United States Patent [19]

Thompson

[11] **3,764,053**

[45] **Oct. 9, 1973**

[54] **AUTOMATIC NAILING APPARATUS**

[76] Inventor: **Einar T. Thompson,** 107 White Gate Rd., Pittsburgh, Pa. 15238

[22] Filed: **June 23, 1971**

[21] Appl. No.: **155,891**

[52] **U.S. Cl.** **227/111**

[51] **Int. Cl.** **B27f 7/02**

[58] **Field of Search** 227/7, 111

[56] **References Cited**

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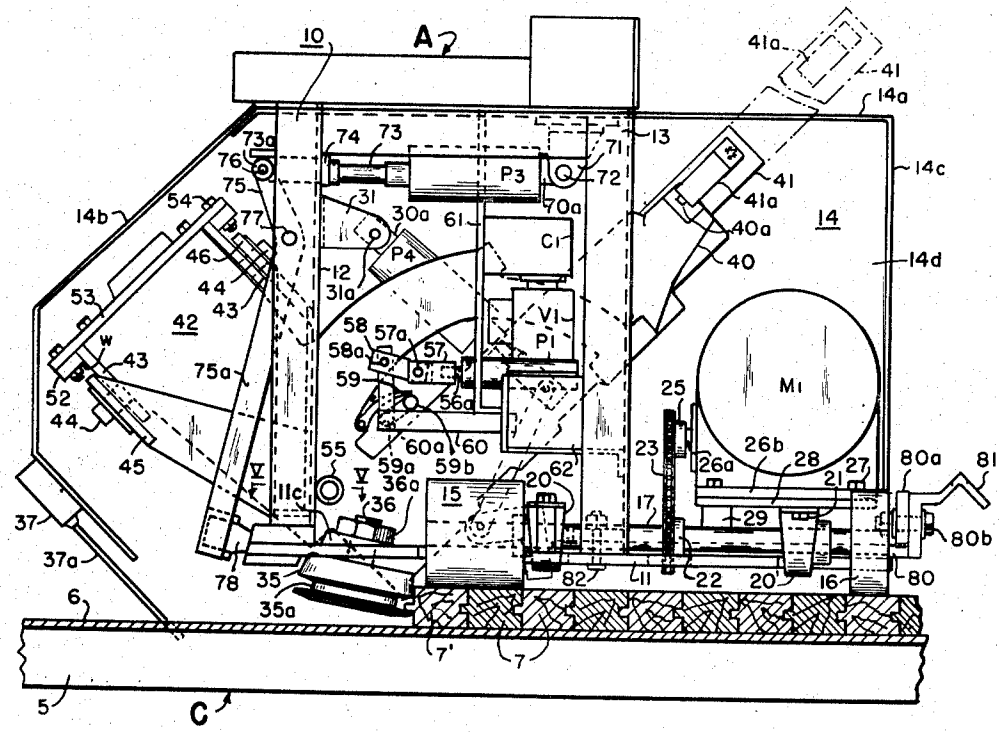
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Primary Examiner—Granville Y. Custer, Jr.
Attorney—Green, McCallister & Miller

[57] **ABSTRACT**

A machine or apparatus for laying wood floors, particularly in large areas, such as gymnasiums, is provided having a wheeled, frontwardly positioned floor board aligning and nailing unit and a wheeled, aligned, backwardly positioned, guide and position-advancing and setting unit for the nailing unit. The nailing and guide units are adjustably coupled together and actuated in synchronism for back and forth movement along the floor area. The apparatus can be controlled in its operation by manual means, by automatic electric switch control means, by valve means or any combination of such means and is adapted to move back and forth across a room in alignment with a previously laid longitudinally extending run of floor members. A detachable, wheeled control unit is shown for alternative mounting on leading sides of the nailing unit during its back and forth movements along a floor area. Position change and locator means is connected between the nailing and control units to vary their spaced relation as the nailing operations progress. The apparatus can be progressively advanced and set to provide a desired abutting or clearance spaced relationship between adjacent floor board runs; it has a fluid motor operated hammer for assuring a proper nailing positioning of a floor board of a run.

