May 31, 1960 W. F. H. GORN 2,938,213

AUTOMATIC HAND-NAILER

Filed Sept. 4, 1956 8 Sheets-Sheet 1

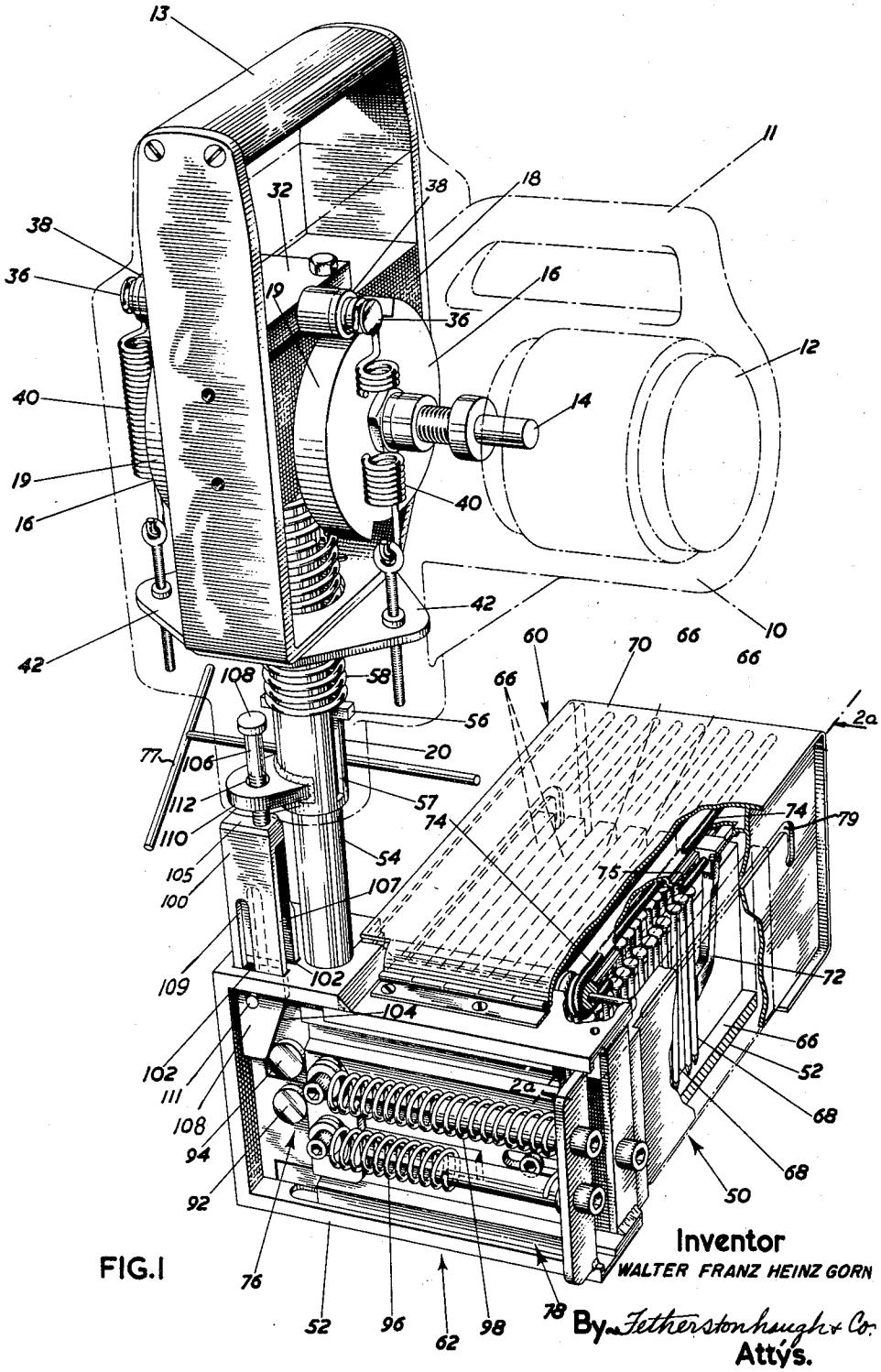

FIG. 1

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AUTOMATIC HAND-NAILER

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FIG.2

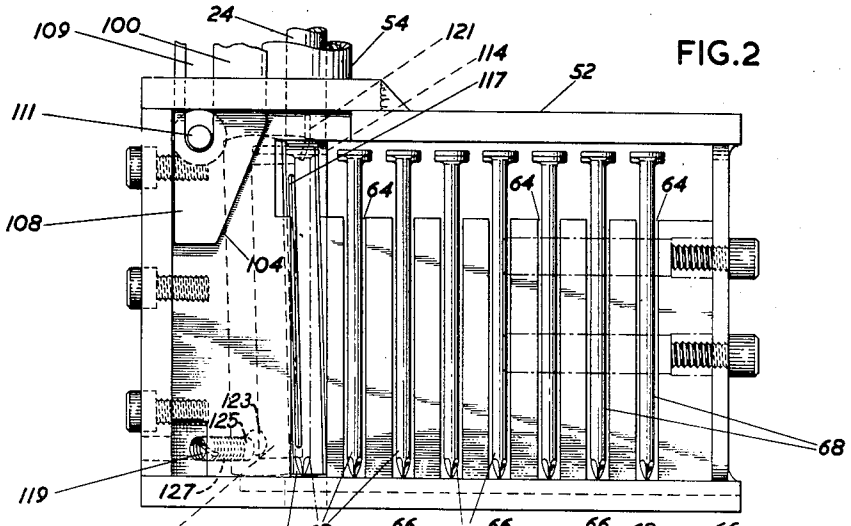


FIG.3

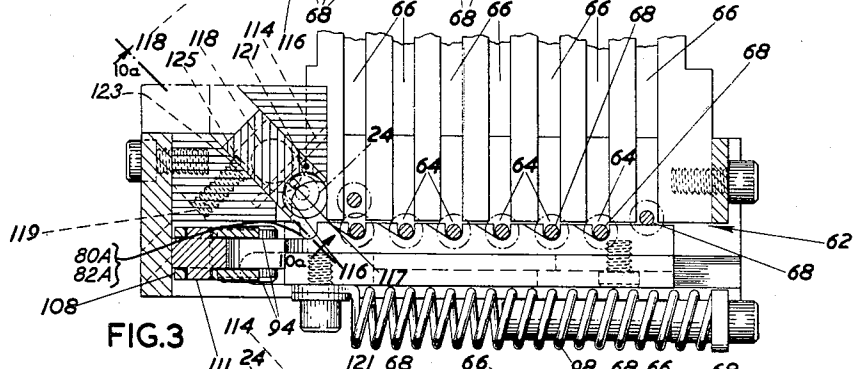


