided with a circular hole 19b and a substantially horizontally extending slot 19c. This supporting plate 19 is also formed with a substantially vertically extending slot 19d intermediate to the other two corner portions of the supporting plate 19.

With the supporting plate 19 being of the construction as hereinbefore described, the plate 19 is attached to the framework 1 in position as shown in FIG. 2 by means of three bolt members 20a, 20b, and 20c respectively extending through the hole 19b and the slots 19c and 19d and tapped into the framework 1 in such a way that said plate 19 is pivotable about the bolt member 20a through an angular distance which is limited by the size of the slots 19c and 19d through which the bolt members 20b and 20c respectively extend. The purpose of permitting the plate 19 to be pivotable as hereinabove described will be mentioned later. Preferably, for the purpose of reducing the amount of vibrations transmitted from the motor M when operating to the framework 1 through the supporting plate 19, a plurality of bridges 21 are provided between said plate 19 and said framework 1. These bridges 21 may be integrally formed either with the supporting plate 19 or with the framework 1.

Disposed adjacent the supporting plate 19 is a bracket member 22 secured to the framework 1 and having a bearing member 22a extending substantially horizontally and positioned free of the head portion of the bolt member 20c. An adjustment screw member 23 extends threadably through said bearing member 22a and has a lower end formed with a knob 23a and the other end rigidly connected to a circular plate member 23b. A compression spring 24 is interposed between the circular plate member 23b and an abutment 19e protruding from the upper right corner portion of the supporting plate 19 whereby said supporting plate is normally urged to rotate counterclockwise about the bolt member 20a.

From the foregoing, it is clear that, by turning the knob 23a of the adjustment screw member 23 in either direction about its longitudinal axis, the contact pressure exerted between the periphery of the roller 18 and the peripheral rim portion 11c of the rotary drum 11 can be suitably adjusted.

CHUTE SECTION

This chute section is clearly illustrated in FIGS. 6

to 13, although the arrangement of this chute section with respect to the fastener feeding apparatus proper is illustrated in FIGS. 1 and 2.

The chute section comprises a pair of suitably spaced rails 25 and 26 each having a rectangular cross-section, the upper edges of said spaced rails 25 and 26 forming a track along which each one of fasteners is downwardly guided by gravity, and an impeller assembly for removing incorrectly mounted or displaced fasteners from the track. The chute section further comprises a guide strip 27 of a width slightly greater than the maximum width of the adjustable space between said rails 25 and 26, which strip extends in parallel relation to and above the track and the space between said rails.

As shown in FIGS. 1 and 2, these rails 25 and 26 extend through the opening 10d of the fastener receiving funnel 10 and are mounted on the downwardly inclined platform 10c of the hopper section in such a way as hereinafter described. A plurality of L-shaped pieces (for example two) are generally indicated by 28 and each have an upright portion 28a and a base portion 28b and are provided for each one of the two rails 25 and 26 with the upright portion of each of said L-shaped pieces 28 rigidly secured to the outer sides of said rails 25 and 26 while the base portion 28b has an elongated slot (not shown) through which a bolt 29 is tapped into the platform 10c. Because of the elongated slot formed in each of the base portions 28b of the corresponding L-shaped pieces 28, the rails 25 and 26 supported by said L-shaped pieces can be moved, if the bolts 29 are unfastened, to adjust the width of said track to suit to the diameter of the stud portion of each one of the fasteners guided along the track. It is to be noted that, as shown, the upright portion 28a of each one of the L-shaped pieces 28 provided on the side of the rail 26 may be longer than that of the L-shaped pieces provided on the side of the rail 25 so that the guide 27 can be carried in position by the upper ends of the upright portions of the L-shaped pieces provided on the side of the rail 26 as clearly shown in FIG. 6.

While the rails 25 and 26 are attached to the framework 1 through the downwardly inclined platform 10c in the manner as hereinbefore described, a rear end portion of the track, i.e., the raised portions of said spaced rails 25 and 26, is situated in the funnel mouth above the level of the longitudinal axis of the shaft member 12 and the front end portion of said track, i.e., the lower portions of said spaced rails 25 and 26, is connected with the escapement assembly as described later.

At the rear end portion of the track, a fastener receiving plate 30 is secured to the outer side of the rail 26. This fastener receiving plate 30 extends laterally from said rail 26 toward the interior of the rotary drum 11 for receiving in succession each of the lots of fasteners, carried by the corresponding scoop members 11d and gravity fed thereto as the rotary drum 11 is rotated in the direction X by the motor M, and for guiding the received fasteners on to the track.

Opposed to this fastener receiving plate 30 is a barrier plate 31 (FIG. 1) secured to the outer side of the other rail 25 and extending upwardly therefrom for preventing the fasteners which are received and guided on to the track by the plate 30 from falling on to the funnel 10 without entering into the track or space between the spaced rails 25 and 26.

