Oct. 22, 1963 A. C. SWANSON 3,107,355

FOOT-GUIDED NAILING MACHINE

Filed Oct. 26, 1960 4 Sheets-Sheet 1

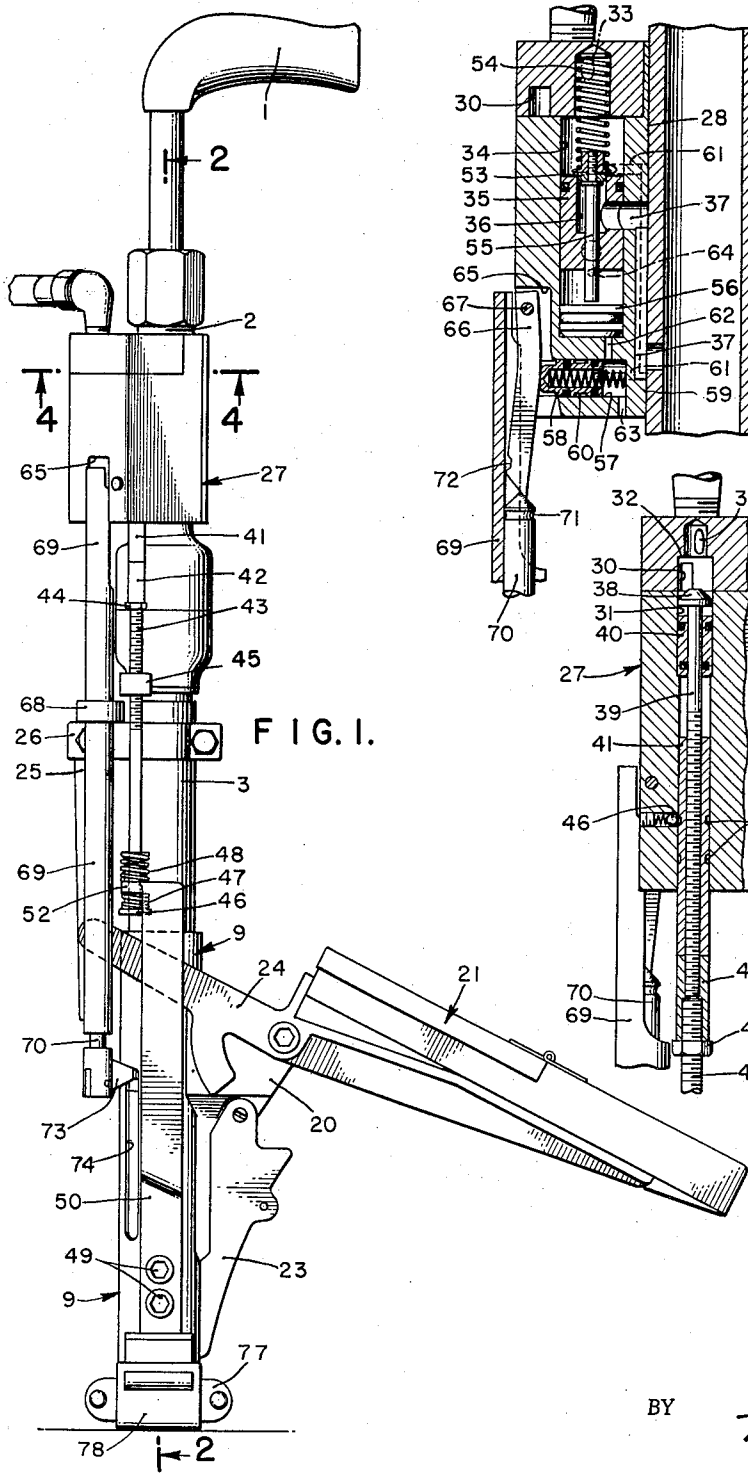

FIG. 1.

FIG. 5.

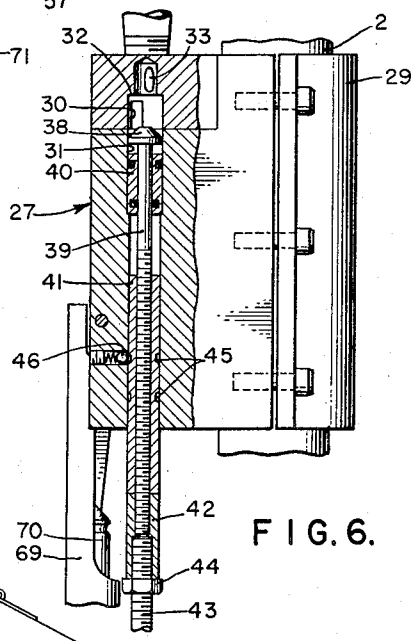

FIG. 6.

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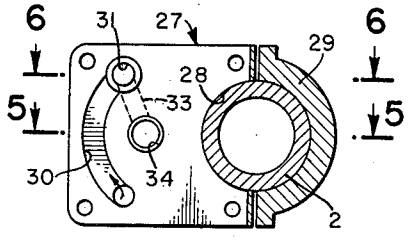

FIG. 4.