FIG.4

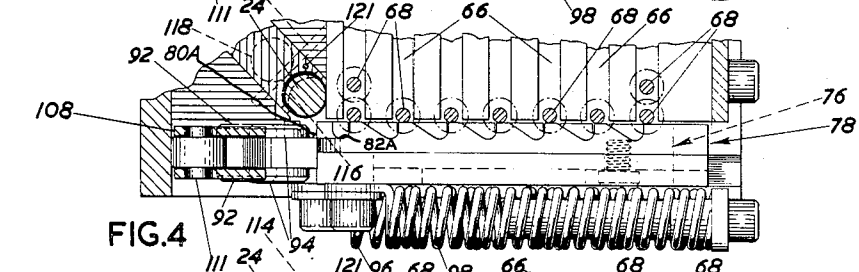
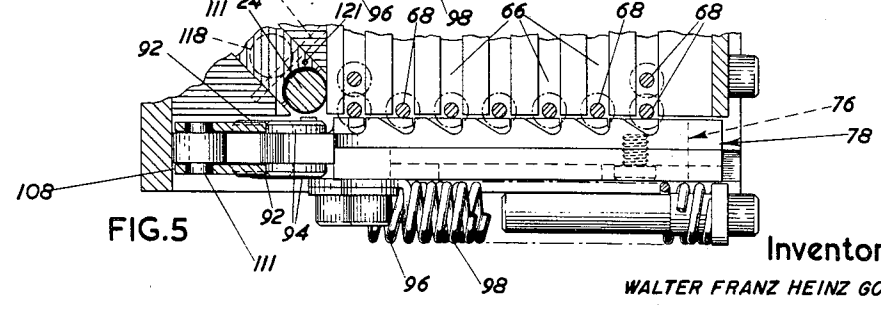


FIG.5



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AUTOMATIC HAND-NAILER

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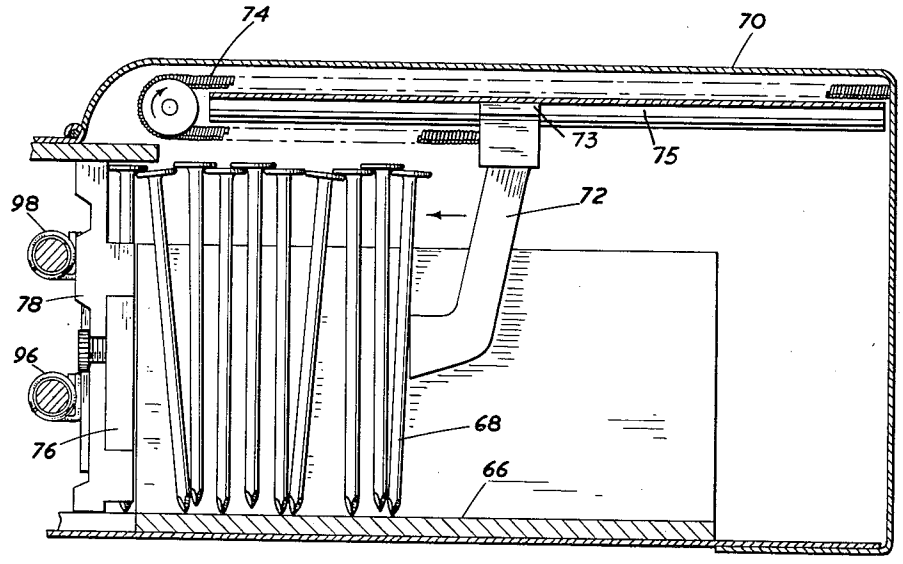

FIG. 2a

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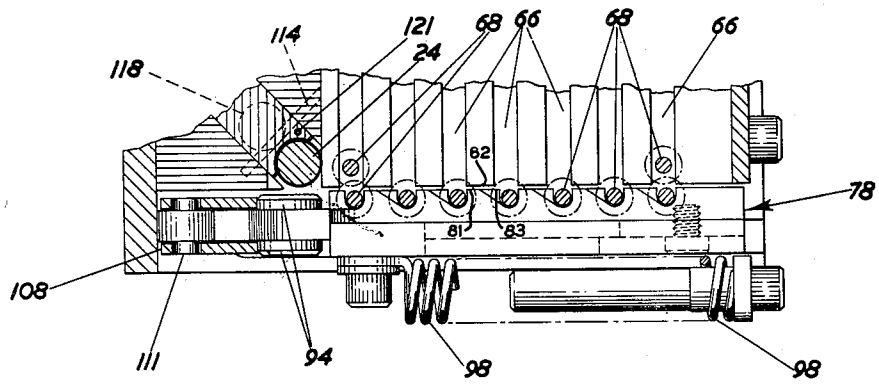