The details of each one of the rails 25 and 26 will be now described with reference to FIGS. 7 to 9. Since the rails 25 and 26 are similarly constructed, only the rail 25 will be referred to for the sake of brevity. It is also to be noted that, in the following description, when reference is made to the track formed by the spaced rails 25 and 26, it should be understood as cooperating with the other rail 26 of which the details are omitted for the sake of brevity.

Particular attention is first directed to the rear portion of the rail 25 which is situated inside the opening 10d of the fastener receiving funnel 10. The portion of the rail adjacent the rear end extremity (to which the plates 30 or 31 are fitted) has the upper edge cut off in the lengthwise direction to give a substantially V-shaped portion of the track as shown in FIG. 9(a) so that as many as possible of the fasteners entering in the track can be guided by the track. The upper edge of the remaining half of the rear portion of the rail is cut off at the outer side with respect to the track in such a configuration as shown in FIG. 7 and, from rear to front, the track has such cross-sections as shown in FIG. 9(b), (c) and (d) in sequence.

The reason for the provision of such a particular configuration throughout the remaining half of the rear portion of the rail is to cause those fasteners which are incorrectly mounted on or displaced from the track to fall off the track into the funnel. A portion of the track having a cross section such as shown in FIG. 9(c) also acts in cooperation with an impeller 32 as can be understood later.

Either of the rails 25 and 26, the rail 25 in this instance, carries a pair of electrodes 25a and 25b as shown in FIG. 7 which are secured in spaced relation with respect to each other on the upper edge of the portion of the rail exterior of the funnel 10. Each one of the electrodes 25a and 25b is secured on the upper edge of the rail in such a manner that the electrode is embedded in a notch 25c or 25d, formed on the rail 25, in an electrically insulated manner with respect to the rail, i.e., by the use of adhesive material having an electrically insulating character, with a corresponding lead wire 33a or 33b extending therefrom across or through the rail 25.

These electrodes 25a and 25b are electrically associated with the drive section through an electrical circuit shown in FIG. 14 for intermittently rotating the motor M thereby avoiding unnecessary use of electricity and, concurrently, controlling the number of fasteners supplied to the escapement assembly via the track.

Referring to the electrical circuit diagram of FIG. 14, there is provided a voltage transformer VT having a primary winding connected in parallel to the motor M which is in turn connected to a suitable power source, and a secondary winding. A bridge rectifier BR has a pair of input terminals connected to the secondary winding of the transformer VT and a pair of output terminals, one of which is directly connected to the electrode 25c through the lead wire 33a and the other connected to the electrode 25b through the lead wire 33b by means of a potentiometer P and a parallel circuit which consists of a relay R and a series connected resistor and capacitor circuit. The relay R is operatively associated with a first relay switch SW₁ disposed between the rail 26 and the junction between the electrode 25b and the parallel cir-

cuit, and a second relay switch SW_2 disposed between the motor M and the power source. As long as the relay R is in an inoperative position, the switches SW_1 and SW_2 are respectively opened and closed.

The circuit diagram of FIG. 14 is such that, only when the row of fasteners on the track has a length greater than the distance between the electrodes 25a and 25b which shortcircuit between both electrodes 25a and 25b to the ground, which is the rail 26, is the relay brought to an operative position in which condition the switches SW_1 and SW_2 are respectively closed and opened. The switch SW_1 is designed such that, even if the shortcircuit between the ground and the electrode 25b is released, it is maintained in the closed position as long as the relay R is in its operative position.

It is to be noted that the series connected resistor-capacitor circuit which is disposed in parallel relation to the relay R is provided for delaying the activation of the relay R whereby, even if two fasteners spaced with respect to each other a distance substantially equal to the distance between the electrodes slide over said electrodes causing a momentary shortcircuit; the relay will not be instantly brought to its operative position.

The electrodes 25a and 25b and their associated electrical circuit function satisfactorily only when the fasteners employed are made of metal or other electrically conductive material. Nevertheless, the switch SW_2 controls the motor M such that when the relay R is in the inoperative position and hence the switch SW_2 is closed, the motor M runs to drive the rotary drum 11 and, when the relay R is in the operative position and hence the switch SW_2 is opened, the motor M does not run and the rotary drum 11 accordingly ceases to rotate.

Thus, it is clear that, when the last of the fasteners in the row on the track pass through the lowermost electrode 25a, the relay R is deactivated, permitting the motor M to run and rotate the rotary drum by means of the roller 18 in the predetermined direction whereby lots of fasteners can be supplied onto the track in the manner hereinbefore described.