26 Claims, 31 Drawing Figures



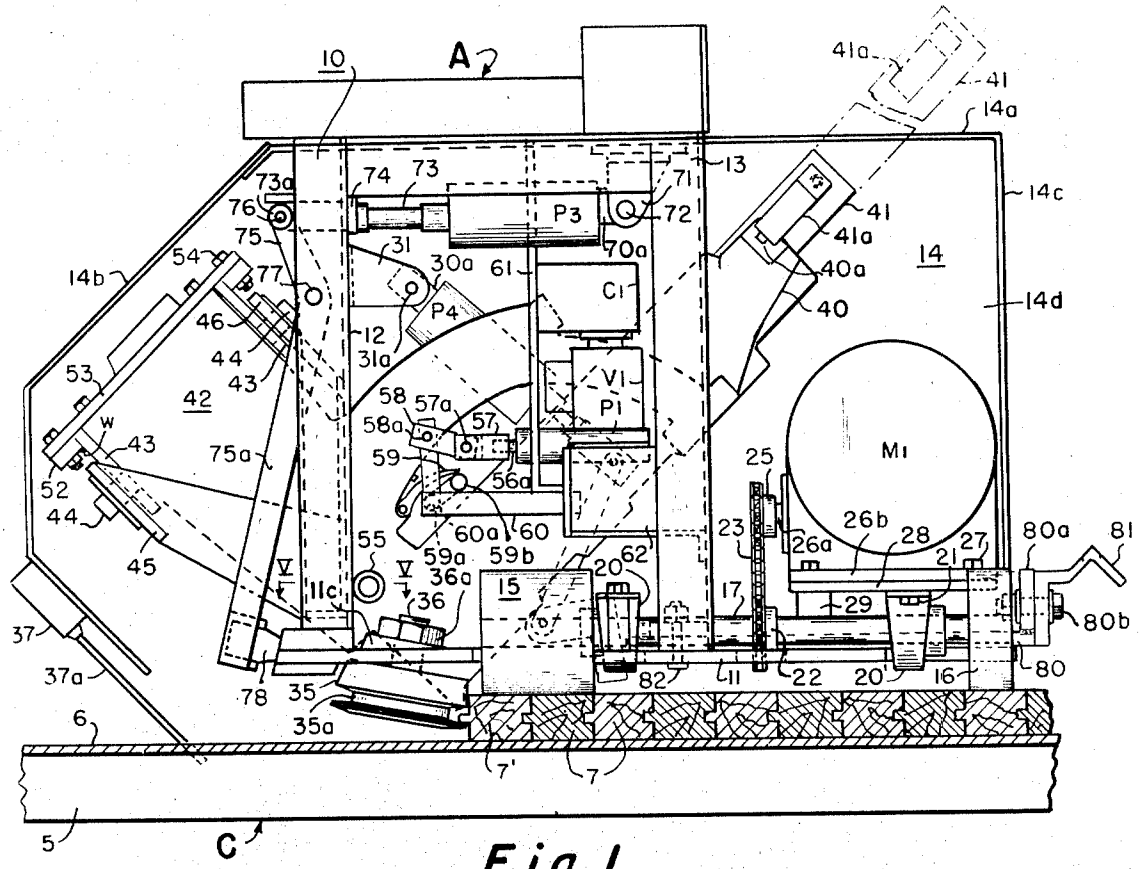


Fig. 1

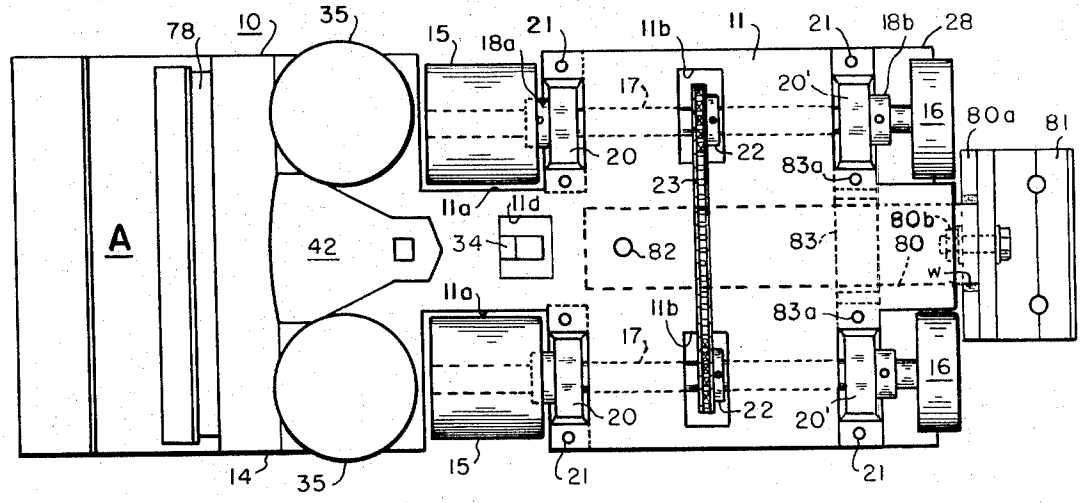


Fig. 2

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