FIG.6

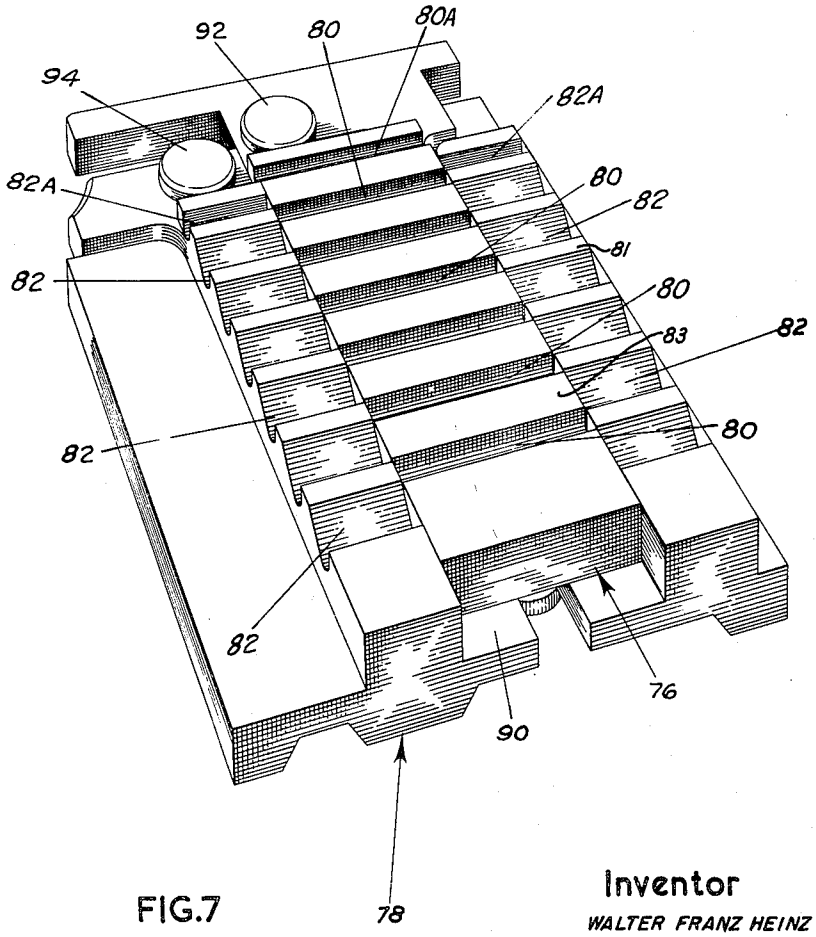

FIG.7

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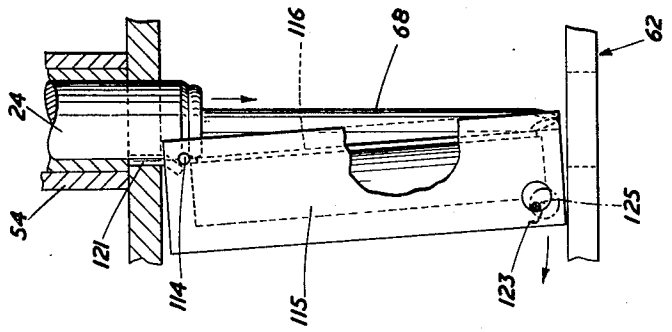