In connection with the provision of these electrodes 25a and 25b, care must be taken that each one of these electrodes is embedded in the corresponding notch with the upper surface lying in the same plane as the upper edge of the rail having such notch and with a pair of gaps on the both sides of the electrode being filled with the adhesive material used. The reason for this is to provide a smooth surface free of obstacles which might hamper the sliding movement of the fasteners along the track.

Referring back to FIGS. 10 to 13, the construction of the impeller 32 will be now described. The impeller 32 is provided for positively removing the incorrectly mounted or displaced fasteners from the track while permitting passage therethrough of those fasteners which are correctly positioned on the track.

The impeller 32 comprises a cylindrical member 34 rigidly mounted on a spindle 35 carried in a manner as hereinafter described. The spindle 35 is carried by a link member 36 (FIGS. 2, 10 and 13) having one end rotatably supporting said spindle at a substantially intermediate portion of the latter and the other end connected with a corresponding end of an arm member 37 of which the other end is rigidly connected to

or integrally formed with the front end portion of the arched member 10b (FIG. 1). The connection between the individual adjacent ends of said link member 36 and the arm member 37 is made in such a manner that, as shown in FIG. 13, the end portion of the link member 36 is formed with a notch 36a for accommodating therein a return spring 38 having one end connected with said link member and the other end connected or engaged with the end of the arm member 37 and with a connecting member 39 tapped into the end of the link member 36 through the end of the arm member 37 and the return spring 38. The return spring 38 normally acts to bias the spindle 35 toward the track.

The cylindrical member 34 is formed on its periphery with a plurality of protrusions 34a each extending over the entire width of said member 34 in parallel relation to the longitudinal axis of said spindle 35. As shown in FIG. 12(a) and (b), some of these protrusions 34a have a uniform height over the entire length thereof while others have a varying height thereover. These two types of protrusions 34a are provided in random order on the periphery of the cylindrical member 34 in equidistantly spaced relation for facilitating the removal of the incorrectly positioned fasteners from the track. Nevertheless, even if only one of these two types of protrusions 34a is provided, the impeller 32 functions satisfactorily. However, in the case where the fastener used is in the form of a round-headed screw or the like, the use of the type such as shown in FIG. 12(b) with or without the other type of FIG. 12(a) is recommended.

The spindle 35 also carries a pair of blade wheels 40 rotatably mounted on both sides of said cylindrical member 34 and also a rubber lined roller 41 rigidly mounted on one end of said spindle 35, the other end of said spindle 35 adjustably receiving a set screw 42 while a compression spring 43 is interposed between one of the blade wheels 40 and a head portion of said screw 42. Another compression spring 44 is interposed between the end of the link member 36 and the other blade wheel 40 so that the blade wheels 40 are pressed in the opposite directions toward the cylindrical member 34 for rotation together with the cylindrical member 34 unless any sufficient load is imparted to either or both of said blade wheels 40.

While in the arrangement as hereinbefore described, the impeller 32 rotates in response to the rotation of the rotary drum 11 which drives the rubber lined wheel 41 in contact with the inner peripheral surface of the rim portion 11c of the rotary drum 11. More particularly, since the link member 36 is biased by the return spring 38, the rubber lined roller 41 contacts the rim portion of the rotary drum 11 so that rotation of the drum 11 causes the rubber lined roller 41 to rotate in the opposite direction, thus causing the rotation of the cylindrical member 34. The rotation of the cylindrical member 34 is then frictionally transmitted to the blade wheels 40 to rotate the latter.

It is to be noted that, while the cylindrical member 34 is positioned just above that portion of the track having the cross section of FIG. 9(c), the minimum distance between the upper edges of the rails 25 and 26 to any one of the protrusions 34a on the periphery of the cylindrical member 34 should be substantially equal to the thickness of a head portion of any one of the fasteners used. For this purpose, the diameter

of the cylindrical member 34 and the rubber lined roller 41 is suitably selected.

Each one of the blade wheels 40 has its periphery integrally formed with a plurality of equidistantly spaced blades 40a as shown in FIG. 11, each of said blades 40a being oriented preferably in the direction opposite to the direction of rotation of said blade wheel. While the protrusions 34a on the cylindrical member 34 act to remove those fasteners from the track which are either displaced angularly in the lengthwise direction of the track or mounted on above the adjacent two head portions of the fasteners, the blades 40a on each one of the blade wheels 40 act to remove those fasteners from the track which are laterally displaced with respect to the track. The fasteners removed off from the track by the impeller 32 obviously fall into the fastener receiving funnel 10. To ensure this, the pair of the blade wheels 40 are arranged such as to overhang the track with the cylindrical member 34 extending over the track substantially as shown in FIG. 9(c).

Referring further back to FIG. 2, the guide 27 is configured as shown and has a rear end portion formed into a tongue-like end 27a and a front end situated rearwardly of the front ends of the rails 25 and 26 and pivotally connected with a guide extension 45.