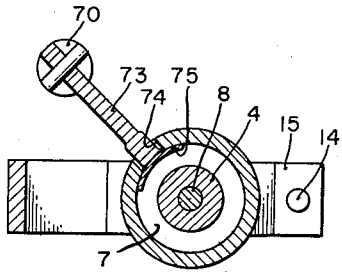

FIG. 7.

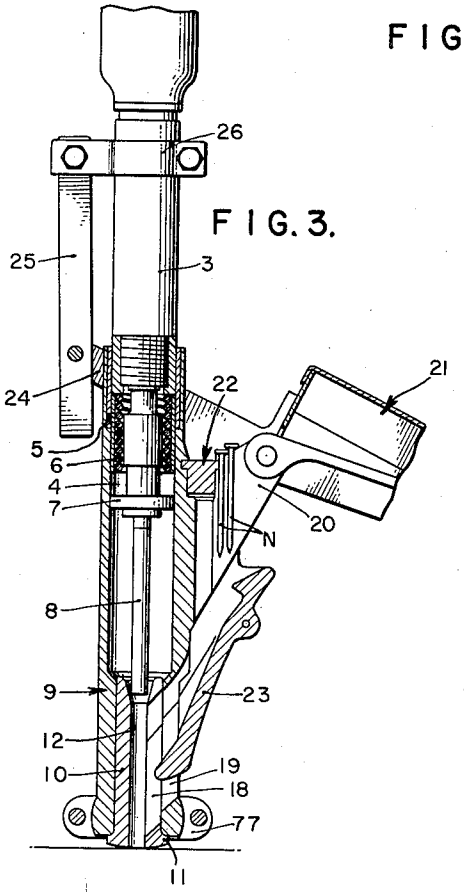

FIG. 3.

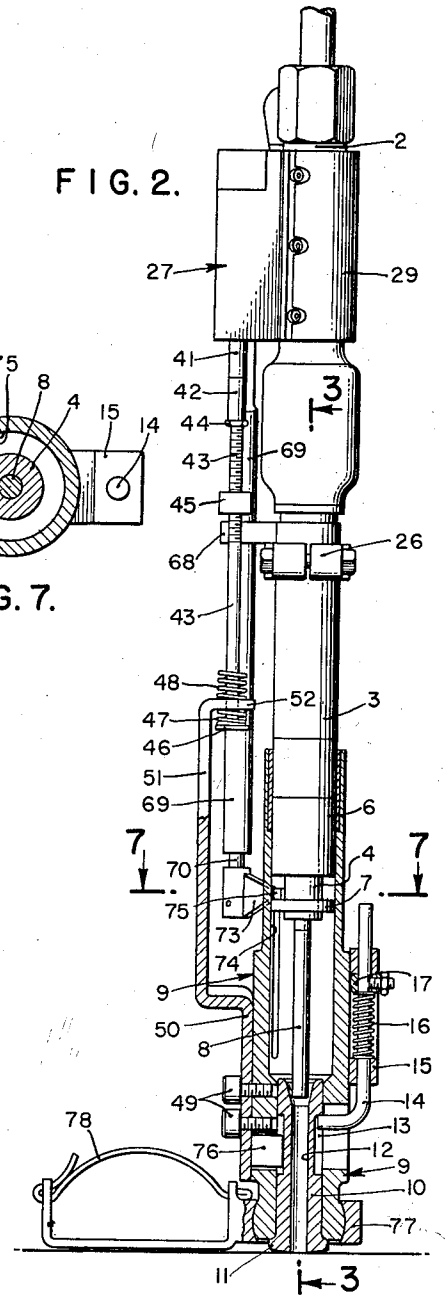

FIG. 2.

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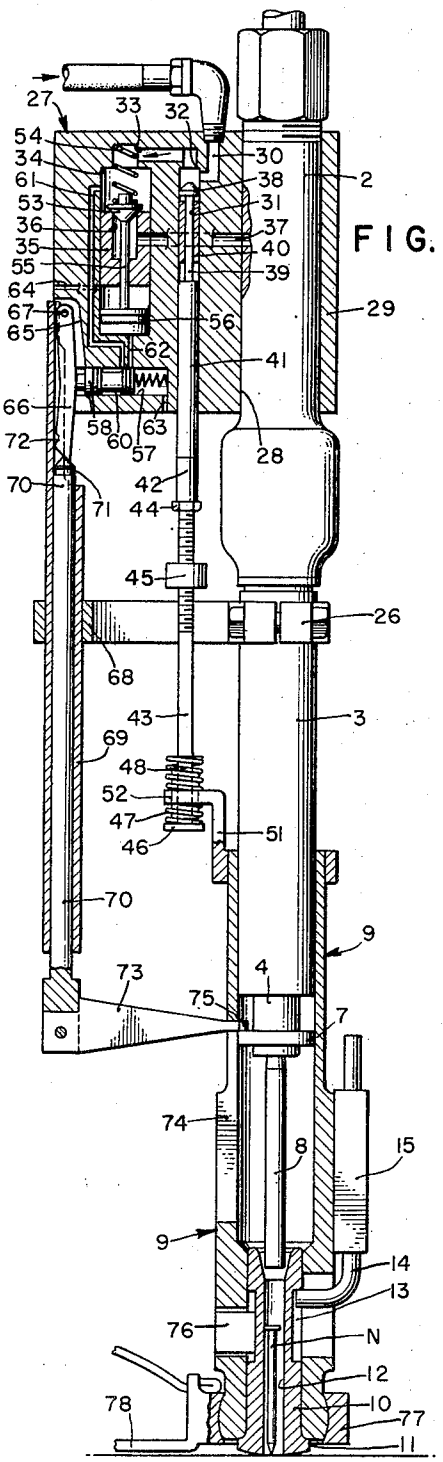