FIG. 10a

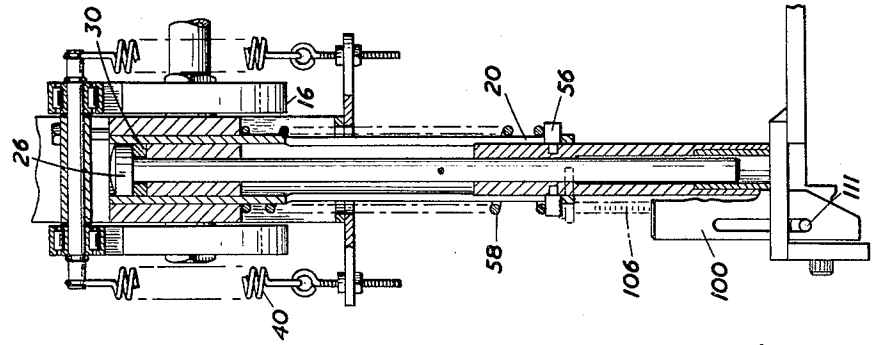

FIG. 8

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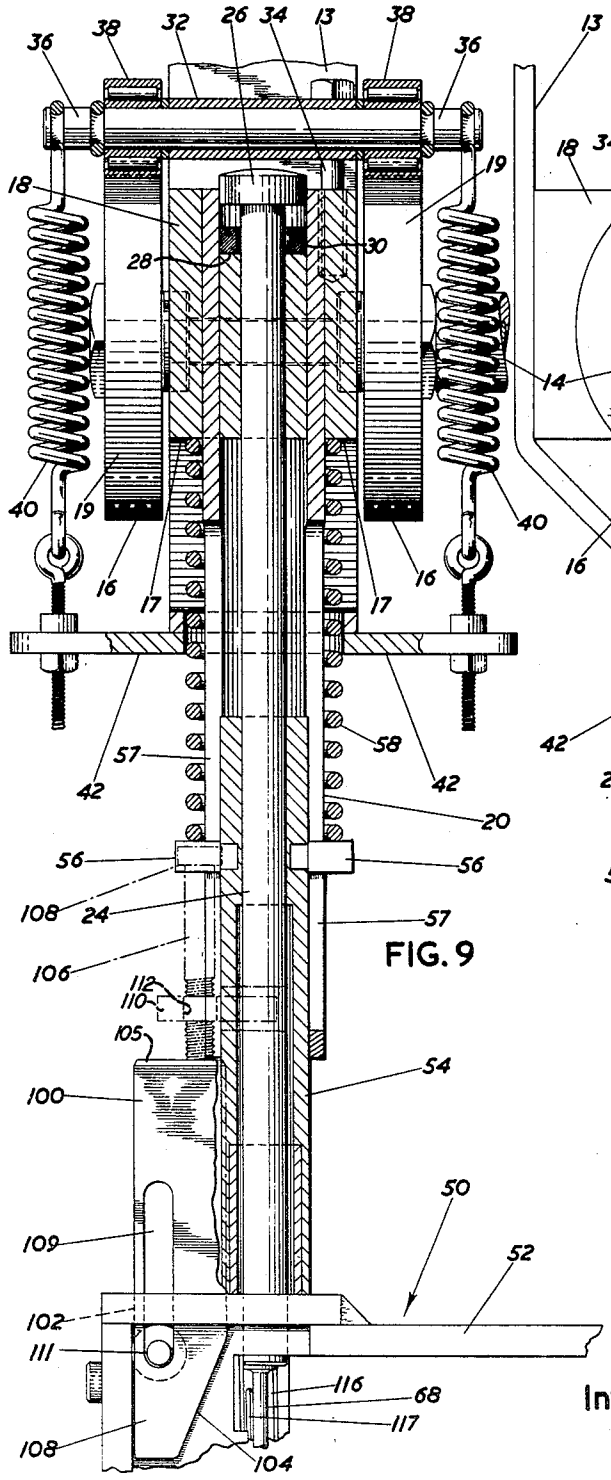

FIG. 9

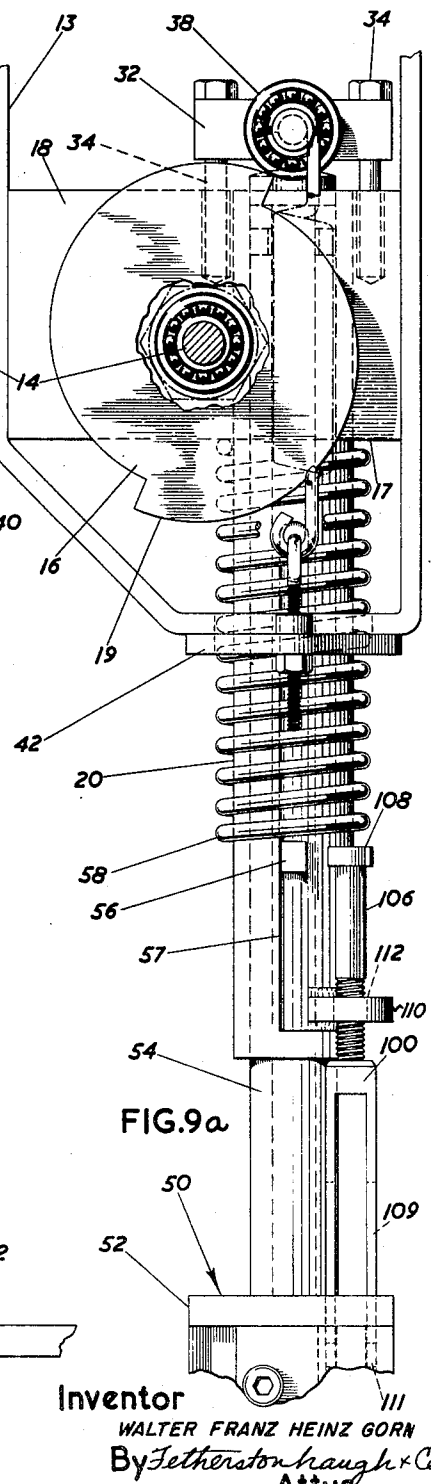

FIG. 9a

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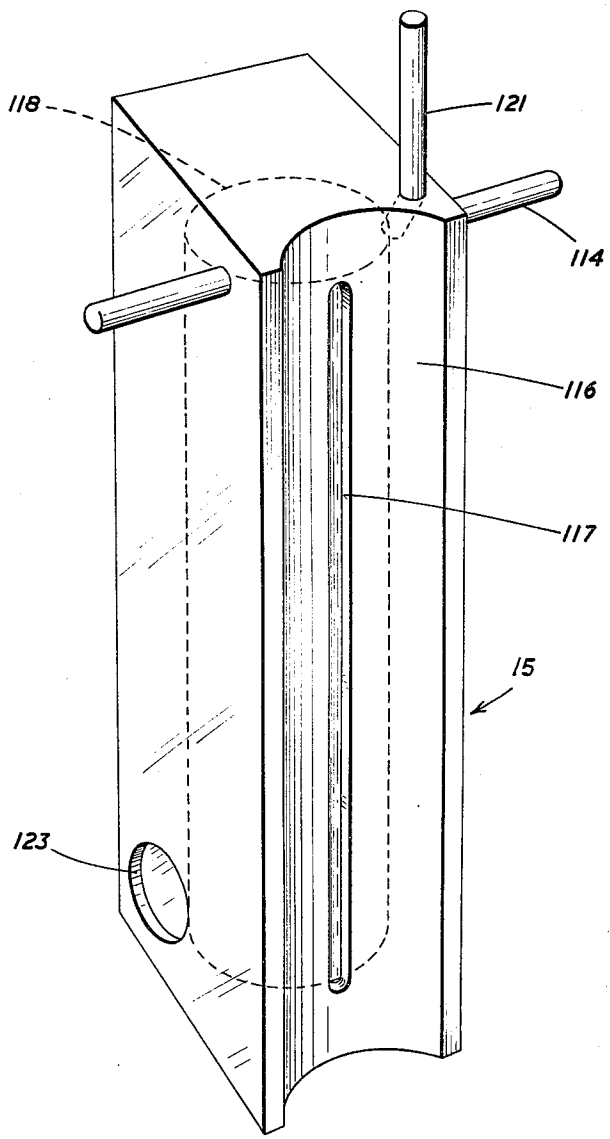