The rear end extremity of the tongue-like end 27a terminates substantially below the cylindrical member 34 of the impeller 32 for guiding the fasteners that have been passed through the impeller 32 from above.

The guide 27 is supported in the manner as hereinbefore described and overlies the track, above the region normally occupied by the fastener heads. This prevents the displacement of the fasteners as they slide down the track onto the escapement section. For facilitating the smooth sliding movement of the fasteners, an air jet nozzle 46 is provided for blowing air toward the head portion of the fasteners so as to cause the latter to positively slide downward toward the escapement section. This air jet nozzle 46 may be supported either by the guide 27 or one of the rails 25 and 26 and is connected with a suitable air source (not shown) through a tubing 46a which said air source may be the same air source used in association with the escapement section.

ESCAPEMENT SECTION

This escapement section feeds the row of screws singly from the track of the chute section to the power operated screw driver in timed relationship. The construction of the escapement section is clearly illustrated in FIGS. 15 to 20.

Referring to these figures, the escapement section generally comprises a solid body 47 of a substantially rectangular prism shape having therein a cylinder bore 47a of relatively small diameter and a cylinder bore 47b of larger diameter than that of the cylinder bore 47a. In the small bore 47a, a piston rod 48 is operatively inserted and normally urged to the left by the action of a compression spring 49 interposed between the right-hand extremity of said piston rod 48 and the end of said bore 47a with a working chamber 50 formed therebetween within said bore.

In the large bore 47b, a plunger 51 having at least

one land 51a formed on the periphery of said plunger within the bore 47b is operatively inserted. The land 51a of the plunger 51 defines within the bore 47b a pair of first and second working chambers 52 and 53.

The first working chamber 52 communicates with a suitable air source through a port 52a, which may be the same source which communicates with the air jet nozzle 46 (FIG. 2), which source provides continuous supply of air thereto. The other chamber 53 communicates with the power operated screw driver through a port 53a by means of a pressure control provided in said screw driver for intermittently supplying air thereto in a timed manner, the air being of the same pressure as the air supplied to the first working chamber 52.

The plunger 51 is operable in such a manner that, so long as no air is supplied to the second working chamber 53, said plunger 51 is biased to the right by the air under pressure within the first working chamber 52 and is biased to the left only when the air under pressure is supplied to the second working chamber 53. This is possible because the pressure receiving area of the land 51a facing toward the first working chamber 52 is smaller than that facing toward the second working chamber 53, such design being well understood by those skilled in the art.

An adjustment screw 54 is threadably extending through the solid body 47, one end of the screw situated within the large bore 53 and the other end formed into a control knob, and, by turning this adjustment screw 54, the stroke of movement of the plunger 51 can be determined as desired. The reason for the provision of this adjustment screw 54 will be understood later.

The solid block 47 also has a fastener passage 55, the upper portion of which is in the form of a slot having a crevice 55a of a width slightly greater than the diameter of the stud portion of the fasteners (FIG. 20) and the lower portion in the form of a hole 55b through the solid body 47. This lower portion of the passage 55 communicates with the port 53a through the working chamber 50 by means of passages 56a and 56b for the purpose described below.

A slider 57 having a diagonally extending slot 57a is provided with a slidable plate 57b having a through hole 57g of the same diameter as that of the passage 55 and slidably carried by the solid body 47 at 47c which said slidable plate 57b carries thereon a pair of blocks 57c and 57d. These blocks 57c and 57d have their respective opposed edges shaped such as to form said diagonally extending slot 57a over the width thereof with the space therebetween substantially equal to or slightly greater than the width of the crevice 55a of the passage 55. Particular attention is called to the fact that the thickness of the edge of the block 57d which defines the slot 57a in cooperation with the corresponding edge of the other block 57c is less than that of the block 57c by an amount substantially equal to the space of the slot 57a, and this provides a stand-by position 62 in cooperation with the surface of the supporting plate 59.

The sliding movement of this slider 57 is effected by a substantially square shaped connecting plate 58 which is in turn connected to an outer end of the plunger 51 at 58a. The plate 58 acts not only to transmit the reciprocal movement of the plunger 51 to

the slider 57, but also to restrict the stroke of the piston rod 48 an extremity of which abuts thereagainst due to the action of the compression spring 49.

The supporting plate 59 also functions to prevent slider 57 from the solid body 47, a supporting plate 59 the separation of the slider 57 from the solid body 47. One surface of plate 59 is integrally formed with a pair of brackets 59a and 59b and has a flat opposite surface such that the sliding movement of slider 57 is unimpeded. The supporting plate 59 is secured to the solid block 47 by means of a pair of set bolts 60a and 60b tapped into the corresponding threaded holes 47d and 47e formed in the solid body 47. Particularly as shown in FIG. 20, the blocks 57c and 57d are each formed with respective clearances 57e and 57f through which the bolts 60a and 60b extend by means of bushings 61a and 61b loosely situated in said clearances 57e and 57f.

