

Feb. 17, 1942.

J. L. HUNTER ET AL

2,273,268

METHOD AND APPARATUS FOR DRIVING NAILS

Original Filed March 24, 1937

3 Sheets-Sheet 1

Fig. 1.

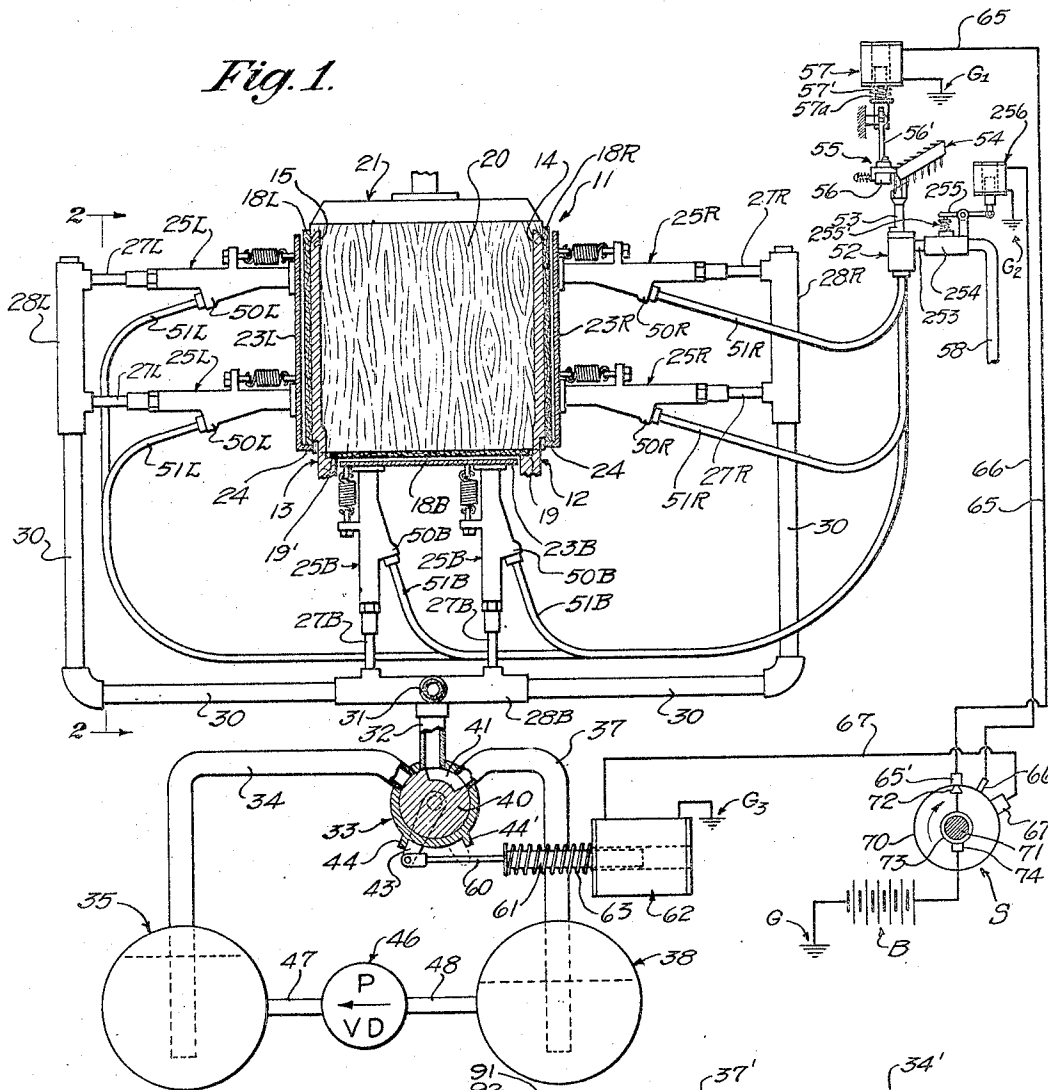
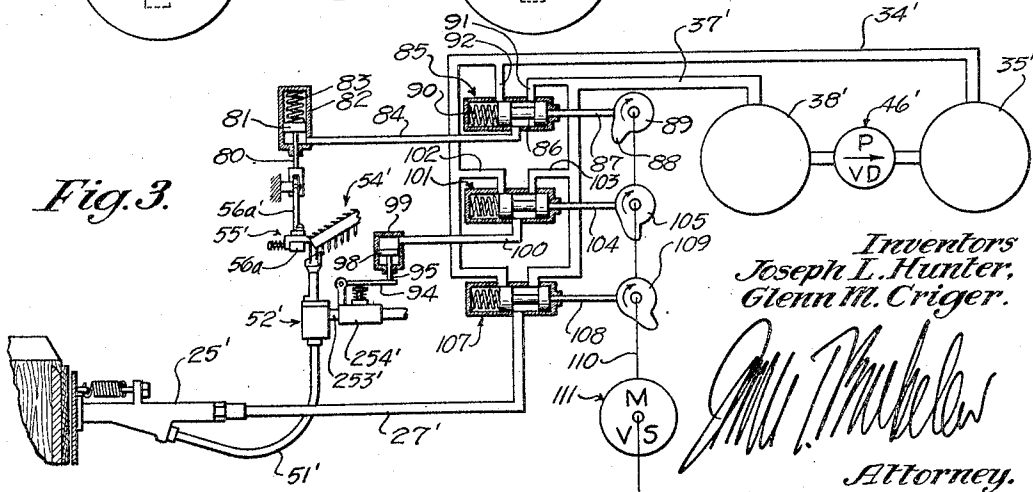


Fig. 3.



Inventors
Joseph L. Hunter,
Glenn W. Criger.

Attorney.