FIG. 10

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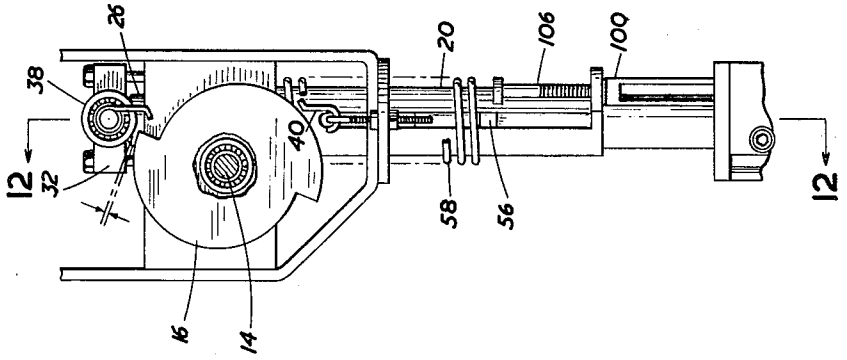

FIG. 13

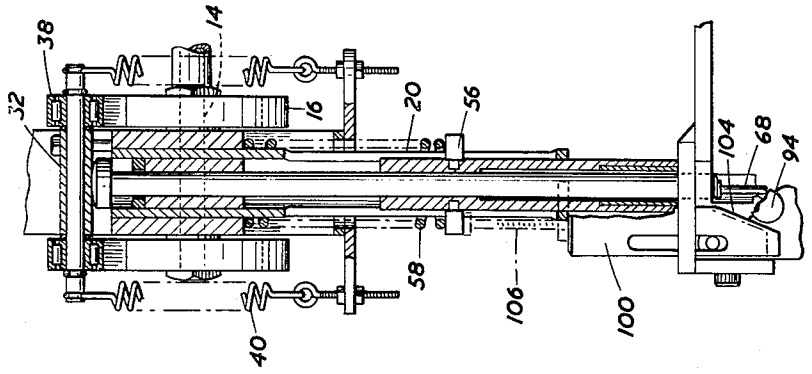

FIG. 12

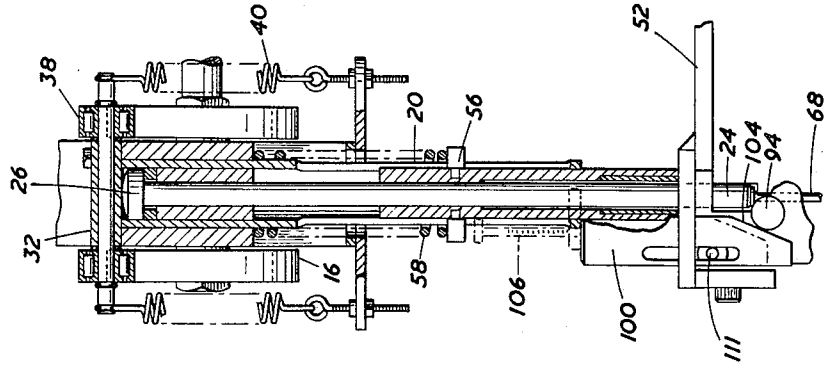

FIG. 11

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United States Patent Office

2,938,213

Patented May 31, 1960

2,938,213

AUTOMATIC HAND-NAILER

Walter Frans Heinz Görn, Stratford, Ontario, Canada, assignor to Canadian Fabricated Products Limited, Stratford, Ontario, Canada

Filed Sept. 4, 1956, Ser. No. 607,829

3 Claims. (Cl. 1—46)

This invention relates to a nailing machine.

The nailing machine comprises a means for holding nails to be driven, a mechanism known as the driving assembly including a surface adapted to contact the head of said nail and to drive it into material to be nailed, a means for intermittently supplying nails to the path of said surface, known as the "nail supply means" synchronized with the motion of said driving assembly in driving the nails into the material as supplied.

It is an object of this invention to provide means for ensuring that only one nail at a time is fed to the path along which the nail is driven, hereinafter referred to as "the driving rod path."

It is a further object of this invention to provide a reciprocating conveyor member which oscillates in a direction between the driving rod path and the nail supply, oscillating between limit positions known as "remote" and "adjacent" positions.

It is an object of this invention to provide means for synchronizing the movement of the nail driving mechanism with the reciprocating conveyor in such a way that a nail is moved into the path of the driving rod after each nail is driven.

It is also an object of this invention to provide a support surface for the nail before and during the striker operation, wherein the surface slopes inwardly and downwardly relative to the driving rod path to contact the nail at its head and adjacent the point thereof to support it in alignment with the driving rod, wherein the nail is attracted and held on said support by magnetic force and wherein the support surface is releasably biased into the position described above to be moved out of this position by the downward motion of the driving rod.

It is also an object of this invention to provide apparatus of non-magnetic material within the effective flux path of the magnetic nail holder so that the flux will not be distorted.