While the supporting plate 59 is secured to the solid block 47 in the manner as hereinabove described, the pair of the brackets 59a and 59b are respectively connected with the front end portion of the rails 25 and 26 with the rails situated between said brackets. Thus, it is clear that the solid body 47 is connected with the rails 25 and 26 through the brackets 59a and 59b of the supporting plate 59.

It should be noted that the diagonally extending slot 57a has an entrance connected with the track of the chute section and an exit connected with the crevice 55a of the passage 55. The slider 57 is designed to operate in response to the reciprocal movement of the plunger 51 in such a manner that when the plunger 51 is in a retracted position as shown in FIG. 15, 16 or 17, the entrance of the slot 57a is aligned with the rail 25 with the stand-by position 62 in exact alignment with the space between the two rails 25 and 26 and, when the plunger 51 is in an extended position as shown in FIG. 18 or 19, only the exit of said slot 57a is aligned with the crevice 55a.

It is clear from the above description that the fasteners on the track of the chute section can be successively supplied to the upper opening of the passage 55 in response to the movement of the plunger 51 in such a way that the first fastener in the row which is resting in the stand-by position 62 is separated from the subsequent fastener by the wedging action of the tapered edge of the block 57c as the latter is moved to the left and thereafter the first fastener moves along the slot 57a to the exit of said slot 57a and then to the upper opening of the passage 55 guided by a cover plate 63 (FIGS. 1, 2, and 15) which will be mentioned later.

The solid body 47 is also formed with a groove 47f and a pair of chambers 47g and 47h respectively communicating with the groove 47f as shown. A pair of retaining blocks 64 and 65 each having a finger 64a or 65a are respectively loosely accommodated within the chambers 47g and 47h with the fingers 64a and 65a overlaying the upper opening of the passage 55. These retaining blocks 64 and 65 are biased in opposite directions with respect to the other by means of compression springs 66 and 67 so that the fingers 64a and 65a permit the passage 55 to be opened.

For selectively closing and opening the passage 55 by means of the fingers 64a and 65a of the respective retaining blocks 64 and 65, and operating bar 68

formed at a substantially intermediate portion with a pair of recesses 68a and 68c each having an inclined surface 68b or 68d is slidably received in said groove 47f of the solid body 47. This slidably operating bar 68 has one end formed with a groove 68e for receiving the thickness of the plate 58 whereby the movement of the plunger 51 can be transmitted to said bar 68. A similar connection between the bar 68 and the plate 58 may be made between the slider 57 and the plate 58.

A pair of balls 69 and 70 are operatively positioned within the chambers 47g and 47h between the recesses 68a and 68c of the operating bar 68 and tapered edges 64b and 65b of the retaining blocks 64 and 65, respectively, so that, when the plunger 51 is moved to the left as shown in FIG. 18 or 19, the retaining blocks 64 and 65 are moved toward each other against the compression springs 66 and 67 and substantially close the opening of the passage 55. More specifically, as the operating bar 68 moves to the left in response to the leftward movement of the plunger 51, the balls 69 and 70 roll over the respective surfaces 68b and 68d of the grooves 68a and 68b causing the retaining blocks 64 and 65 to move toward each other, thus establishing the condition as shown in FIG. 18. On the other hand, when the operating bar 68 is returned to the right, the retaining blocks 64 and 65 move away from each other due to the action of the compression springs 66 and 67 and the balls 69 and 70 roll into the respective recesses 68a and 68c in the operating bar 68.

It is to be noted that when the retaining blocks 64 and 65 are positioned such as shown in FIG. 18, substantially closing the passage 68, a space is left between the fingers 64a and 65b of said retaining blocks 64 and 65 of a size sufficient to retain the fastener, with the head portion of said fastener resting on the upper surfaces of said fingers in a bridge-like manner. The fastener retained by the retaining blocks 64 and 65 through the respective fingers 64a and 65b is, of course, dropped into the passage 55 as said blocks 64 and 65 move away from each other in which condition the through hole 57g in the slidable plate 57b of the slider 57 is in alignment with said passage 55. Naturally, the lowermost opening of the passage 55 is, as shown in FIG. 15, connected with a coupling 71 which is in turn connected with the power operated screw driver by means of a suitable tubing 72 (FIGS. 1 and 2).

Cover plate 63 is formed with a substantially U-shaped notch 63a of a width substantially equal to the diameter of the passage 55 or the diameter of the head portion of the fastener employed in connection with the fastener feeding apparatus and is suitably secured, for example by the use of a plurality of set screws, on the upper surface of the solid body 47 to confine the various elements located in the solid body 47 beneath the undersurface of said cover plate 63. The substantially U-shaped notch 63a is positioned above the front end of the track of the chute section and the passage 55 while the guide extension 45 (FIGS. 1 and 2) overlays said notch 63a.