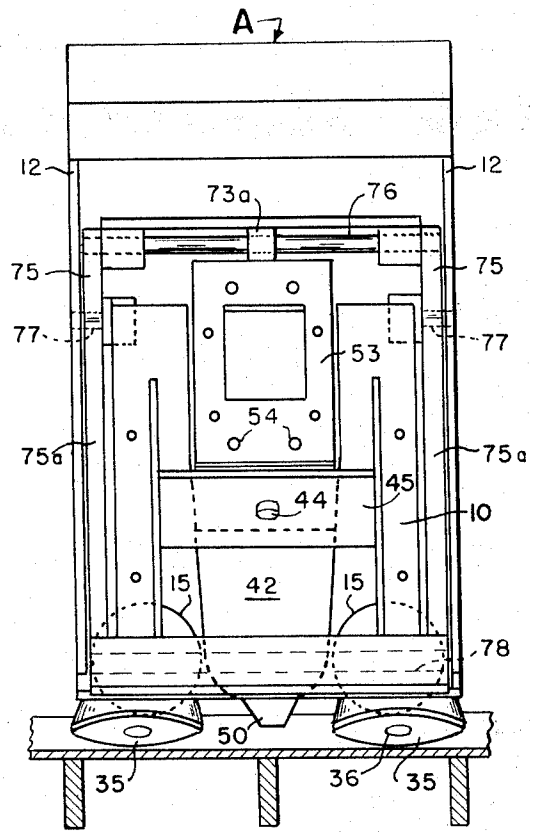


Fig. 3

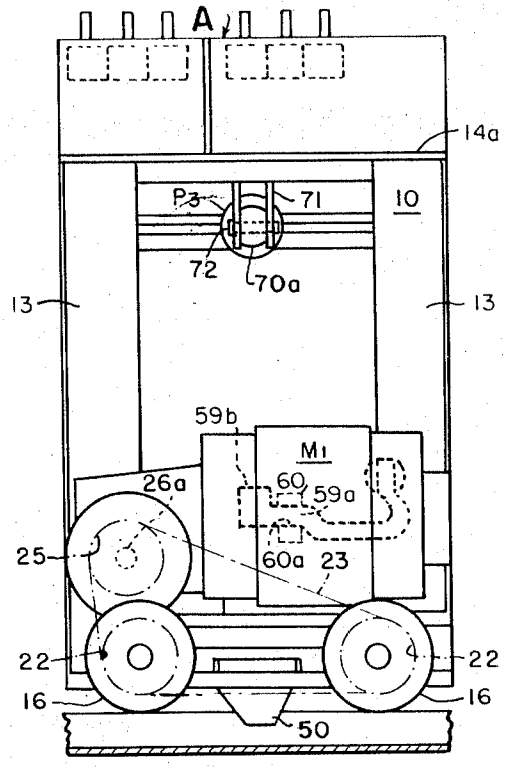


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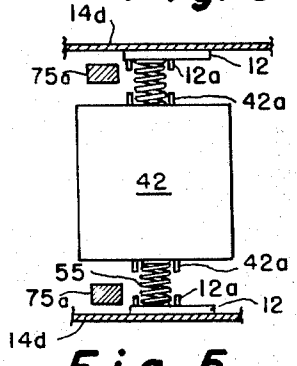