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3 Sheets-Sheet 2

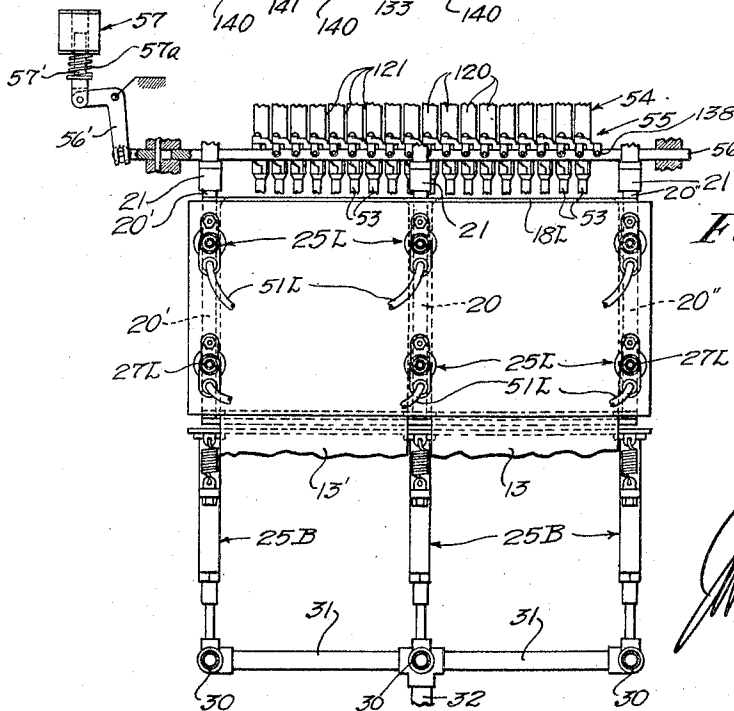
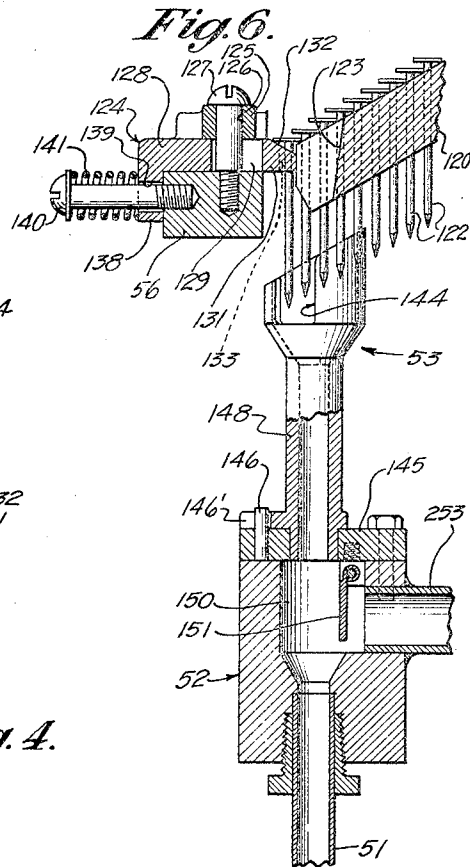
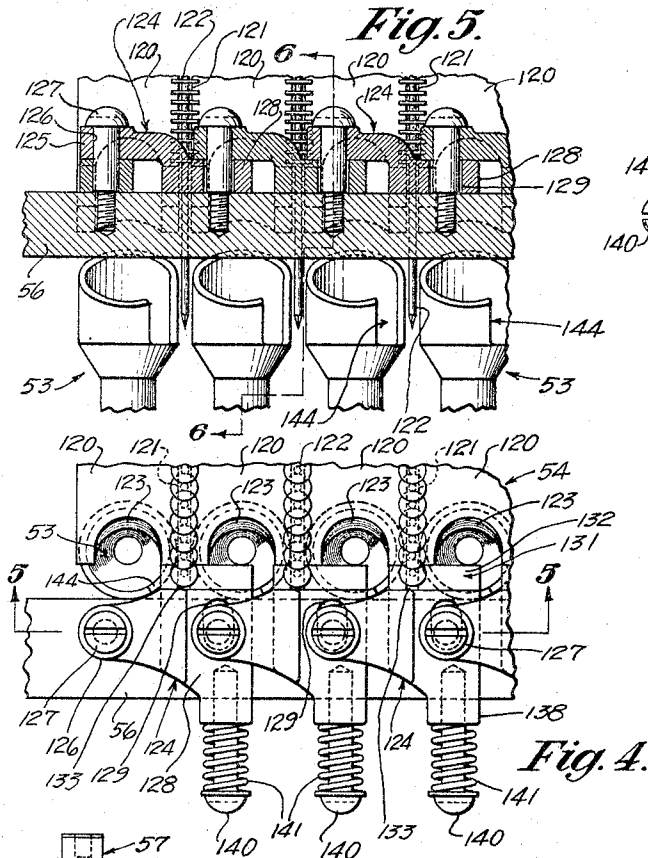


Fig. 2.

Inventors
Joseph L. Hunter,
Glenn M. Criger.

Attorney.

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3 Sheets-Sheet 3

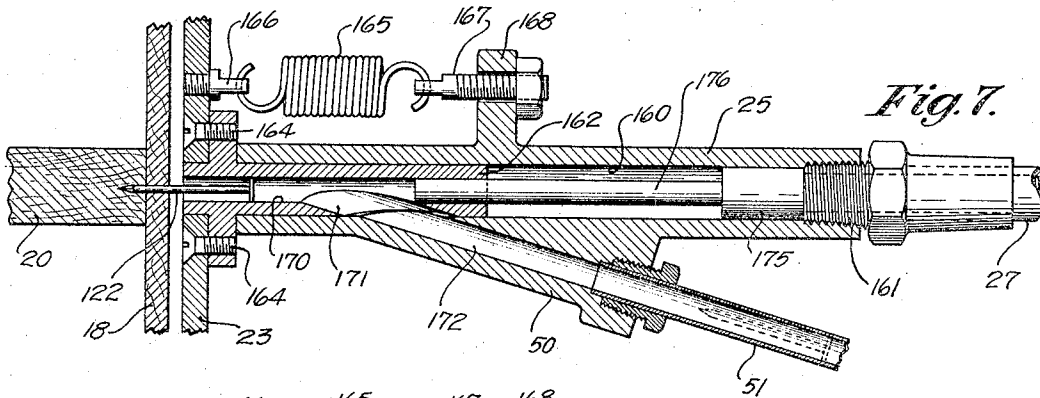


Fig. 7.

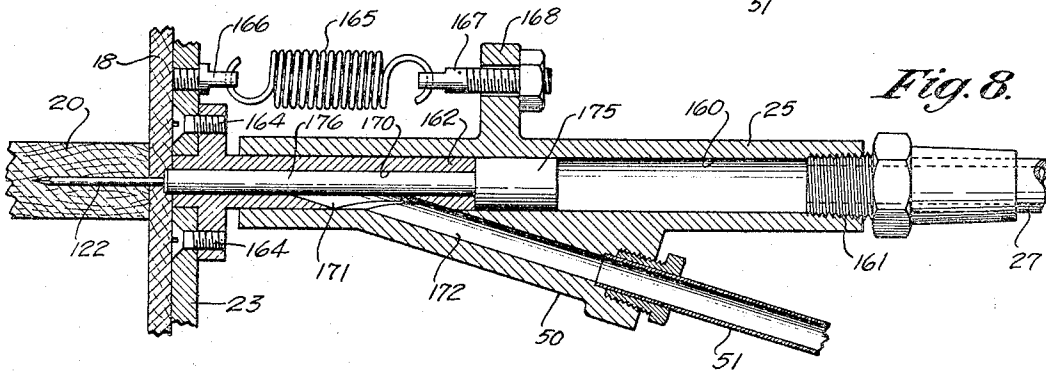


Fig. 8.

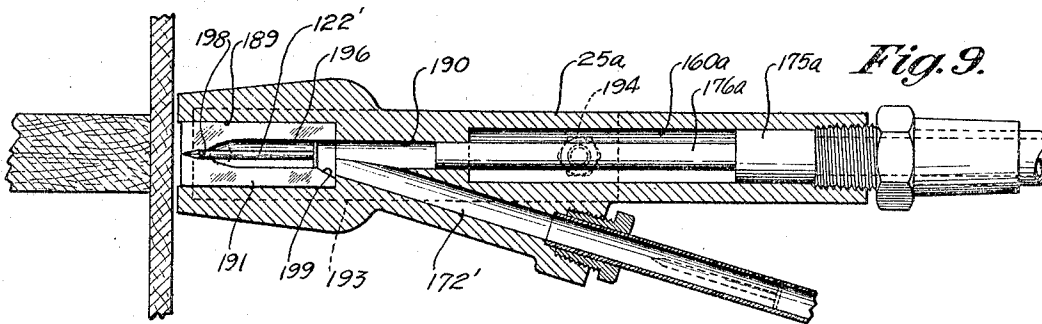


Fig. 9.