FIG. 8.

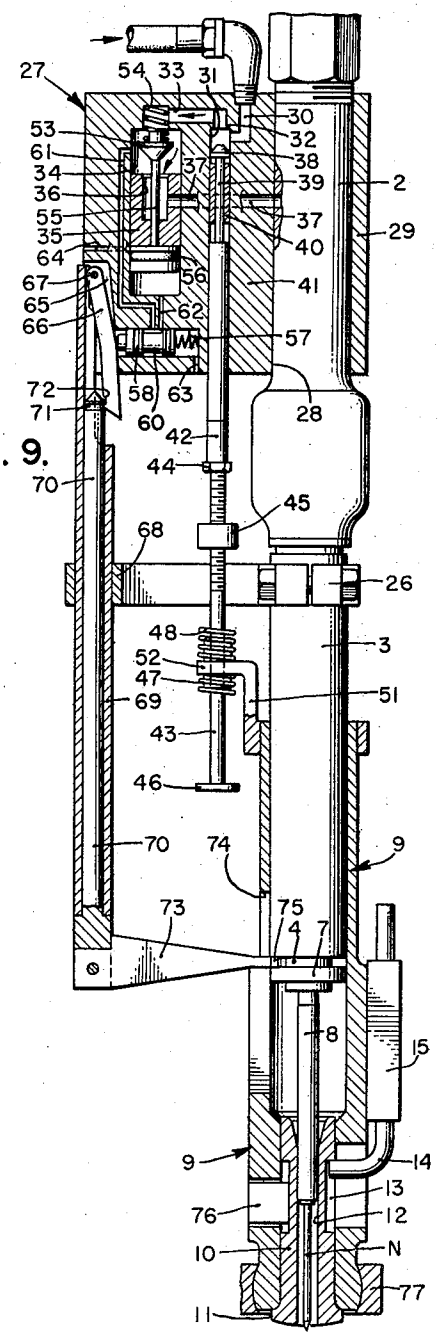

FIG. 9.

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FOOT-GUIDED NAILING MACHINE

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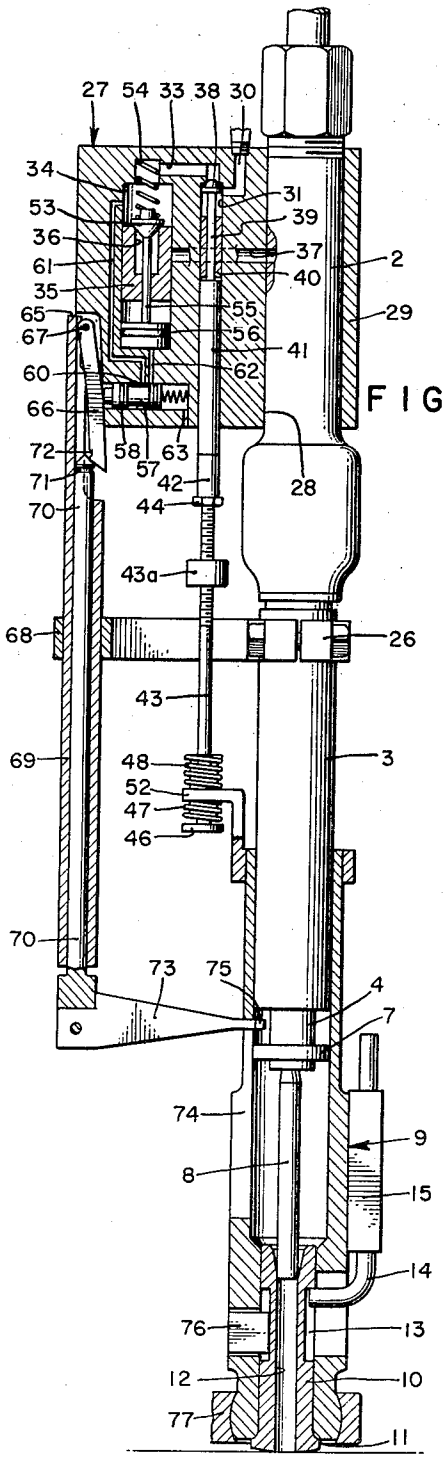
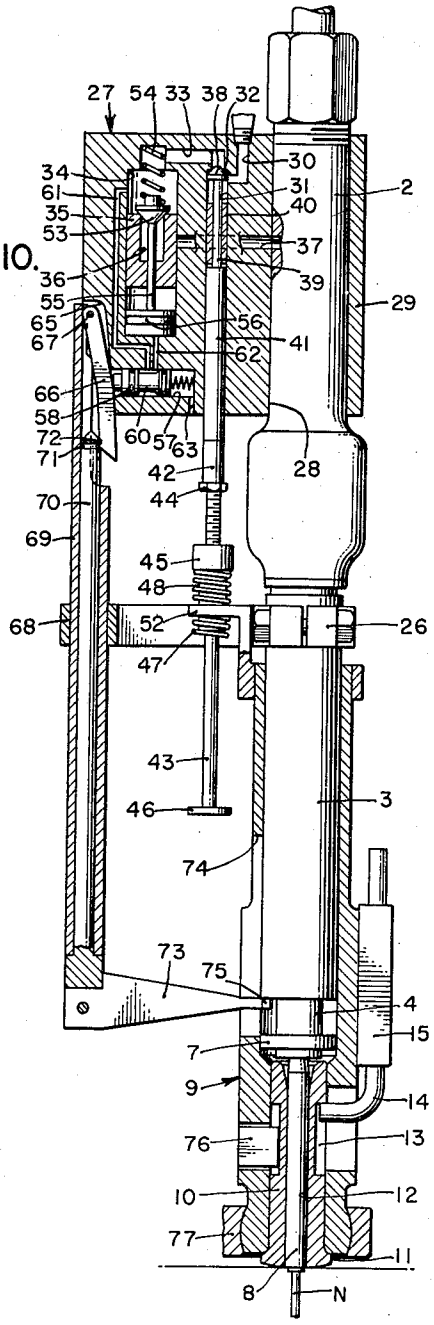