Fig. 5

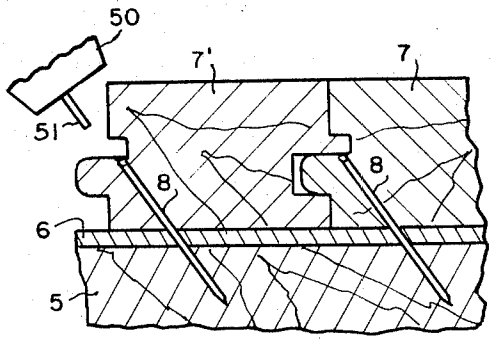


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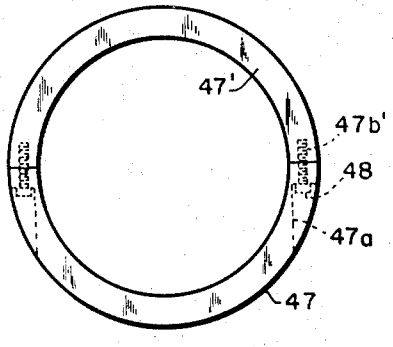


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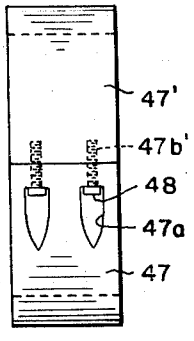


Fig. 8

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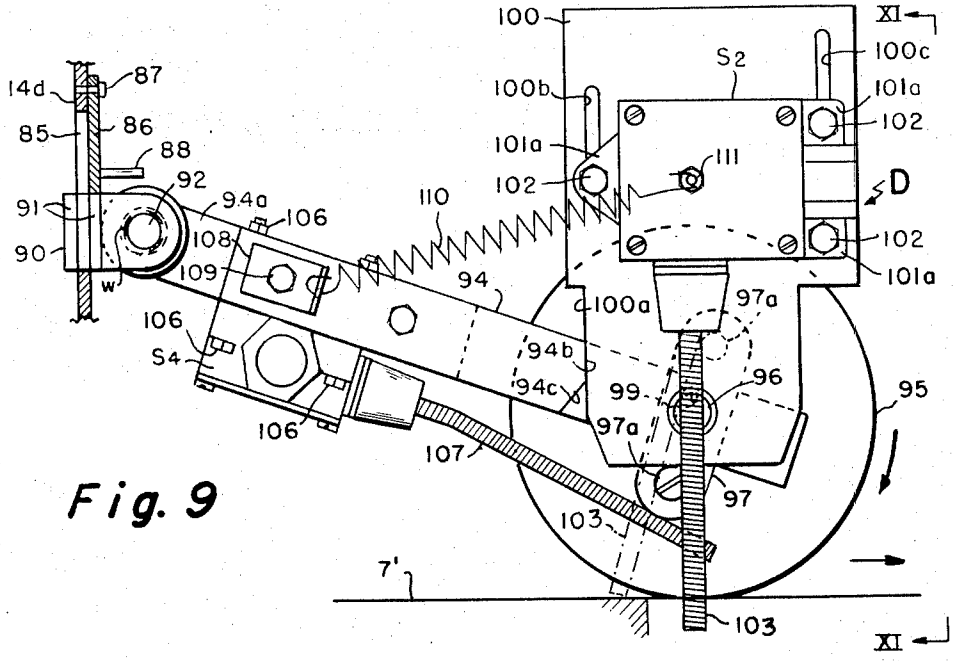