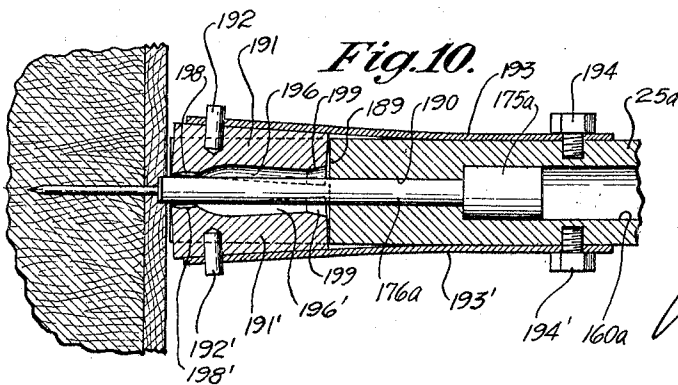


Fig. 10.

Inventors
Joseph L. Hunter,
Glenn M. Criger.

Joseph L. Hunter

Attorney.

UNITED STATES PATENT OFFICE

2,273,268

METHOD AND APPARATUS FOR DRIVING NAILS

Joseph L. Hunter and Glenn M. Criger, Riverside, Calif.; said Criger assignor to said Hunter

Substituted for abandoned application Serial No. 132,802, March 24, 1937. This application April 21, 1941, Serial No. 389,626

24 Claims. (Cl. 1—10)

This invention has to do in a general way with nailing machines and is more particularly directed to improvements in such machines which find special application in connection with box-making machinery.

This application is a re-file of application Serial No. 132,802, filed March 24, 1937, by Joseph L. Hunter and Glenn M. Criger, entitled "Method and apparatus for driving nails."

As is well known to those familiar with the art, the conventional box making machine consists in a general way of a form adapted to support and turn the box heads, the shook or side slats being nailed to the heads on one side at a time, such sides being located in a horizontal plane during the nailing operation. The nails are individually delivered from strippers by means of nail picks into funnels through which they fall into nail delivery tubes being guided by such tubes under the action of gravity into chucks from which they are driven by a plurality of driving plungers carried on a single operating head.

It is one object of this invention to materially increase the speed of operation over that in the conventional nailing machine by providing a box making machine in which all three sides of the box are nailed in a single operation, thus eliminating the time usually consumed in turning the box three times in order to complete its fabrication. In this same connection, our invention contemplates the production of a box making machine in which the zone for feeding the nails for all three sides of the box is located in a single region positioned at any predetermined point in respect to the remainder of the machine, thereby facilitating the observation and control of the nail feeding unit.

It is a further object of this invention to provide a box making machine of the class described, which will require less power for its operation than conventional machines, and which will operate with increased efficiency. In this connection our invention contemplates a material reduction in the weight of the moving parts and the counter balanced actuation of all of the nail driving plungers. Also, our invention contemplates through the feature of nailing three sides of the box at once, the opposed action of the driving forces on two of the opposite sides of the box.

As an instrumental means for accomplishing the objectives numerated above, our invention contemplates as one of its primary features, a nailing machine or a nail driving unit in which the nails are pneumatically driven or propelled

into driving location from the feeding unit in which they are received from the pick. Through the use of this pneumatic feed, we obtain a nailing unit in which the nails may be driven in any direction. Furthermore, we have discovered that through the use of our pneumatic feed we are able to drive the nails into at least partial penetration with the work to be nailed, from which position the head of the nail can be struck to drive it home. It will thus be seen that in one form of our invention the device can be incorporated in a machine which will operate effectively and efficiently without the use of the conventional chuck. In this same connection, however, our invention contemplates a machine in which the nails can be driven in any direction into chucks which will support such nails in normal relation with the work into which they are to be driven.

Although various means may be employed for striking the head of the nail to drive it home in a machine of the general character outlined above, our invention contemplates as a preferred combination, the use of a machine in which the nail driving plungers are hydraulically actuated. This arrangement materially reduces the weight of the moving parts and has a particular advantage in a machine such as a box making machine, where a plurality of the nail driving units are arranged for simultaneous operation upon three sides of the box. The use of the hydraulic drive in a machine of this character permits the counter balanced action of all of the driving plungers and affords convenient means for compensating for different widths in the side shook used in fabricating the boxes.

In this last mentioned connection, our invention also contemplates stop means which are associated with the driving plungers and which are so arranged with respect to the driving plungers that all of the nails will be uniformly countersunk a predetermined amount.

Our invention also contemplates as an important feature, the provision of a novel nail feeding funnel which is particularly adapted for use in conjunction with the pneumatic nail feeding mechanism, such funnels being so designed as to constitute a safety mechanism which will prevent the admission of bent or deformed nails to the nail delivery tube, thereby avoiding the possibility of the tubes becoming blocked or jammed through the admission of deformed nails.

As a feature toward the embodiment of our invention in a machine that operates entirely automatically or semi-automatically, the inven-

tion also contemplates means for controlling the operation of the nail pick, the pneumatic feed, and the hydraulic drive, in timed relation with each other.

The details in the construction of a preferred embodiment of our invention, together with other objects attending its production, will be best understood from the following description of the accompanying drawings which are chosen for illustrative purposes only, and in which:

Fig. 1 is an end elevation with parts in section and with conventional parts diagrammatically shown, which illustrates a preferred embodiment of the box making machine contemplated by this invention;

Fig. 2 is a side elevation taken in the plane represented by the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic elevation with parts in section illustrating a modified form of valve and valve actuating mechanism for controlling different elements of the box making machine, contemplated by this invention, in timed relation with each other;

Fig. 4 is a fragmentary plan view illustrating a preferred form of nail pick contemplated by this invention;

Fig. 5 is a sectional elevation taken in a plane represented by the line 5—5 of Fig. 4;

Fig. 6 is an offset sectional elevation taken along the line 6—6 of Fig. 5;

Fig. 7 is a sectional elevation illustrating a preferred form of nail driving unit contemplated by this invention, illustrating the parts in position where the nail is ready to be driven home by the plungers;

Fig. 8 is a sectional elevation similar to Fig. 7, showing the relative positions of the parts when the nail has been struck by the plunger and driven home;

Fig. 9 is a sectional elevation similar to Fig. 7 but showing a modified form of nail driving mechanism which embodies the chuck; and

Fig. 10 is a sectional elevation taken through the center line at right angles to Fig. 9, illustrating the plunger in its extended position.

Referring now to the drawings with particular reference to Figs. 1 and 2, which illustrate the principle involved in the construction of a box making machine contemplated by this invention, reference numeral 11 indicates a form which supports all the pieces that go to make up a finished box. The form 11, as shown herein, is chosen merely to illustrate the principle involved in the embodiment of the nailing unit contemplated by our invention in a box making machine, and for that reason, we have not shown the shook and head supporting and feeding mechanism, nor the automatic box ejector which are embodied in the complete machine, but have merely illustrated a rigid form or frame for supporting the box members which will be sufficient to clearly illustrate the principle involved in the machine contemplated by this invention.