In the drawings:

Figure 1 shows a perspective view of the nailing machine with the upper casing removed;

Figure 2 shows the side view of the nail magazine with the conveyor removed;

Figure 2*a* shows a view taken along lines 2*a*—2*a* of Figure 1;

Figures 3 to 6 show a series of top views illustrating the nail conveyor operation;

Figure 7 shows a perspective view of the conveyor;

Figure 8 is a section of the operating means for the striker and driving rod.

Figure 9 is a section similar to Figure 8, in operating position;

Figure 9*a* is a view at right angles to the view of Figure 9;

Figure 10 shows the support surface, magnetic element and slot;

Figure 10*a* shows the support being a view along the line 10*a*—10*a* of Figure 3;

Figures 11 and 12 are sections taken along the same locations as are Figures 8 and 9 but showing different operative stages in the driving of a nail;

Figure 13 is a side view at right angles to the view of Figure 12.

In the drawings an upper casing 10 supplies a mounting for a block 18 to which is connected a motor 12. Integral with the casing and rigidly connected to the block 18 is a pair of handles 11 and 13 for easy manual operation of the machine. From the motor 12 extends a shaft 14 on which are mounted a pair of spiralling step cam wheels 16 and the rotation of the motor 12 is such that the cam surfaces 19 spiral outwardly during rotation. The shaft 14, cam wheels 16 and motor 12 are rotatably mounted in the block 18 from which extends downwardly a sleeve 20. A driving rod provided with a shank 24 and a head 26 is contained in the sleeve 20 with the outer diameter of the head 26 making a sliding fit with the inner diameter of the sleeve 20. An inwardly extending shoulder 28 provided with a washer 30 at the upper end thereof limits the downward motion of the head 26 relative to the sleeve 20, at the point where the upper surface of the head 26 is substantially level with the upper surface of the block 18.

A striker 32 is adapted to be seated on the upper surface of the block 18 above the head 26 and two studs 34 attached to the striker 32 project downwardly slidably into corresponding holes on the block 18 whereby the striker 32 may move up and down relative to the block 18 under the guidance of the studs 34. A shaft 36 extends through the striker and on each side thereof carries bearings 38 which are adapted to roll on the cam wheel surfaces 19 whereby the striker 32 moves up and down relative to the block 18 in accord with the contour of such surface. A pair of tension springs 40 extend between the ends of shaft 36 and a cross arm 42 rigidly connected to the block 18 and thereby bias the striker 32 toward the block 18 and the bearings 38 toward the cam wheel surfaces 19.

Below the downwardly extending sleeve 20 is provided a nail magazine 50 having a body 52. Upwardly extending from the magazine is an inner sleeve 54 having an outer diameter such as to slidably telescope in the downwardly extending sleeve 20 and an inner diameter to slidably receive the driving rod 24. The magazine body below the driving rod 24 is bored to provide a passage for the driving rod 24 therethrough. A pair of outwardly projecting studs 56 rigidly mounted in the upwardly extending sleeve 54 form the lower shoulder for a compression spring 58 which surrounds sleeve 20 and bears upwardly on the lower face 17 of the block 18. A vertical slot 57 in sleeve 20 allows the studs 56 to project through this sleeve and the sleeve 20 to move vertically relative to the studs. Slot 57 is closed at its lower end to prevent removal of studs 56 from sleeve 20. Thus it will be seen that the telescoping body sleeve 20 and the magagine sleeve 54 are biased to their maximum extension by the compression spring 58, and the block 18 and driving rod 24 are correspondingly biased away from the magazine 50.

The nailing magazine body 52 is generally rectilinear and may be constructed from a single block of metal having two sides 60 and 62 converging adjacent the path of driving rod 24, such sides 60 and 62 being generally parallel to such path. On one of these sides 62 is provided a series of parallel equally spaced exit opening 64. The block 52 is slotted to provide guideways 66 leading to such openings 64, the guideways 66 being open to the upper surface of the block 52.

The openings 64 and the guideways 66 are of a width to slidably receive the thickness of a nail shank 68.

therein and are of a height to receive a substantial portion but not all of the length of such nail shank **68**. It will be seen from the drawings that such guideways **66** are adapted to receive a number of such nails. The block **52** is provided with a hinged cover **70** and mounted on such casing is a finger **72** corresponding to each such guideway **66** and slidable parallel thereto. Each finger **72** is biased toward the guideway exit opening **64** by a coil spring **74** and each finger **72** extends into a guideway **66** to bear upon the rearmost nail shank **68** therein and thus bias the nails therein toward the guideway opening **64**. The cover **70** is preferably hinged to the block **52** for easy opening for the loading of nails in the guideways **66**.

Each finger **72** is provided with a head **73** adapted to move in an individual guideway **75** in the cover **70**. A key **77** is insertable in slots **79** on each side of the cover. Slots **79** are so located that the key **77** moving therein is adapted to move the fingers **72** collectively away from the conveyor **76**. Thus the magazine is loaded by lifting the cover **70**, thereby moving upwardly the guideway **75**, fingers **72** and spring **74**. The nails may then be inserted in each of the guideways **66** to a convenient depth. The key **77** is then inserted in the slot **79** and the fingers **72** "cocked" to the position remote from conveyor **76**. While in this position the finger **72** and cover **70** are rotated into closed position together, the fingers falling into place in guideway **66** behind the rows of nails therein. When the key **77** is withdrawn, the finger **72** under the impulsion of spring **74** bias the nails in each of the guideways toward conveyor **76**.