From the foregoing, it becomes clear that the escapement section of the above construction functions in the following manner.

Assuming that the first of the fasteners down-

wardly guided by the track of the chute section is in the stand-by position 62 while the plunger 51 is in the condition as shown in FIGS. 16 and 17, the leading fastener is separated from the subsequent fasteners by the wedging action of the tapered edge of the block 57c of the slider 57 when air under pressure is supplied to the second working chamber 53 of the large diameter bore 47b to cause the plunger 51 to move to the left and then to establish the condition as shown in FIGS. 18 and 19.

As the slider 57 moves to the left in response to the movement of the plunger 51, the fastener in the diagonally extending slot 57a is guided through the passage 55. However, prior to the arrival of this fastener above the passage 55, the retaining blocks 64 and 65 are moved toward each other in response to the movement of the plunger which moves the operating bar 68 to the left and, therefore, the fastener is suspended by the fingers 64a and 65a of the retaining blocks 64 and 65 in the manner as hereinbefore described at the time the plunger 51 completes its leftward movement. At the same time, the piston rod 48 is moved to the left by the action of the compression spring 49 such that the lower portion of the passage 55 communicates with the small diameter bore 47a via passage 56a and then with the second working chamber 53 through the passage 56b, thus permitting the pressurized air within the second working chamber 53 to vent into the lower portion of said passage 55 and then to the tubing 72 whereby the fastener, which has been resting within the tubing 72 where it was previously fed, can be thrust onto the power operated screw driver, clearing the tubing 72.

When the air supplied to the second working chamber 53 through the port 53a ceases in response to a signal generated by the pressure control built in the power operated screw driver, the air contained in said chamber 53 vents from chamber 53 through the passage 55 to the atmosphere by means of, for example, said pressure control while the plunger 51 moves to the right by the effect of pressure differential between said two chambers 52 and 53. As the plunger moves to the right in the manner described above simultaneously with the movement of the bar 68, the slider 57 and the piston rod 48 against the compression spring 49, the retaining blocks 64 and 65 move away from each other thus dropping the fastener onto the passage 55 which fastener then travels to the tubing 72. Substantially at the same time, the communication between the passage 55 and the second working chamber 53 is cut off by the piston rod 48 closing the passage 56a, thus completing one cycle of operation of the escapement section.

ANOTHER PREFERRED EMBODIMENT

This embodiment of the present invention is shown in FIGS. 21 and 22 and is intended for the construction of the chute section and the escapement section as a single unit which functions in substantially same manner as in the foregoing embodiment without any reduction of performance. However, the embodiment shown in FIGS. 21 and 22 has an additional advantage in that if a plurality of types of fasteners are used in a ship furnished with the fastener feeding apparatus of the present invention

additional fastener feeding apparatus need not be purchased or furnished to suit the subsequently selected type of fasteners. In this case, all that is necessary is to replace the previously used unit with another one since the hopper section and its associated drive section can be commonly employed in connection with any various types of fasteners.

Referring now to FIGS. 21 and 22, the pair of the rails 25 and 26 are, in the present embodiment, mounted on a flat carriage 80, a rear end portion of which is outwardly bent to form a supporter plate 80a. This flat carriage 80 has at the bent portion an opening 80b through which the rails 25 and 26 extend and is formed on its flat surface portion with a plurality of register holes 80c.

As clearly shown in FIG. 21, the impeller 32 is mounted on the supporter plate 80a in a manner similar to the way it was mounted on the front end of the arched member 10a of the funnel 10 in the first embodiment.

For connecting the chute unit including the escapement section to the funnel 10, the opening of the funnel 10 is cut to form a recess 10d' which corresponds to the opening 10d of the foregoing embodiment. A plurality of registers 82 are formed on the upper surface of the platform 10c, which engage the register holes 80c on the flat carriage 80 thus maintaining the chute unit firmly in position on the platform 10c. Although not shown, at least one set screw may be provided for rigidly connecting the chute unit to the platform 10c.

In the event that it is preferred to fix the space of the rails 25 and 26 to provide different track width for each chute unit including the escapement section, a spacer piece 81 may be provided at the rear of the track sandwiched between the rails 25 and 26.

OPERATION

The operation of the fastener feeding apparatus either according to the first preferred embodiment or according to the second preferred embodiment is as follows. Assuming that a plurality of fasteners, for example, screws of one particular type are contained in the funnel 10 of the hopper section and a main switch (not shown) is switched on to operate the motor M, lots of screws are successively upwardly transported by the scoop members 11d as the rotary drum rotates. Each time the scoop members 11d arrive at the top position, the screws fall on to the plate 30 and then to the track.