F I G.11.

F I G.10.



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United States Patent Office 3,107,355 Patented Oct. 22, 1963

3,107,355

FOOT-GUIDED NAILING MACHINE

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Filed Oct. 26, 1960, Ser. No. 65,048
6 Claims. (Cl. 1—106)

This invention relates to foot-guided nailing machines, more particularly to nailing machines of the type disclosed in Patent No. 2,546,354 issued March 27, 1951, to C. J. Bacon et al., entitled, "Nailing Machine." Nailing machines of this type are primarily adapted for nailing subroofing and subflooring to rafters and floor joists.

Included in the objects of this invention are:

First, to provide a nailing machine utilizing a power hammer having a nail-driving pin, and which incorporates novel automatic control means whereby the nailing operation automatically commences when the operator sets the machine with a nail in the barrel against a board and moves the nail-driving pin into operative engagement with the nail, and automatically stops when the nail is driven flush or is countersunk a preselected distance so that the quality of the nailing operation is not dependent upon the skill of the operator.

Second, to provide a nailing machine which is so arranged that the power hammer is not activated unless movement of the nail-driving pin is initially arrested by a nail in the barrel of the machine, and with its point bearing against a board or other member underlying the barrel, so that unless a nail is in the barrel and the barrel is held against an underlying surface the nailing operation cannot occur.

Third, to provide a nailing machine having a power hammer which incorporates a novel valve and control means so arranged that the machine may accommodate different lengths of nails without adjustment of the control means, as the power hammer is not activated until the nail is engaged, irrespective of its length, but which may be readily adjusted to ensure that all nails are driven precisely to the desired depth.

Fourth, to provide a nailing machine which incorporates magnetic means associated with the nail-guiding bore to prevent the nail from dropping from the machine as it is moved from one nailing location to another.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIGURE 1 is a side view of a nailing machine with the parts shown in the positions assumed at the start of the nail-driving cycle;

FIGURE 2 is a longitudinal, partial elevational, partial sectional view taken through 2—2 of FIGURE 1 with the handle shown fragmentarily;

FIGURE 3 is a fragmentary, partial sectional, partial elevational view taken through 3—3 of FIGURE 2, that is, in a plane parallel with FIGURE 1;

FIGURE 4 is an enlarged, transverse, sectional view taken through 4—4 of FIGURE 1, showing particularly the inlet passages to the valve mechanism;

FIGURE 5 is an enlarged, fragmentary, sectional view taken through 5—5 of FIGURE 4 showing the valve mechanism;

FIGURE 6 is a fragmentary, partial sectional, partial side view taken through 6—6 of FIGURE 4 showing another portion of the valve mechanism;

FIGURE 7 is an enlarged, transverse, sectional view taken through 7—7 of FIGURE 2, illustrating the relationship of the valve-operating finger with the operating end of the pneumatic hammer assembly;

FIGURES 8, 9, 10, and 11 are substantially diagrammatical views with the parts rearranged to bring them

into a common plane, in order to illustrate the operation of the nailing machine. More particularly, FIGURE 8 shows the relationship of the parts of a machine at the commencement of the nailing cycle before engagement of the nail by the nail-driving pin; FIGURE 9 illustrates a subsequent position in which the nail-driving pin has moved into engagement with the nail; FIGURE 10 shows a subsequent position of the machine when the nail has been driven to its final position; and FIGURE 11 shows the position of the parts as the nail-driving pin is being retracted just before movement to the initial position shown in FIGURE 8.