It will be noted that the cover **70** is located sufficiently close to block **52** to prevent nails falling out of guideways **66** if the machine is used in an inverted position. A conveyor **76** and an independently movable actuator **78** are provided facing the openings **64** and both are provided with surfaces **81** and **83** respectively adapted to slide on the block surface **62** about said openings, in a direction perpendicular to the longitudinal direction of the openings **64**, the conveyor and actuating member being movable toward and away from the path of driving rod **24**. The conveyor **76** and actuator **78** are two independently slidable members known collectively as "the conveyor members" divided along a line in said sliding direction, the members each being adapted to reciprocate in such sliding direction and such travel being between limits equal to the spacing of the opening **64**. Such limits are known as the "adjacent" and the "remote" limit by virtue of their relationship to the driving rod path. Moreover, each of the members **76** and **78** is provided with grooves **80** and **82** respectively, of a depth to receive the thickness of a nail shank therein and the grooves **80** and **82** are spaced as are the openings **64**. Moreover, the grooves **80** and **82** are so located relative to the limits that a groove **80** and a groove **82** aligns with an opening **64** at either of said limits whereby a nail may be ejected from an opening **64** under the impulsion of fingers **72** into a pair of aligned empty grooves **80** and **82** at a limit; and also a nail ejected from a groove **80** at a limit will be received into a guideway **64** against the biasing pressure of the finger **72**.

It will be seen from Figure 7 that the conveyor **76** is adapted to ride in a wide rectangular groove **90** in the actuator **78** and that each member as its end adjacent the nailing location is provided with a pair of cam studs **92** and **94** respectively adapted to cooperate with the driving rod actuating member. It will be seen that the grooves **80** in the conveyor are generally straight sided, that is, the sides generally project toward the guide way openings **64**. The conveyor actuator **78** is provided with grooves **82** having one straight side but with the side adjacent the driving rod path chamfered to a considerable degree for a purpose to be hereafter noted. A pair of compression springs **96** and **98** connected to the block **52** at the end remote from the driving rod path are connected to studs on the conveyor **76** and actuator **78** and bias

such members strongly in the direction of the driving rod path.

Slidably mounted on the block **52** is a bifurcated cam actuating striker **100** (which is the driving rod actuating member) which projects through slots **102** in the block and has a pair of chamfered surfaces **104** adapted to contact the conveyor members cam studs **92** and **94** and in passage to move each of said studs and its associated member a distance equal to the distance between openings **64**. The actuating striker **100** is provided at its upper extremity with a horizontal surface **105** and with a bolt **106** projecting upwardly therefrom terminating in a head **108**. The sleeve **20** of the block **18** is provided with a lateral projection **110** apertured at **112** to receive the bolt **106** the head thereof being larger than aperture **112**. The projection **110** acts to depress the driving rod actuating member **100** by downward pressure on its upper surface **105** and to lift actuating member **100** by upward pressure on head **108**.

Slots **109** in actuator **100** receive studs **111** on the magazine body. The effect of studs **111** is to bear on the sides of slots **109** during the exertion of cam pressure by the chamfered surfaces **104** whereby the actuator **100** is prevented from binding against adjacent parts of the magazine.

Pivotally mounted on the block **52** on pins **114** at right angles to the driving rod path is a nail support element **115** (shown in Figures 10 and 10*a*) including a concave surface **116** of the same radius as the driving rod path. The concave surface **116** is releasably biased inward to slope inwardly into the driving rod path. A slot **117** with its axis in a vertical plane parallel to the driving rod path provides a passage for magnetic flux from a magnetic element **118** mounted on the nail support element on the side remote from the concave surface **116**.

Spring **121** mounted in a corresponding aperture in body **52** biases the support element about pins **114** based in body **52** into the driving rod path while the support element is supplied with an aperture whose edge forms a shoulder **123** in the lower portion thereof whereby a shoulder **123** is formed to cooperate with an adjustable stop **125** to control the inward slope of the concave surface **116** and vary its slope for various sizes of nails.

The adjustable stop is mounted on the end of bolt **127** to rotate therewith and control the slope of surface **116**. The bolt **127** is threaded and mounted in a correspondingly threaded bore **119** in the body **52** as shown in Figures 2 and 3.

The inward slope of the surface compensates for the differences in diameter of head and point so that the nail is retained in a position aligned with the driving rod path. Thus as the driving rod **24** travels downward following the nail into the material the concave surface **116** pivots back out of the way to allow free travel of driving rod **24**.

As previously mentioned the parts of the nail supply assembly should be of non-magnetic mateiral to avoid interfering with the operation of the magnetic element **118**.

The device is shown in the rest position in Figure 8.

In operation the lower surface of the block **52** is held against the area of the material wherein the nail is to be inserted. The motor is turned on and the operator presses on the handle **11** moving block **18** and sleeve **20** toward the nailing location. Such pressure has the effect of moving the mounting for the cam wheel toward the nailing location while the striker **32**, pulled downward by tension springs **40**, follows the movement of the block **18** while driving rod **24** either follows downward by gravity or by the pressure of striker **32** on head **26**, the position.

However, when the lower extremity of the driving rod **24** contacts the nail head and the nail point contacts the surface of the material, such downward movement of the driving rod **24** is halted, the head **26** bears upwardly on the striker **32** and if downward pressure on the block

18 continues, the head 26 projects above the upper surface of the block 18 to correspondingly raise striker 32 above the surface of the block, against the bias of springs 40. Similarly the bearings 38 will be separated from the cam wheel surfaces 19 during a portion of the cam wheel rotation, the length of the portion depending on the upward projection of head 26 above block 18 and therefore on the pressure exerted.

As the cam wheels 16 rotate, it will be seen that since during the portion of their rotation the wheel surfaces 19 contact the bearings 38, the bearings and therefore the striker are alternately lifted and dropped to supply nailing force to head 26 which is transmitted through driving rod 24 to the nail.