Some of the screws which are incorrectly mounted on the track are removed therefrom because of the particular configuration of the upper edge the rails 25 and 26 and by the impeller 32 rotating in contact with the rotary drum 11. The screws passing the impeller 32 slide down the track in a row toward the front of the track.

When the row of the screws on the track extends beyond the distance between the lowermost and uppermost electrodes 25a and 25b, the relay R is activated whereby the switch SW₁ is closed so as to maintain the relay R in the self-energized condition and the switch SW₂ is opened to deactivate motor M.

When the last of the screws lined in a row on the track passes the lowermost electrode 25a, the circuit of FIG. 14 opens and the relay is rendered inoperative causing the switches SW₁ and SW₂ to open and close

respectively. Therefore, the motor M is again activated and rotates the rotary drum 11.

The screws in the row on the track are understood as successively fed to the power operated screw driver through the escapement section in the manner as hereinbefore fully described.

In the event that it is desired to change the chute-escapement unit when screws remain on the track, these screws can be manually removed by pivoting the guide extension 45 away from the opening of the passage 55 of the escapement section.

Although the present invention has been fully described in conjunction with the preferred embodiments thereof, it is to be noted that various changes and modifications are apparent to those skilled in the art. For example, the fastener feeding apparatus can be employed in connection with various types of fasteners other than screws, such as rivets, bolts, or other like gib-headed fastening members. Furthermore, since the apparatus itself can be manufactured in a relatively compact size, it may be used by do-it-yourself fans.

In view of the foregoing, therefore, unless otherwise they depart from the scope of the present invention, such changes and modifications are to be understood as included therein.

What is claimed is:

1. A fastener feeding apparatus for use in association with a power operated fastening tool, which comprises means adapted to contain therein a number of fasteners, a rotary drum forming a part of said container means and having a plurality of peripherally spaced scoop members, a drive means for rotating said rotary drum in one predetermined direction thereby permitting said scoop members to upwardly carry a plurality of fasteners in lots from within said container means as said rotary drum is rotated, a downwardly inclined track for downwardly guiding in a row the fasteners that have been carried by said scoop members, means rotatable in a direction counter to the rotational direction of said rotary drum for positively removing some of the fasteners guided by said track which are incorrectly mounted on or displaced from said track, said removing means being arranged such that the fasteners removed thereby can drop into said container means, and an escapement assembly operatively connected with said track and including a passage, means for successively separating each one of the row of the fasteners at the opening of said passage, at least one pair of slidable retaining blocks capable of sliding in opposite directions in response to said separating means in such a manner that, when said separating means is in position to separate successively the first of the fasteners in the row from the subsequent fasteners, said retaining blocks are moved close to each other with the space between these blocks ready to support the separated fastener and, when said separating means is in position to return to its original position, said retaining blocks are moved away from each other to release the fastener that has been retained thereby to permit said fastener to drop by gravity into the passage, and a compressed air supply control communicating with said passage for selectively supplying compressed air thereto from an air source thereby causing the fastener dropped into said passage to be rapidly fed to the power operated fastening tool.

2. A fastener feeding apparatus as claimed in claim 1, wherein said container means comprises a fastener receiving funnel formed with a substantially semicircularly arched member having one lengthwise edge inwardly recessed and the other lengthwise edge being straight, and an inclined wall member secured to said recessed edge of said arched member forming a container chamber in cooperation with the rotary drum for accommodating therein the fasteners and said drive means includes an electrically operated motor having a drive shaft mounted with a rubber lined roller in contact with the peripheral surface of said rotary drum for rotating said rotary drum.

3. A fastener feeding apparatus as claimed in claim 2, wherein said inclined wall member is formed with a plurality of horizontally extending projections facing toward the interior of the funnel for indicating the approximate number of the fasteners contained in the funnel.

4. A fastener feeding apparatus as claimed in claim 1, wherein said track is formed with a pair of rails downwardly extending in a spaced relation with respect to each other from the interior of the funnel toward the escapement assembly, said rails being adjustably spaced to provide the desired track width.

5. A fastener feeding apparatus as claimed in claim 1, wherein said removing means comprises an impeller formed with a cylindrical member and a pair of blade wheels mounted on a common shaft and sandwiching said cylindrical member, said impeller being positioned above said track with said blade wheels overhanging said track.

6. A fastener feeding apparatus as claimed in claim 1, wherein said track comprises a pair of rails downwardly extending in spaced relation with respect to each other from the interior of the funnel toward the escapement assembly and further comprising an electrical control circuit for selectively bringing said drive means into operative and inoperative positions to rotate and stop said rotary drum in response to the respective presence and absence of the row of fasteners on the track formed by said rails.

7. A fastener feeding apparatus as claimed in claim 1, wherein said track, said escapement assembly and said fastener removing means are made into a single unit.