The foot-guided nailing machine utilizes a pneumatic hammer assembly which may be in most respects conventional. The hammer assembly includes a handle 1 which in the conventional hammer assembly may also serve as the means for conducting air to the hammer. In the exercise of the present invention, the air is supplied through the side of the pneumatic hammer assembly, as will be described hereinafter, and the passage through the handle is closed off.

Below the handle 1 the hammer assembly includes a tubular stem 2 which is joined to a conventional cylinder structure 3 from which protrudes a reciprocable plunger 4. In the exercise of the present invention, the cylinder structure is modified by the addition of a sleeve 5 which encloses the upper portion of the plunger 4 and also encloses a conventional retainer spring 6. The plunger 4 is modified to form a flange 7. The lower end of the sleeve 5 and the upper side of the flange 7 serve to operate a control means for a valve structure which will be described hereinafter.

Fitted in the lower end of the plunger 4 is a nail-driving pin 8. The lower end of the pneumatic hammer assembly, that is, the lower end of the cylinder structure 3 and sleeve 5 are adapted to enter a cylindrical barrel 9. The lower end of the barrel 9 is reduced in diameter internally to receive a cylindrical nosepiece 10. The nosepiece 10 protrudes slightly from the lower end of the barrel 9 and is provided with an external flange 11 to limit upward movement of the nosepiece within the barrel 9.

The nosepiece 10 is provided with a central bore 12 adapted to receive nails N, and also to receive the nail-driving pin 8 so that nails may be driven downwardly through the bore 12 into an underlying board.

At least one side of the nosepiece 10 is provided with a groove 13 which receives the lower inturned end of an L-shaped retainer bar 14. The retainer bar includes an upright portion extending vertically through a guide member 15 secured to the side of the barrel 9. The vertical portion of the retainer bar 14 receives a spring 16 and an adjustable collar 17. The retainer bar yieldably retains the nosepiece 10 within the barrel 9.

At approximately right angles to the groove 13, the nosepiece 10 is provided in its side wall with a nail-receiving slot 18 which registers with a nail-receiving slot 19 formed in the barrel 9. Extending upwardly from the slotted side of the barrel 9 is a bracket 20 which pivotally mounts a nail hopper 21. The bracket 20 also incorporates a nail-feeding mechanism 22 so that nails may be dropped, one at a time, downwardly alongside the barrel 9. The nails when dropped are deflected by a pivotally mounted guide finger 23 into the slots 19 and 18 for delivery to the bore 12 of the nosepiece 10. The nail hopper 21 includes a hopper arm 24 which extends across and at one side of the axis of the barrel 9, and is connected by a link 25 to a clamp 26 secured to the upper portion of the cylinder structure 3.

Except for minor changes in the construction of the pneumatic hammer assembly to facilitate cooperation

with the valve structure forming a part of the present invention, the previously described structure may be considered as conventional and is in fact more completely disclosed in the previously mentioned Patent 2,546,354. More particularly, the background structure for cooperation with the present invention involves the barrel 9 and nosepiece 10 with means for feeding nails, one at a time, so as to be received in the bore 12 for engagement by the nail-driving pin 8 and the associated pneumatic hammer assembly which is adapted to be manually reciprocated relative to the barrel 9 so as to maintain the nail-driving pin 8 in engagement with the nail during the driving operaton and to raise the nail-driving pin so that a succeeding nail may be received in the bore 12. In the exercise of the present invention, a novel valve mechanism is provided which is designed to supply air to the pneumatic hammer, as the nail-driving pin 8 is brought manually into position for engagement with a nail, and automatically terminates the supply of air to the hammer when the nail has been driven, either flush with an underlying board or has been countersunk a predetermined distance therein.

The valve mechanism includes a valve body 27 which is provided with a semicylindrical side 28 held against the tubular stem 2 by a mating semicylindrical clamp member 29. The upper side of the valve body 27 is provided with an inlet passage 30 which communicates with the side of a primary valve bore 31 disposed vertically in the valve body 27. The upper end of the primary valve bore 31 is provided with a shoulder which forms a valve seat 32 controlling the flow through a connecting passage 33, which leads to the upper end of a secondary valve bore 34 also disposed vertically in the valve body 27. The secondary valve bore 34 is provided intermediate its ends with a liner 35 having a socket 36 therein, the upper end of which forms a valve seat. The liner 35 is provided with a side port which communicates through a passage 37 to the interior of the tubular stem 2. The passage 37 may include a vertical channel defined by confronting walls of the cylindrical side 28 of the valve body 27 and the tubular stem 2, as shown best in FIGURE 5.