It has been noted that the arc of contact of cam wheel surfaces 19 and bearings 38 decreases as the pressure on block 18 increased. If the pressure is increased sufficiently to cause a greater separation than that taken up by the variation of radius of cam wheel 16, then there will be no contact of cam wheel surfaces 19 and bearings 38 and therefore no striker action, the striker 32 remaining suspended on the bolt and head 26 (see Figures 12 and 13).

Thus no striker action will take place until the pressure is sufficiently decreased. This feature of the invention ensures that the driving strokes on the nail will be relatively light so that the initial strokes will not disalign the nail.

As shown in Figure 11, with proper weight on the handle 11 the repeating strokes of the striker 32 will gradually drive the nail into the material and the block 18 will move gradually downward with the striker 32 following subject to the cyclic oscillation due to the effect of cam wheels 16. Thus the block 18 and its rigidly attached sleeve 20 move toward the magazine block 52 against the bias of compression spring 58.

After a short initial downward movement of sleeve 20 the projection 110 on the sleeve 20 will contact shoulder 105 on the bifurcated actuating member 100 to move it also downwardly.

It should be noted at this point that due to the urging of springs 96 and 98, conveyor 76 and conveyor actuator 78 are moved to their limiting positions adjacent the driving rod path, that is to the position shown in Figure 3.

The beginning of the cycle of operations is described with the sleeves 20 and 54 extended and a nail in the driving rod path ready to be driven so that the grooves 80A and 82A are empty and the conveyor is in the position shown in Figure 3.

The sequence of conveyor operations during the driving of a single nail will now be described:

As the driving rod 24 continues to move the nail into the material, the bifurcated actuator 100 is urged further downwardly and contacts and moves the conveyor actuator 78 away from the driving rod path a distance of roughly half the spacing between the nail grooves 80. The arrangement of the conveyor 76 and the nails is then as illustrated in Figure 4 and the nails have been pushed by the chamfered surfaces of conveyor actuator 78 back into guideways 66 and clear of conveyor 76.

At this point in the travel of actuator 78, the cams 104 on the bifurcated member 100 contact cams 94 as well as 92 to move actuator 78 and conveyor 76 together away from the driving rod path until actuator 78 reaches its limiting position remote from the driving rod path. Conveyor 76 is free to move in this way since all nails were pushed out of the conveyor grooves 80 by the actuator 78. The position at the end of this step is shown in Figure 5.

When the actuator 78 has reached its limiting position the chamfered surfaces 104 have passed the cam studs 94 so that the vertical sides 107 of the bifurcated actuator slides along studs 94 retaining actuator 78 at its remote limit position but causing no movement of the actuator past the remote limit position. The bifurcated actuating member 100, however, continues to move downward and the chamfered surfaces 104 continue to move conveyor 76, by means of studs 92, until the conveyor 76 reaches its remote limit position. The arrangement of the conveyor members is then as shown in Figure 6 which is the position of the various members when the shank 24 has fully driven a nail into the material. It will also be noted that due to the spaces, of the limit positions, the grooves 80 and 82 of the conveyor members are again aligned beneath openings 64 so that the adjacent nails in guideways 66 are urged by fingers 72 into the aligned grooves. It should also be noted that each nail is now located in an aligned groove which is the next groove in the driving rod path direction along the conveyor to that groove in which such nail was received in Figure 3.

Meanwhile as the driving rod 24 travels downward following the nail into the material, the concave surface 116 pivots back out of the way to allow free travel of driving rod 24.

The nail having been driven, the operator releases pressure on casing 10 and sleeve 20 and compression spring 58 bearing on stud 56 moves the sleeve and casing upward relative to block 52 and inner sleeve 54. Projection 110 on sleeve 20 rides up the bolt shank 106 without moving it, until the projection 110 contacts bolt head 108 to move the bifurcated actuating member 100 upwardly. The restraining force of vertical side 107 of member 100 is first removed from cam studs 92, while still restraining cam studs 94. The conveyor 76 does not then start to move since it is locked to actuator 78 by the nails in the aligned grooves. However, when the vertical surface 107 passes above cam studs 94 the actuator 78 is released and with conveyor 76 is snapped back to its position adjacent the driving rod path. Moreover, the nail, contained in the driving rod adjacent aligned grooves 80A and 82A, is moved to just beside the driving rod path and within the range of the magnetic element 118, so that the nail is drawn onto the concave surface 116 to be held for the striking action at the next location. The position of the conveyor members is then as shown in Figure 3. The whole assembly is then moved to a new location and the striking of a new nail initiated.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In an automatic nailing machine a reciprocally movable hammer defining a hammer path, means for supporting a nail at its head and adjacent its tip, said means including a surface releasably biased at its lower end into said hammer path to so support said nail, and a magnet mounted with said surface adapted to draw nails from a nail supply location onto said surface.

2. In a nailing machine, a block, a shank adapted to longitudinally transmit driving force to a nail head and to travel in the same direction as such nail is driven into the wood, the travel of such shank defining a path, means for supporting a nail at its head and adjacent its tip, said means including a member having a concave surface, having its lower end resiliently biased into said nailing stroke path to so support said nail, and a magnet adapted to attract nails on to said concave surface and means for supplying nails to the field of said magnet.

3. A nail driving assembly including: a block, a striker mounted thereon movable with respect to said block, said striker being biased in one direction relative to said block, a pair of cam wheels each having at least one crest and an equal number of troughs rotatably mounted on a common shaft and being so arranged relative to said striker that a part of said striker rides on one cam wheel and a part of said striker rides on the other cam wheel, said striker parts being spaced from one another whereby said striker parts ride on said cams to be moved against said bias by a crest and released to move with said bias by a trough, means for rotating said cam wheel shaft, means located to contact said striker between said

spaced parts to receive the impact of said striker on movement of said striker in one direction and transmitting said impact to the head of a nail.

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