Reference numerals 12 and 13 indicate shook supporting members, such members being formed with vertical inside shook supporting plates 14 and 15 adapted to support the lower edges of side shooks indicated by numerals 18R and 18L. These shooks may be supported against vertical movement in any suitable manner as will be hereinafter described. The bottom shook 18B is supported between shoulders 19 and 19', formed on the members 12 and 13 at the bottom edge of the upright supports 14 and 15. Reference numeral 20 (Fig. 1) indi-

cates a head which is positioned between the three shooks 18R, 18L and 18B and is held in the pressure engagement with the bottom shook 18B by means of the pressure head 21. It will be understood that a head is positioned at each end of the box between the respective shooks, and in the event of a partitioned box, another will be located mid-way between the two end heads. Such construction is illustrated in Fig. 2 and in this event it will be observed that each of the inside shook supports 13 and 12 are formed in two pieces indicated at 13 and 13' in Fig. 2. The three heads in this type of box are illustrated at 20, 20' and 20'' in Fig. 2.

Positioned at the outside of the respective shooks 18R, 18L and 18B, we provide corresponding plate members, which will be hereinafter referred to as stop plates or pressure plates, and which are indicated by reference numerals 23R, 23L and 23B. Plates 23R and 23L have lips 24 at their lower edges adapted to support the shooks 18R and 18L.

Each of the plate members 23R, 23L and 23B is secured to the extending end portions of a plurality of sleeve members (to be hereinafter more completely described) which are contained within what may be termed driving cylinders indicated generally by reference numerals 25R, 25L and 25B. Each of these cylinders contains a nail chamber, which is located within the sleeve, and a nail driving plunger arranged so as to advance the respective sleeves and consequently to advance the corresponding plate members into engagement with the respective shook as the nails are driven into the wood from their respective chambers.

In the present embodiment of our invention, the nail driving plungers within the cylinders 25R, etc., are hydraulically actuated and for the purpose of giving a balanced action to all of the driving plungers so that the plate members 23R, etc. may be uniformly advanced during the final movement of the respective plungers, and further to permit the counter balanced action of the plunger units in cylinders 25L and 25R, we prefer to supply the cylinders with hydraulic fluid from a single source. In the form shown, it will be observed that the cylinders 25R, etc., are equipped with hydraulic connections 27R, 27L and 27B which communicate with header pipes 28R, 28L and 28B.

It will be understood in this connection that the cylinders 25R, etc., are arranged in banks positioned in planes which are aligned with the planes of the heads 20, the number of cylinders in each bank corresponding to the number of nails required for the particular sized box to be constructed. For the purpose of illustration herein, we have shown each bank of cylinders as comprised of only two, but it will be understood that in actual practice there would be one or more cylinders for each shook, and where the box may have one or more shooks on a side, the number of cylinders would be correspondingly increased. In the present embodiment of our invention the different banks of cylinders which are coplanar with each head are all interconnected through the medium of pipes, generally indicated by reference numeral 30, and the successive coplanar bank units are all interconnected through the medium of pipes 31, which communicate between the bottom pipe heads 28B. The hydraulic system thus formed is supplied with pressure fluid through a connection 32 and a valve generally indicated by reference

numeral 33, which in turn communicates with the pressure feed conduit 34, from a pressure chamber 35.

Although various means may be employed for effecting the retractive movement of the plunger members in the cylinders 25R, etc., we have for the purpose of illustration herein, shown an arrangement in which this retractive movement can be effected by a vacuum or suction action applied through the same conduit system just described above, within the cylinders immediately following the nail driving advance of the plungers therein. For the purpose of holding the plunger members in retracted position until the second driving stroke is to be imparted to the head of the nails in the chambers, the conduit system and the valve are arranged so that the suction or vacuum is normally maintained within the cylinders behind the pistons therein. With this last mentioned feature in mind, therefore, the valve 33 is shown as being a three-way valve, having a suction outlet 37, which communicates with what may be termed a vacuum or suction chamber 38. The valve 33 which is diagrammatically illustrated herein, is shown as embodying a core 40, having a recess 41 adapted to selectively establish communication between the connection 32 and the connection 37 or the connection 32 and the connection 34, thereby applying either vacuum or pressure to the conduit system depending upon the position of the core. For the purpose of actuating the core to these two positions, it is provided with a lever member 43, adapted to engage stops 44 and 44' on the valve housing.

In this embodiment of our invention, we have illustrated an arrangement in which vacuum or suction is maintained in the chamber 38 and pressure is maintained in the chamber 35, through the medium of a variable discharge pump 46 having its outlet 47 communicating with the chamber 35 and its inlet 48 communicating with the chamber 38.

As has been previously pointed out, it is one of the fundamental objects of this invention to provide a nailing machine of the class described, in which all of the nails for all three sides of the box may be simultaneously conveyed from a single nail feeding zone and delivered into the respective driving chambers 25R, etc. The nails are located in positions normal to the plane of the shank so that the advancing action of the respective plungers will strike the heads of the nails and drive them all home at once. For the purpose of accomplishing this general objective, each of the cylinders 25R, etc., is formed with the nail inlet connection, such connections being indicated by reference numerals 50R, 50L and 50B. Each of these connections 50R, etc., as will appear from the detailed description of the nailing cylinders hereinafter given, communicates with the nail receiving chamber located within the sleeve, and the outer end of each of these connections 50R, etc., has a nail delivery tube secured therein, such tubes being indicated by reference numerals 51R, 51L and 51B.

All of the tubes 51R, etc., lead through bends of relatively wide radius to a plurality of nail feeding boxes or funnels generally indicated in Fig. 1 by reference numeral 52. The top of each nail feeding box is provided with a funnel 53, the details of which will be hereinafter more fully described and each funnel is positioned at the lower end of an inclined nail stripper of any conventional type, indicated by numeral 54.

A nail pick mechanism, indicated at 55, is provided for the purpose of picking the nail individually from the strippers 54, and delivering them into the respective funnels, such pick members being mounted upon a pick bar 56 which is actuated through a bell crank 56' from a solenoid 57.

It will be observed that each of the nail delivery conduits, which incidentally includes the box 52 and the funnel 53, has a substantially vertical inlet portion through which the nails will fall by gravity, such nails coming to rest at some point in the first bend of the corresponding delivery conduit.

For the purpose of driving a nail so located in a conduit on through the remaining length of the conduit and into the nail receiving chamber in the corresponding cylinder 25R, etc., the boxes 52 are provided with compressed air inlet connections 253, each of which is equipped with a valve member 254 preferably in the nature of a poppet valve, which, in the present embodiment of our invention, is adapted to be actuated through the medium of lever 255 from an electrical solenoid 256. Compressed air is delivered to the high pressure side of the valve members 254, through compressed air connections 58 leading to any suitable source of high pressure air or gas not shown.

The pick bar and the compressed air valve are shown as being electrically actuated, and in order that this same type of actuating means may be utilized throughout to obtain timed relation in the actuation of the pick bars, the compressed air valve and the hydraulic control valve, we have also shown the lever member 43 which actuates the hydraulic control valve 40 as being connected through a link 60 with the armature 61 of an electrical solenoid 62. The armature 61 is associated with a compression spring 63 which normally holds the valve in the position shown in Fig. 1, where communication is established in the connection 32 and its associated conduit system and the vacuum or suction chamber 38.