The primary valve bore 31 is provided with a primary valve 38 which engages the valve seat 32. The primary valve is provided with a downwardly extending valve stem 39 which extends downwardly through a guide liner 40 having suitable sealing elements. The lower portion of the valve stem 39 below the guide liner 40 is provided with an extended screw-threaded portion on which is screw-threaded an adjustable sleeve 41. The lower end of the valve stem 39 protrudes from the sleeve 41 and is screw-threaded into a lock collar 42, which in turn is screw-threaded onto the upper end of a connecting rod 43 and secured thereto by a lock nut 44. The adjustment sleeve 41 is provided with a pair of spaced detent grooves 45, either one of which is engageable by a ball detent 46 so as to retain the primary valve 38 either in an open position, as indicated in FIGURE 6, or in its closed position.

The connecting rod 43 is provided with an extended screw-threaded portion which receives an adjustable stop nut 45. The lower end of the connecting rod 43 terminates in an end flange 46. Above the end flange 46 the connecting rod 43 receives a lower and upper cushion spring 47 and 48. Secured to the side of the barrel 9, opposite from the retainer bar 14, by means of screws 49, is a strap 50 which extends upwardly and forms an offset portion 51 terminating at its upper end in a horizontal bracket 52. The bracket 52 guides the lower end of the connecting rod 43 and is interposed between the cushion springs 47 and 48. As will be brought out hereinafter, manual relative movement of the pneumatic hammer assembly and the barrel 9 effects movement of the primary valve 38 between its open and closed positions.

The secondary valve bore 34 receives a secondary valve 53 adapted to engage the valve seat formed at the upper end of the liner socket 36. A spring 54 disposed above the secondary valve 53 tends to hold the valve on its seat. The liner 35 is fixed in position by a screw indicated by dotted lines in FIGURE 5. The secondary valve 53 is provided with a stem 55 which extends downwardly through the liner 35. Freely slidable in the secondary valve bore 34 below the liner 35 is a shuttle plunger 56 which is urged downwardly by the stem 55.

The valve body 27 is provided below the secondary valve bore 34 with a pilot valve bore 57, preferably extending horizontally into the valve body from one side thereof. Slidably mounted in the pilot valve bore 57 is a pilot valve 58, the outer end of which is adapted to protrude from the bore 57 and the valve is urged outwardly by a spring 59. The pilot valve 58 is provided with an annular groove 60 isolated from the pilot valve bore 57 by suitable seal rings. An air supply passage 61 extends from the upper part of the secondary valve bore 34 above the liner 35 to the side of the pilot valve bore 57 for communication with the annular groove 60. A connecting passage 62 axially offset from the air supply passage 61, with respect to the pilot bore 57, communicates between the pilot valve bore and the lower end of the secondary valve bore 34. At the extreme inner end of the pilot valve bore 57 there is provided an exhaust or vent passage 63 extending to the outside of the valve body 27. The relationship of the passages 61, 62, and 63 with respect to the pilot valve bore 57 and pilot valve 58 is such that the pilot valve 58 may occupy an outer or extended position such as shown in FIGURE 5, whereby the connecting passage 62 and exhaust passage 63 afford communication with the lower end of the secondary valve bore 34; and occupy an axially inner position in which the air supply passage 61 and the connecting passage 62 are in communication. Immediately below the liner 35, the secondary valve bore 34 is also provided with an exhaust passage 64.

The valve body 27 is provided with a vertical slot 65 which intersects the outer end of the pilot valve bore 57. Pivotally mounted in the slot 65 is a latch lever 66, a pivot pin 67 being provided at a level above the pilot valve bore 57 so that the latch lever 66 depends therefrom and extends below the valve body 27.

The clamp 26, which is connected by the link 25 to the hopper arm 24, may also include a bracket arm 68, which secures a vertically disposed guide tube 69. The upper end of the guide tube 69 is cut away on one side and its remaining side overlies the slot 65 so as to cover the latch lever 66. An operating rod 70 is slidably mounted in the guide tube 69. The upper end of the operating rod 70 is beveled and provided with a latch notch 71 which cooperates with the beveled lower end of the latch lever 66 and a notch 72 adjacent thereto.

The operating rod 70 is provided with a laterally extending finger 73 adapted to extend through a slot 74 formed in the barrel 9. The tip end of the finger 73 terminates in an arcuate portion 75 adapted to fit in the annular groove or channel formed between the sleeve 5 and the flange 7.

In order to prevent loss of nails from the bore 12 of the nosepiece 10, the nosepiece and adjacent wall of the barrel 9 are slotted to receive a magnet 76, which may be retained in place by the lower end of the strap 50. To facilitate use of the magnet 76, the nosepiece 10 and barrel 9 are formed of nonmagnetic material.

The lower end of the barrel 9 forms a spherical zone and is adapted to receive a correspondingly-shaped collar 77 for limited universal movement. Extending laterally of the collar 77 is a stirrup 78 adapted to receive a person's foot. The stirrup 78 is a conventional part of the nailing machine, and is also shown in Patent No. 2,546,354.