8. A fastener feeding apparatus as claimed in claim 5, wherein said impeller includes a roller rigidly mounted on said common shaft and pressure contacted with the inner peripheral surface of said rotary drum whereby said impeller rotates counter to the rotational direction of said rotary drum.

9. A fastener feeding apparatus as claimed in claim 1, wherein said escapement assembly further includes a hydraulically operated plunger movable between extended and retracted positions for operating both the separating means and the retaining blocks in response to the reciprocal movement of said plunger.

10. A fastener feeding apparatus for use in association with a power operated fastening tool, which comprises a fastener receiving funnel formed with a substantially semicircularly arched member having one lengthwise edge inwardly recessed and the other lengthwise edge being straight and an inclined wall member secured to said recessed edge of said arched member forming a container chamber in which a

plurality of fasteners are accommodable, a rotary drum partially defining said container chamber and having a plurality of peripherally spaced scoop members, a drive means including an electrically operated motor having a drive shaft mounted with a rubber lined roller in contact with the inner peripheral surface of said rotary drum for rotating the latter thereby permitting said scoop members to upwardly carry a plurality of fasteners in lots from within said container chamber, at least one pair of spaced rails arranged in a downwardly inclined manner for providing a guide track along which a plurality of fasteners that have been carried by said scoop members are downwardly guided by gravity, a deflector secured to one of said rails at a portion adjacent to the rear of said track for guiding a plurality of lots of fasteners dropped from the scoop members on to said track, an impeller including a common shaft having one end portion rigidly mounted with a cylindrical member and a pair of blade wheels sandwiching said cylindrical member and each rotatable with said cylindrical member and the other end portion rigidly mounted with a rubber lined roller whereby said impeller is rotatable counter to the rotational direction of the rotary drum and also counter to the direction of sliding movement of the row of the fasteners along the guide track for positively removing some of the fasteners in the row which are incorrectly mounted on or displaced from said guide track, said impeller being arranged such that the fasteners removed thereby can be dropped into said container chamber, and an escapement assembly operatively connected to the front of said track and including a passage, a hydraulically operated plunger movable between extended and retracted positions in a timed manner with respect to the operation of the power operated fastening tool, means for restricting the passage of fasteners to said passage when said plunger is in the retracted position and for separating the first of the row of the fasteners from the subsequent fasteners and then guiding said first fastener to the opening of said passage when said plunger is in the extended position, at least one pair of slidable retaining blocks capable of sliding in opposite directions in response to the reciprocal movement of said plunger in such a manner that, when said plunger is in the retracted position, said retaining blocks are moved close to each other with the space between these blocks ready to support the separated fastener, and, when said plunger is in the extended position, said retaining blocks are moved away from each other to release the fastener that has been retained thereby to permit said fastener to drop by gravity onto the passage, and a compressed air supply control for selectively supplying compressed air to said passage for

causing the fastener dropped into said passage to be rapidly fed to the power operated fastening tool, the flow of said compressed air therethrough being substantially regulated in response to the reciprocal movement of said plunger.

11. A fastener feeding apparatus as claimed in claim 10, further comprising means for adjusting the contact pressure exerted between said rubber lined roller mounted on the drive shaft of the motor and the peripheral surface of said rotary drum.

12. A fastener feeding apparatus as claimed in claim 10, further comprising a electrical motor control circuit including a pair of electrodes mounted on one of said rails in a spaced relation with respect to each other and in an electrically insulated manner with respect to said rail, a power source, a parallel circuit including a relay having operatively associated first and second relay switches and a series connected circuit consisting of a resistor and a capacitor, said parallel circuit being series connected between said power source and one of said electrodes through said first switch and also the other of said rails, the other of said electrodes being directly connected with said power source, said second switch being connected between the motor and its power source, whereby, only when said two electrodes are short-circuited due to the row of the fasteners sliding along the guide track, is said relay operated so as to open said second switch to intermit the rotation of said motor and concurrently to close said first switch to maintain said relay in the self-energized position so long as said other of said electrodes and said other of said rails are shortcircuited with respect to each other and, when the row of the fasteners slides by gravity past said other of said electrodes without short-circuiting the latter to said other of said rails, said relay can be returned to the original condition.

13. A fastener feeding apparatus as claimed in claim 12, wherein a potentiometer is provided between said parallel circuit and said power source for regulating the value of potential supplied from the power source.

14. A fastener feeding apparatus as claimed in claim 10, wherein a guide is provided above the space between said two spaced rails for preventing displacement of the fasteners as they slide by gravity down the track onto the escapement assembly, said guide having one end situated substantially below the impeller and the other end pivotally connected with a guide extension which overlies the passage of said escapement assembly.

15. A fastener feeding apparatus as claimed in claim 10, wherein said rails, said escapement assembly and said impeller are made into a single unit.

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