The pick bar 56 is normally held in a position to prevent nails from falling from the stripper 55 by means of a compression spring 57a which is associated with the armature 57' of the solenoid 57, and likewise the air valve member 254 is normally held in its closed position by means of a compression spring generally indicated at 255' in Fig. 1.

The solenoids 57, 256 and 62 are provided with conductors 65, 66 and 67, respectively, which lead to brush contact members 65', 66' and 67', respectively. The solenoids 57, 256 and 62 are grounded as indicated at G₁, G₂, and G₃.

For the purpose of successively energizing the solenoids 57, 256 and 62 in this embodiment of our invention, so that they are effective to successively actuate the pick bar to drop a nail into the inlet portion of each of the nail feed conduits, open the air valve to admit compressed air to the delivery conduits and drive the nails so admitted into the nail receiving chambers, and lastly to actuate the valve 33 to admit hydraulic pressure fluid to the respective cylinders and thereby drive the nails so delivered home, we employ a switch member generally indicated by reference letter S in Fig. 1.

This switch member which also incorporates the brushes 65', 66' and 67' embodies a revolving commutator 70 mounted upon a shaft 71 and having a single contact point 72 which is conductively connected to a slip ring 73, such slip ring being connected to a source of potential B

through a brush 74. The source of potential is grounded as indicated at G.

The shaft 71 may be rotated by hand or in any other suitable manner such as by means of driving connections operatively associated in timed relation with suitable shoo and head board feeding means, and during a complete rotation of the shaft 71, the contact member 72 engages successively the brush member 65' to actuate the pick bar, thereby delivering a nail into each of these respective funnels 53.

Such nails, as hereinabove pointed out, fall by gravity through the inlet portion of the corresponding nail feed or nail delivery conduit to a point where they come to rest. As the shaft 73 continues to rotate, it next engages the contact member or brush 66' which energizes the solenoid 256 to admit compressed air through the valves 254. The admission of such air is, through an operation to be hereinafter more completely described, effective to positively drive the nails through the respective conduits, irrespective of the direction of the conduit, into the corresponding nailing cylinders 25R, etc. As the shaft 71 continues to rotate from this point on, it next engages the brush 67', thereby energizing the solenoid 62 which is effective to actuate the valve core 40 to swing the same to a position in which communication is established between the pressure chamber 35 and the connection 32 which feeds the pressure conduit system. The hydraulic fluid thus admitted to the pressure conduit system is effective to simultaneously drive all of the nail driving plungers in the respective cylinders 25R, etc., in counterbalanced relation with each other, thereby effecting the completion of the nailing operation. As the contact member 72 leaves the brush 67', electrical connection to the solenoid 62 is broken, and the spring 61 becomes effective to return the valve to the position shown in Fig. 1, where suction is applied in the successive cylinder members, whereby the plungers therein are drawn to their retracted positions.

In this latter connection it will be understood that various means may be employed for effecting the retractive movement of the piston members within the respective cylinders, the use of suction therein being employed in the present disclosure merely because such means are more susceptible to clear illustration in the particular combination chosen to describe the invention.

It will also be understood that various other means may be employed for controlling the respective operations just described above. For example, in Fig. 3 we have diagrammatically illustrated an arrangement whereby the control of the pick bar, the compressed air valve, and the hydraulic plunger control valve may be effected through the medium of the combination of mechanical and hydraulic means. In this last mentioned figure, we have shown a single nailing cylinder indicated by reference numerals 25', which has a nail delivery conduit 51' and a hydraulic pressure conduit 27'. The nail feeding means is generally indicated by the numeral 52', such means being equipped with a compressed air inlet 253' which has a control valve 254'. The nail stripper is indicated by reference letter 54' and the pick bar by reference numeral 56a. Numeral 35' indicates the pressure chamber, numeral 38' the suction chamber, and numeral 46' the variable discharge pump. A pressure line 34' leads from the pressure chamber 35' and a suction line 37' leads to the suction chamber 38'.

The bell-crank 56a' which actuates the pick bar is connected with a plunger rod 80 which has a piston member 81 secured to its upper end, such piston member being contained within a cylinder 82 and being pressed to a downward position where the pick bar is held in neutral position by means of a compression spring 83. The region of the cylinder 82 below the piston 81 is provided with a connection 84 which leads to a valve member generally indicated by reference numeral 85. This valve member is in the nature of a two-piston valve, shown as comprising a cylinder which contains a divided piston 86 mounted upon a piston rod 87, the end of which is positioned for engagement by a nose 88 on a cam member 89. The stem is pressed into engagement with the cam member by a compression spring 90 and the cylinder 85 is provided with connections 91 and 92 which communicate with the suction and pressure conduits 37' and 34', respectively. With the valve in the position shown, connection 84 communicates with the connection 91 and suction is applied within the cylinder 82 with the piston holding the pick bar in its neutral position. When the piston member 86 is advanced by the rotation of the cam member 89 in the direction of the arrow shown thereon, communication is established between the connection 84 and the pressure connection 92, whereby the piston member 81 is elevated to actuate the pick bar, and thereby release the nails from the stripper's edge.

The air valve 254' is equipped with a pivoted lever member 94 which is adapted to open the valve and when it is depressed, such lever member being attached to the lower end of a piston rod 95 which has a piston 98 on its upper end, contained within a cylinder 99. The cylinder 99 communicates through a connection 100 with suction valve 101 similar in its construction and operation to valve 85, such valve 101 having a pressure connection 102 and a suction connection 103. The piston member within this last mentioned valve has an outwardly extending stem 104 positioned with its extending end in engagement with a cam member 105.

The connection 27' which controls the delivery of hydraulic fluid to the cylinder 25' communicates with a third piston valve member of the general type described above, such valve member being indicated by reference numeral 107, the piston therein having a stem 108 which is in engagement with a third cam member 109.

These cam members 89, 105 and 109 are all mounted on a common shaft diagrammatically indicated by the center line 110 which may be driven from any suitable source of power, generally indicated by reference numeral 111. It will be observed that the position of the cam noses on the cam members 89, 105 and 109 are such that the valve members 85, 101 and 107 are actuated in the order named to establish communication between the respective cylinders 82, 99 and 25' and the pressure conduit 34'. It will thus be seen that for one complete rotation of the shaft 110, the pick bar is advanced to release the nail, the compressed air valve is opened to drive the nail into place and hydraulic pressure is applied to the driving plunger within the cylinders 25', thereby causing the plunger to strike the nail and drive it home. The rotation of the shaft 110 may be under manual control, such as by means of a switch controlled motor, or it may be under automatic control depending upon the construc-

tion of the remainder of the box making machine.

From the foregoing description, it is believed that the principle of operation involved in the box making machine contemplated by this invention, will be clearly apparent, and we will now describe the details in the construction of a preferred form of nail feeding mechanism and certain preferred forms of nail driving mechanism, respectively.