Operation of the foot-guided nailing machine is as follows:

The nailing machine is lifted slightly and moved from place to place by the operator's foot. The operator also raises and lowers the handle **1** to move the pneumatic hammer assembly relative to the barrel **9**, and at the same time to actuate the nail hopper **21** and nail-feeding mechanism **22** so that nails may be delivered, one at a time, with each raising and lowering of the handle **1** to the slots **19** and **18**, so as to be received, one at a time, in the bore **12** of the nosepiece **10**. In this respect the operation of the machine is essentially the same as that shown in the above-mentioned patent.

The herein described valve mechanism which controls the supply of air to the pneumatic hammer is best illustrated in the diagrammatical views in FIGURES 8, 9, 10, and 11. In this regard, it should be noted that the valve body **27** is fixed to the pneumatic hammer assembly and moves therewith.

With reference first to FIGURE 8, when a nail has been received in the bore **12** of the nosepiece **10** and the pneumatic hammer assembly including the valve body **27** has been raised to its upper extreme position, the bracket **52** of the strap **50** has engaged the lower cushion spring **47** so as to draw the primary valve **38** downward to permit the flow of air from the inlet passage **30** to the secondary bore **34**. In this condition of the valve structure, the secondary valve **53** is held against the valve seat at the upper end of the socket **36** and the liner **35**; the shuttle plunger **56** is in its lower position; the pilot valve **58** is in its outer position so that both sides of the shuttle plunger **56** are exposed to atmospheric pressure. With this arrangement of the parts, air does not flow to the pneumatic hammer.

Reference is now directed to FIGURE 9. When the pneumatic hammer assembly and valve body are moved downward until movement of the nail-driving pin **8** is arrested by a nail in the bore **12**, the flange **7** engages the finger **73** so that downward movement of the rod **70** is also arrested. This causes the upper end of the rod **70** to engage the latch lever **66** so as to force the pilot valve **58** inward, thereby connecting passages **61** and **62** to the groove **60** so as to supply air to the underside of the shuttle plunger **56**. Upward movement of the shuttle plunger **56** raises the stem **55** and secondary valve **53**, so as to raise the valve from its seat and permit the flow of air to the pneumatic hammer assembly and initiate the nail-hammering operation.

Reference is now directed to FIGURE 10. Flow of air continues until the adjustable stop nut **45** engages the upper cushion spring **43** so that the primary valve **38** is moved to its closed position. The level in the downward movement of the nail-driving pin **8** at which the air supply is cut off may be accurately predetermined by the adjustable stop nut **45**. Consequently, the nail may be driven flush with an underlying board or countersunk a preselected distance. When the air supply to the primary valve **38** is shut off, air supply through the pilot valve to the underside of the shuttle plunger **56** is also shut off, consequently the spring **54** returns the secondary valve **53** to its seat. The operating rod **70** and latch lever **66**, however, remain interengaged.

Reference is now directed to FIGURE 11. When the pneumatic hammer assembly and valve structure is raised from the position shown in FIGURE 10 toward the position shown in FIGURE 8, the finger **73** connected to the operating rod **70** engages the upper extremity of the slot **74**, so that continued upward movement of the pneumatic hammer assembly and valve structure raises the latch lever **66** out of engagement with the operating rod **70**. By reason of interengagement between the lower cushion spring **47** and the bracket **52**, the pilot valve **57** is permitted to move to its outer position shown in FIGURE 8. Until the pneumatic hammer assembly and valve structure are fully raised, the conditions shown in FIGURE 8 obtain.

During the nail-driving cycle, that is, during the movement of the nail-driving pin **8** from the position shown in FIGURE 9 to the position shown in FIGURE 10, and the return movement of the nail-driving pin **8** to its upper position shown in FIGURE 8, a new nail is received in the bore **12** of the nosepiece **10** so that the cycle of operations represented by FIGURES 8, 9, 10, and 11 may be repeated.

It will be observed that until the downward movement of the nail-driving pin **9** is arrested by a nail in the bore **12**, the pneumatic hammer remains inactivated. Thus the nail itself must be held from movement by engagement of its point with an underlying board or other member. If the barrel is raised or if there is no nail in the bore **12**, the pneumatic hammer remains inactivated.

It will also be observed that without adjustment various lengths of nails may be accommodated, as the pneumatic hammer will not begin its operation until a nail is engaged by the nail-driving pin **8**.

While a particular embodiment of this invention has been shown and described, it is not intended to limit the same to the exact details of the construction set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. A nailing machine, comprising: a pneumatic hammer assembly including a nail-driving element; a barrel structure defining a bore for receiving a nail and said driving element, and means for feeding nails in sequence to said bore; means connecting said assembly and structure for operating said feeding means and manually operable for moving said driving element in said bore; a control valve mounted on said pneumatic hammer assembly and including first and second series related valve units for controlling the flow of air to said pneumatic hammer assembly; a first control means engageable with said barrel structure prior to engagement of said driving element with a nail in said barrel structure bore to open said first valve unit, and engageable with said barrel structure when said nail-driving means has driven a nail a predetermined distance to close said first valve unit; and a second control means engageable with said nail-driving element and said barrel structure to open said second valve unit subsequent to said first valve unit and initiate operation of said pneumatic hammer assembly as said nail-driving element engages a nail in said barrel, and to close said second valve unit prior to opening of said first valve unit.