Referring now to Figs. 4 to 6, inclusive, for a description of the nail feeding mechanism, it will be observed that the strippers 54 comprise a plurality of downwardly inclined bars 120 spaced apart to leave slots 121 which contain and support the nails 122. The nails are fed into the slot in the conventional manner from a rocking pan not shown. The lower ends of these bars are formed with notches 123, which are slightly beveled as indicated in Fig. 6, such notches being disposed in offset relation with the slots 121. The pick members which are carried by the pick bar 56 are indicated by reference numeral 124, and each of these members are shown as comprising an offset plate which has an undercut pivot portion 125, apertured as indicated at 126 to receive a pivot pin 127. These pick members also have a substantially flat pick portion 128, the under surface of which is flush with the pick bar, such portion extending beneath the pivot portion 125 of the next succeeding pick. The pick portion 128 is provided with an elongated slot 129 which permits the pivotal movement of the pick for a purpose to be later described. The pick portion 128 has an extending lip 131 formed with a downwardly inclined surface 132, such lip being normally positioned in sliding engagement with the lower edges of the stripper bars 120, and being provided with notches 133 which are normally in alignment with the slots 121. When the slots and the notches are in alignment, it will be observed that the lowermost nail will drop into the notch in the pick, and as the pick bar is reciprocated to bring the notch into alignment with the notch 123 in the lower edge of stripper bar, this nail will drop along the inclined surface 132 into the funnel 53.

As has been previously pointed out, the pick members are pivotally mounted upon the pick bar and the feature of having their pivot portions undercut to receive the pick end portion of the next adjacent pick member permits overlapping of pick members and thereby greatly reduces the length necessary in the pick bar for a given number of nail feeding units. The feature of pivoting the pick member permits the same to yield in the event a jam occurs in the notch on the pick, and in order that these members may be yieldably held against the pick bar, we provide each pick portion of the pick with an overlapping flange 138 which extends downwardly along the side of the pick bar and is apertured as indicated at 139 to receive a screw 140, the outer portion of which carries a compression spring 141 bearing against the face of the flange 138.

It will be observed in Figs. 5 and 6 that the funnels 53 are shown as extending into a region closely adjacent the lower edge of the strippers and the pick bars, and in order to permit the nails being drawn into the funnels in the operation just described above, they are formed with side openings or notches indicated by reference numeral 144. The lower ends of these funnels are shown as having a slip fit with a cover plate

145 on the box members 52, and are held in proper position, so far as the alignments of the notches 144 with the nails are concerned, by means of a pin and slot connection, indicated at 146 and 146'. In order to insure the free delivery of any nails admitted to the delivery conduit 51 through the funnel 53, we form the funnels 53 with a throat portion 148 which is of slightly less internal diameter than the delivery conduit 51 and which is of a length not substantially less than the length of the nail to be used. In this way, any nail which will pass through the throat portion 148 of the funnel will be assured of passing through the nail delivery conduit and in the event the nail becomes stuck in the throat portion 148, the funnel can readily be removed through its slip connection to discharge the nail and continue with the operation.

Each of the box members 52, which are shown as carrying the compressed air inlet connections 253 leading to each of the delivery conduits 51, is provided with an air inlet chamber 150, such chamber carrying a flapper valve 151 arranged so as to normally hang in open position in front of the air inlet connection 253 and to be swung upwardly into closed position whenever compressed air is admitted to the chamber 150 from the connection 253. In this way all of the compressed air admitted to the box is delivered directly into the nail delivery conduit 51 and is thereby effective to drive the nail therethrough in the manner pointed out above.

With regards to the size of the conduit 51 and the pressure of the compressed air necessary, it will be understood that these factors depend to a large degree upon the size and type of nail that is being used. The cross-sectional area of the conduit should not be duly large as compared with the head of the nails since the driving efficiency might thereby be reduced. However, sufficient clearance should be allowed to permit free passage of nails of varying head sizes. So far as the pressure is concerned this will again depend upon the size and weight of nail and the type of work that is being nailed. In the event the compressed air is relied upon to effect a partial penetration of the nail with the wood, we have found that for ordinary box nailing operations pressures from 100 to 200 lbs. per sq. in. will operate satisfactorily to give a substantial penetration, and pressure as low as 25 lbs. per sq. in. to satisfactorily locate the nails within a supporting chuck. The valve 254 is not illustrated in detail since any conventional type of valve may be used here, it being preferable that the valve be of a quick acting or poppet type so that the admission of air therethrough simulates an "explosive" action.

Referring to Figs. 7 and 8 we will not describe a preferred form of driving cylinder contemplated by this invention. This cylinder indicated generally by reference numeral 25 has a bore 160, into the outer end of which the hydraulic control conduit 27 is threaded as indicated at 161. The open end of the bore 160 contains what we have referred to as a sleeve member 162, such sleeve member being slidably mounted within the bore and having a flange on its outer end which engages the cylinder when the sleeve is in its fully retracted position and which also constitutes means whereby the sleeve may be secured to the plate member 23 through the medium of screws 164. The sleeve 162 is held in its fully retracted position by means of a tension spring 165, such spring having one end

attached to the plate member 23, as indicated at 166, and having its other end attached to an adjustment screw 167 which is contained within a boss 168 formed on the cylinder 25.

The sleeve member 162 is formed with a bore 170 which constitutes what we have termed a nail receiving chamber and the wall of the sleeve has a side opening 171 which communicates with passage 172 in the connection 50 which receives the end of the nail delivery conduit 51. Also contained within the bore 160 of the cylinder member 25 is a piston 175 which is mounted on the outer end of a driving plunger 176, such plunger being of a size such that it will slide through the bore 170 in the sleeve member.

From the construction as shown in Fig. 7, it will be seen that nails delivered into the delivery conduit and driven therethrough by means of the compressed air into the nail receiving chamber 170 through the opening 171 and are driven into at least partial penetration with the wood as illustrated by the position of the nail 122 in Fig. 7. When hydraulic pressure is applied through the conduit 27 into the cylinder 25, it acts upon the piston 175, driving the same forward so that the plunger 176 is brought into striking engagement with the head of the nail 22, and drives the same home to the position shown in Fig. 8.

In this latter connection it is preferable in the operation of a box making machine of the class described, to counter-sink the nails a predetermined amount when they are driven completely home. For the purpose of accomplishing this objective, we form the plunger 176 of a length such that it will extend a slight distance beyond the end of the sleeve member 170 when the piston 175 engages the inner end of the sleeve. In this way, it will be seen that as the piston engages the inner end of the sleeve, it forces the same forward until the plate 23 engages the member into which the nail is being driven, and when this takes place the work into which the nail is being driven acts as a stop to limit further forward movement of the piston and the driving plunger. The end of the driving plunger having been formed so as to extend a slight distance from the sleeve member when the piston engages the other end of the sleeve member, it will be seen, as is clearly illustrated in Fig. 8, that the nails will be countersunk an amount corresponding to the difference in lengths between the plunger and the sleeve.

The feature of using the movable sleeve of the type illustrated in Figs. 7 and 8 has a further advantage in that it compensates automatically for different thicknesses of shook or pieces into which the nails are being driven.

In Figs. 9 and 10 we have illustrated a modified form of nailing cylinder which embodies a chuck adapted to hold the nails in normal relation with the work into which they are driven and in which the nails are driven into supporting engagement with the chuck by means of the compressed air.

In this embodiment of our invention, the cylinder 25a has a bore 160a and a piston and plunger unit indicated by 175a and 176a, respectively, similar to those described above in connection with Figs. 7 and 8. The outer end of the cylinder contains an enlarged slot or notch 189 which is positioned in substantial alignment with the more restricted passage 190, which normally receives the lower or outer end of the plunger 176a. The notches or slots 189 contain a pair

of oppositely disposed chuck jaws 191 and 191' which are mounted through the medium of pins 192 and 192' on the free ends of leaf springs 193 and 193', such springs being secured to the cylinder by screws 194 and 194' (see Fig. 10).