2. In a nailing machine having a pneumatic hammer assembly including a nail-driving element, a barrel structure having a nail-receiving bore, and means for feeding nails to said bore, wherein said pneumatic hammer assembly and barrel structure are relatively movable manually to operate said nail-feeding means and to bring said nail-driving element into operative engagement with a nail in said bore, a control means for said pneumatic hammer, comprising: a valve body mounted on said pneumatic hammer assembly for movement therewith; series-related primary and secondary valve units in said valve body for controlling flow of air to said pneumatic hammer assembly; primary and secondary control devices for said valve units operably connected with said pneumatic hammer assembly and with said barrel structure; said primary control device including setting means operable to open said primary valve when said nail-driving element is positioned to permit entry of a nail into the bore of the barrel structure, and adjustable terminating means operable after said nail-driving element has driven a nail a predetermined distance to close said primary valve unit; said secondary control device including means operable subsequent to said setting means to open said secondary valve as said nail-driving element engages a nail in said bore, to initiate operation of said driving means, and to close said secondary valve after operation of said terminating means thereby to reset said secondary valve unit for subsequent operation of said setting means.

3. In a nailing machine having a pneumatic hammer assembly including a nail-driving element, a barrel structure having a nail-receiving bore, and means for feeding nails to said bore, wherein said pneumatic hammer assembly and barrel structure are relatively movable manually to operate said nail-feeding means and to bring said nail-driving element into operative engagement with a nail in said bore, a control means for said pneumatic hammer, comprising: means responsive to relative movement of said pneumatic hammer assembly and barrel structure as said nail-driving element engages a nail in the bore of said barrel structure to initiate operation of said pneumatic hammer assembly thereby to drive a nail from said bore; and adjustable means to terminate operation of said pneumatic hammer assembly when said nail has been driven a predetermined distance.

4. A control means for a nailing machine having a pneumatic hammer assembly including a nail-driving element, a barrel structure having a nail-receiving bore, and means for feeding nails in sequence to said nail-receiving bore, said pneumatic hammer assembly being relatively movable manually to operate said nail-feeding means, and to move said nail-driving element into engagement with a nail in said bore, further movement of the nail-driving element being arrested when the point of the nail rests against a board underlying the barrel structure, said control means comprising: a valve structure mounted on said pneumatic hammer assembly including a series-related primary and secondary valve unit; a primary control operable to open said primary valve unit when said pneumatic hammer assembly and barrel structure are relatively positioned for delivery of a nail to said nail-receiving bore, and to close said primary valve unit when a nail has subsequently been driven a predetermined distance by said nail-driving means; and a secondary control sensitive to said arresting of said nail-driving means by a nail in said nail-receiving bore to open said secondary valve unit thereby to initiate operation of said pneumatic hammer assembly.

5. A nailing machine, comprising: a pneumatic hammer assembly including a cylinder structure and a hammer structure having limited movement relative to said cylinder structure and terminating in a nail-driving element; a barrel structure adapted to receive said cylinder structure and hammer structure and having a nail-receiving bore also adapted to receive said nail-driving element; said pneumatic hammer assembly and barrel structure adapted to occupy a relatively extended position to receive a nail in said bore under said nail-driving element, and a relatively retracted position to displace a nail from said bore by said nail-driving element, movement of said nail-driving element being arrested when the point of said nail rests on a board underlying said barrel structure, thereby to cause relative movement between the nail-driving element and the cylinder structure of said pneumatic hammer structure; and a valve structure for controlling said pneumatic hammer assembly including means sensitive to said relative movement of said nail-driving element and said cylinder structure when movement of said element is arrested by a nail in said nail-receiving bore to initiate operation of said pneumatic hammer assembly and said nail-driving element, and means operable to terminate operative of said pneumatic hammer assembly when said nail has been driven a predetermined distance.

6. A nailing machine, comprising: a pneumatic hammer assembly including a cylinder structure and a hammer structure having limited movement relative to said cylinder structure and terminating in a nail-driving element; a barrel structure adapted to receive said cylinder structure and hammer structure and having a nail-receiving bore also adapted to receive said nail-driving element; said pneumatic hammer assembly and barrel structure adapted to occupy a relatively extended position to receive a nail in said bore under said nail-driving element, and a relatively retracted position to displace a nail from said bore by said nail-driving element, movement of said nail-driving element being arrested when the point of said nail rests on a board underlying said barrel structure, thereby to cause relative movement between the nail-driving element and the cylinder structure of said pneumatic hammer structure; a valve body mounted on said pneumatic hammer assembly including a first valve unit and a second valve unit disposed in series; setting means for opening said first valve unit when said pneumatic hammer assembly and barrel structure are relatively extended; initiating means sensitive to arresting of said nail-driving element by a nail in the bore of said barrel structure to open said second valve thereby to initiate operation of said pneumatic hammer assembly; and adjustable terminating means connected with said setting means for terminating operation of said pneumatic hammer assembly when said nail has been driven a predetermined distance.

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