The inner portions of the jaws 191 and 191' are recessed as indicated at 196 and 196' to form a nail receiving chamber which is of substantially the same cross sectional area and shape as the plunger passage 190. At the outer end portions of the jaws these recesses 196 and 196' taper down to a restricted region formed by recesses 198 and 198' so as to provide a chuck which will effectively support the nails driven therein as indicated in full lines at 122' in Fig. 9. In this connection, it will be understood that the wall of the cylinder is provided with an air inlet passage 172' which communicates with the interior of the cylinder above the chuck and, if desired, the chuck jaw next to this inlet passage may be cut away as indicated at 199.

In operation, the nails driven into the chuck jaws in the same manner described hereinabove, and the admission of hydraulic fluid to the cylinder drives the piston 175a and the driving plunger 176a forward into engagement with the head of the nails, advancing the nail into engagement with the work, and at the same time spreading the jaws to admit the complete expulsion of the nail from the cylinder.

It will be understood that while we have herein described and illustrated certain preferred forms and structural details of our invention and have particularly described the invention in connection with a box making machine, the invention is not limited to the precise details of the particular combination shown herein, but includes within its scope whatever changes fairly come within the spirit of the appended claims.

We claim:

1. A nailing machine embodying the combination of: nail driving means including a nail receiving chamber having an outlet positioned adjacent work to be nailed and a plunger movable through said chamber to drive a nail through said outlet; a nail delivery conduit communicating with said chamber; means for feeding nails one at a time into said conduit; pneumatic means for driving nails through said conduit into said chamber and into partial penetration with said work; and means for actuating said plunger to complete the penetration of said nail into said work.

2. A nailing machine embodying the combination of: nail driving means having a nail receiving chamber; plunger means reciprocable through said chamber to drive a nail from said chamber upon each full driving stroke of said plunger; a nail delivery conduit communicating with said chamber; means for feeding nails into said conduit, pneumatic means for driving nails through said conduit into said chamber, and hydraulic means for moving said plunger through one full driving stroke upon each actuation of said hydraulic means.

3. A nailing machine embodying the combination of: nail driving means having a nail receiving chamber; a nail delivery conduit communicating with said chamber; means for feeding nails into said conduit, and pneumatic means for driving nails through said conduit into said chamber, said pneumatic means comprising an inlet section of said conduit through which nails will fall by gravity, a normally open valve in said inlet section adapted to pass said nails, and means for applying compressed air within said inlet section

below said valve thereby closing said valve and driving a nail from said inlet section through the remainder of said conduit.

4. A nailing machine embodying the combination of: nail driving means including a nail receiving chamber having an outlet positioned adjacent work to be nailed; a nail delivery conduit communicating with said chamber; means for feeding nails into said conduit; and pneumatic means for driving nails through said conduit into said chamber and into the work adjacent thereto, said pneumatic means comprising an inlet section of said conduit through which nails will fall by gravity, a normally open valve in said inlet section adapted to pass said nails, and means for applying compressed air within said inlet section below said valve thereby closing said valve and driving a nail from said inlet section through the remainder of said conduit.

5. A nailing machine embodying the combination of: nail driving means including a nail receiving chamber having an outlet positioned adjacent work to be nailed and a plunger movable through said chamber to drive a nail through said outlet; a nail delivery conduit communicating with said chamber; means for feeding nails into said conduit; pneumatic means for driving nails through said conduit into said chamber and into partial penetration with said work; and means for actuating said plunger to complete the penetration of said nail into said work, said pneumatic means comprising an inlet section of said conduit through which nails will fall by gravity, a normally open valve in said inlet section adapted to pass said nails, and means for applying compressed air within said inlet section below said valve thereby closing said valve and driving a nail from said inlet section through the remainder of said conduit.

6. A nailing machine embodying the combination of: nail driving means having a nail receiving chamber; plunger means reciprocable through said chamber to drive a nail from said chamber upon each full driving stroke of said plunger; a nail delivery conduit communicating with said chamber; means for feeding nails into said conduit; pneumatic means for propelling a nail through said conduit into said chamber and positioning same to be driven by said plunger; hydraulic means for actuating said plunger through one full stroke to complete the driving of a nail so positioned; and stop means adapted for engagement with work into which the nail is driven for limiting the driving movement of said plunger.

7. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a piston in said cylinder; a nail driving plunger on said piston extending into said chamber and reciprocable through said chamber to completely drive a nail upon a full driving stroke of said piston; means for delivering a nail into said chamber at a point between the end of said plunger and the outer end of said sleeve, and hydraulic means for actuating said piston through a full driving stroke to completely drive a nail from said chamber.

8. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a stop on the outer end of said sleeve adapted to engage the end of said cylinder and limit the retractive movement of said sleeve; yieldable means nor-

mally holding said sleeve in a retracted position; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber; means for delivering a nail into said chamber at a point between the end of said plunger and the outer end of said sleeve, and hydraulic means for actuating said plunger, said driving plunger being of a length such that it will have effected the complete ejection of a nail from said chamber when said piston engages the inner end of said sleeve.

9. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a stop on the outer end of said sleeve adapted to engage the end of said cylinder and limit retractive movement of said sleeve; yieldable means normally holding said sleeve in a retracted position; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber; means for delivering a nail into said chamber at a point between the end of said plunger and the outer end of said sleeve, and hydraulic means for actuating said plunger, said driving plunger being of a length such that its driving end will protrude from the outer end of said sleeve a predetermined amount when said piston engages the inner end of said sleeve.

10. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one of said cylinders and having a nail receiving chamber therein; a stop on the outer end of said sleeve adapted to engage the end of said cylinder and limit the retractive movement of said sleeve; yieldable means normally holding said sleeve in a retracted position; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber; means for delivering a nail into said chamber at a point between the end of said plunger and the outer end of said sleeve, hydraulic means for actuating said plunger, said driving plunger being of a length such that it will have effected the complete ejection of a nail from said chamber when said piston engages the inner end of said sleeve, and a plate on the outer end of said sleeve adapted to engage work into which a nail is being driven from said chamber.

11. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a stop on the outer end of said sleeve adapted to engage the end of said cylinder and limit retractive movement of said sleeve; yieldable means normally holding said sleeve in a retracted position; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber; means for delivering a nail into said chamber at a point between the end of said plunger and the outer end of said sleeve, hydraulic means for actuating said plunger, said driving plunger being of a length such that its driving end will protrude from the outer end of said sleeve a predetermined amount when said piston engages the inner end of said sleeve, and a plate on the outer end of said sleeve adapted to engage work into which a nail is being driven from said chamber.

12. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a piston in said cylinder; a nail driving plunger on said pis-

ton adapted for movement through said chamber, said sleeve member and said cylinder having aligned wall openings communicating with said nail receiving chamber; a nail delivery conduit communicating with the wall opening in said cylinder; means for feeding a nail into said conduit; pneumatic means for driving a nail through said conduit into said chamber and into partial penetration with work to be nailed situated adjacent the outlet end of said chamber; a stop on the end of said sleeve adapted to engage the end of said cylinder thereby limiting the retractive movement of said sleeve; yieldable means holding said sleeve in retracted position; a plate member on the outer end of said sleeve adapted to engage said work when said sleeve is advanced by engagement of said piston with the inner end of said sleeve; and hydraulic means for actuating said piston.

13. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber, said sleeve member and said cylinder having aligned wall openings communicating with said nail receiving chamber; a nail delivery conduit communicating with the wall opening in said cylinder; means for feeding a nail into said conduit; pneumatic means for driving a nail through said conduit into said chamber and into partial penetration with work to be nailed situated adjacent the outlet end of said chamber; a stop on the end of said sleeve adapted to engage the end of said cylinder thereby limiting the retractive movement of said sleeve; a yieldable means holding said sleeve in retracted position; a plate member on the outer end of said sleeve adapted to engage said work when said sleeve is advanced by engagement of said piston with the inner end of said sleeve; and hydraulic means for actuating said piston, said driving plunger being of a length such that its outer end protrudes from said sleeve a predetermined amount when the inner end of said sleeve is engaged by said piston.

14. A nailing machine embodying the combination of: a cylinder; a sleeve member slidably mounted in one end of said cylinder and having a nail receiving chamber therein; a piston in said cylinder; a nail driving plunger on said piston adapted for movement through said chamber, said sleeve member and said cylinder having aligned wall openings communicating with said nail receiving chamber; a nail delivery conduit communicating with the wall opening in said cylinder; means for feeding a nail into said conduit; pneumatic means for driving a nail through said conduit into said chamber and into partial penetration with work to be nailed situated adjacent the outlet end of said chamber; a stop on the end of said sleeve adapted to engage the end of said cylinder thereby limiting the retractive movement of said sleeve; yieldable means holding said sleeve in retracted position; a plate member on the outer end of said sleeve adapted to engage said work when said sleeve is advanced by engagement of said piston with the inner end of said sleeve; hydraulic means for actuating said piston, and means for controlling the operation of said nail feed, said pneumatic nail drive, and said hydraulic piston actuating means in timed relation with each other.

15. A nailing machine embodying the com-

bination of: nail locating means having a nail receiving chamber; a nail delivery conduit communicating with said chamber, said conduit having an inlet portion through which a nail will fall by gravity; a normally open valve in said inlet portion; a nail receiving funnel above said valve; and means for admitting compressed air to said inlet portion below said valve thereby closing said valve and driving a nail from the inlet portion of said conduit into said receiving chamber.

16. A nailing machine embodying the combination of: nail locating means having a nail receiving chamber; a nail delivery conduit communicating with said chamber, said conduit having an inlet portion through which a nail will fall by gravity; a normally open valve in said inlet portion; a nail receiving funnel above said valve; and means for admitting compressed air to said inlet portion below said valve thereby closing said valve and driving a nail from the inlet portion of said conduit into said receiving chamber, said funnel having a neck portion of slightly less diameter than the diameter of said delivery tube and of a length not substantially less than the length of a nail adapted to be driven by said machine.

17. A box nailing machine embodying the combination of: a form adapted to support the heads and side shooks of a box; shoe means engaging the tops of said heads; nailing cylinders one for each nail to be driven into said heads and shooks and having nail receiving chambers with their outlets opposite said heads and adjacent the respective shooks; means for pneumatically delivering nails into said receiving chambers; individual nail driving plungers in each of said cylinders adapted to engage the head of a nail in the corresponding chamber; and means for applying hydraulic pressure to all of said cylinders for driving of said driving plungers through one complete nail driving operation.

18. A box nailing machine embodying the combination of: a form adapted to support the heads and side shooks of a box; shoe means engaging the tops of said heads; nailing cylinders having nail receiving chambers with their outlets opposite said heads and adjacent the respective shooks; means for delivering nails into said receiving chambers; a nail driving plunger in each of said cylinders adapted to engage the head of a nail in the corresponding chamber; a source of hydraulic pressure; and means for simultaneously delivering hydraulic nail driving pressure to all of said driving plungers from said source of hydraulic pressure.

19. A box nailing machine embodying the combination of: a form adapted to support the heads and side and bottom shooks of a box; shoe means engaging the tops of said heads; nailing cylinders on said form having nail receiving chambers with their outlets opposite said heads and adjacent the respective shooks; a nail delivery conduit communicating with each of said receiving chambers; means for feeding nails into the respective delivery conduits at a single feeding zone; pneumatic means for simultaneously driving said nails through the respective conduits into said receiving chambers and into partial penetration with the respective shooks adjacent thereto; nail driving plungers in said cylinder adapted for movement through said receiving chambers; and means for simultaneously supplying hydraulic power to said plungers to cause said plungers to

move completely through said receiving chambers and to complete the penetration of the respective nails into the members of said box.

20. A box nailing machine embodying the combination of: a form adapted to support the heads and side and bottom shooks of a box; shoe means engaging the tops of said heads; nailing cylinders on said form having nail receiving chambers with their outlets opposite said heads and adjacent the respective shooks; a nail delivery conduit communicating with each of said receiving chambers; means for feeding nails into the respective delivery conduits at a single feeding zone; pneumatic means for simultaneously driving said nails through the respective conduits into said receiving chambers and into partial penetration with the respective shooks adjacent thereto; nail driving plungers in said cylinders adapted for movement through said receiving chambers; a source of hydraulic pressure; and means for simultaneously applying driving force to all of said plungers from said source of hydraulic pressure to cause said plungers to move completely through said receiving chambers to complete the penetration of the respective nails into the members of said box.

21. In a box nailing machine, the combination of: a form having head supports, an inside shook support and a plate member adapted to engage the outside of a shook engaged by said inside support; a plurality of sleeve members secured to said plate in alignment with heads contained in said form and having nail receiving chambers opening through said plate; cylinders slidably supporting the respective sleeve members; stops on the respective sleeve members adapted to engage the respective cylinders when said sleeves are retracted; yieldable means holding the respective sleeves in retracted position; a piston in each of said cylinders; a plunger on each piston adapted for movement through the corresponding chamber to drive a nail therefrom into the box

pieces adjacent thereto; said plungers being of a length such that they will have completely expelled the nails from the respective chambers when the pistons engage their corresponding sleeves; means for delivering nails into the respective chambers; and means for simultaneously applying hydraulic pressure to the pistons in all of said cylinders.

22. A method of nailing which comprises: pneumatically driving a nail through a confined passage into partial penetration with work to be nailed and then striking the head of the nail to drive it home.

23. A nailing machine embodying the combination of a cylinder having one end open, nail guiding means in the open end of said cylinder having a nail receiving chamber therein, a piston in said cylinder operable toward and away from the open end thereof and having a nail driving plunger thereon to engage a nail in said chamber and to drive the same from the open end of said cylinder, and means for applying fluid power to said cylinder to drive said plunger toward the open end of said cylinder and for applying a retractive force to said piston to draw the same toward the other end of said cylinder.

24. A nailing machine embodying the combination of: a cylinder having one end open, nail guiding means in the open end of said cylinder having a nail receiving chamber therein, a piston in said cylinder operable toward and away from the open end thereof and having a nail driving plunger thereon to engage a nail in said chamber and to drive the same from the open end of said cylinder, means for alternately applying fluid power to said cylinder to drive said plunger toward the open end thereof and applying suction to said cylinder to retract said plunger toward the other end of said cylinder.

JOSEPH L. HUNTER.
GLENN M. CRIGER.