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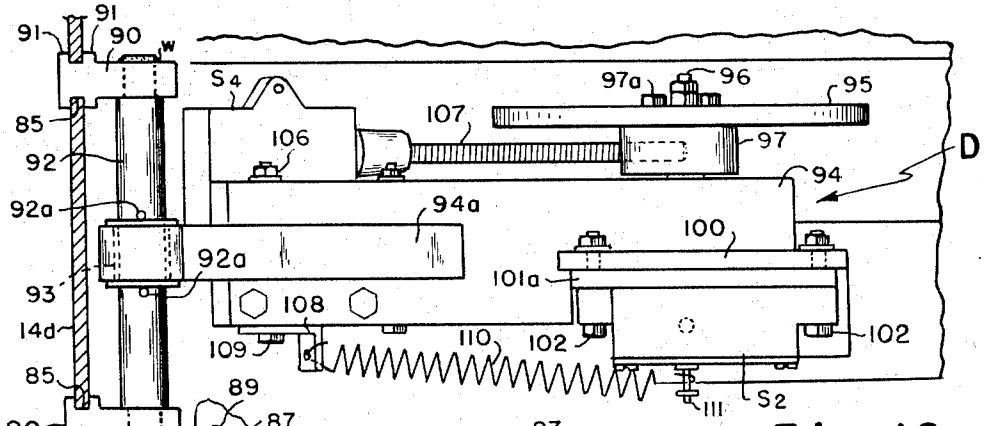


Fig. 10

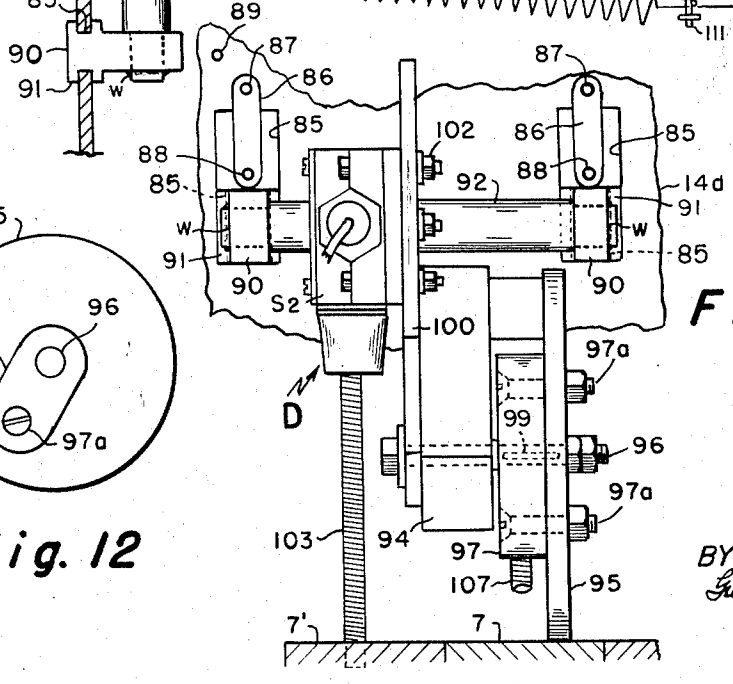


Fig. 11

Fig. 12

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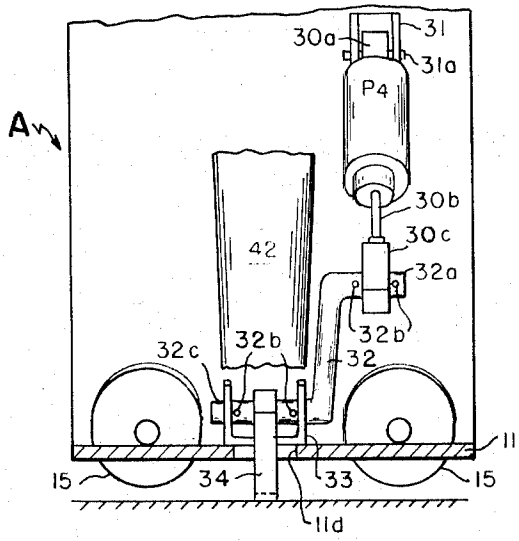


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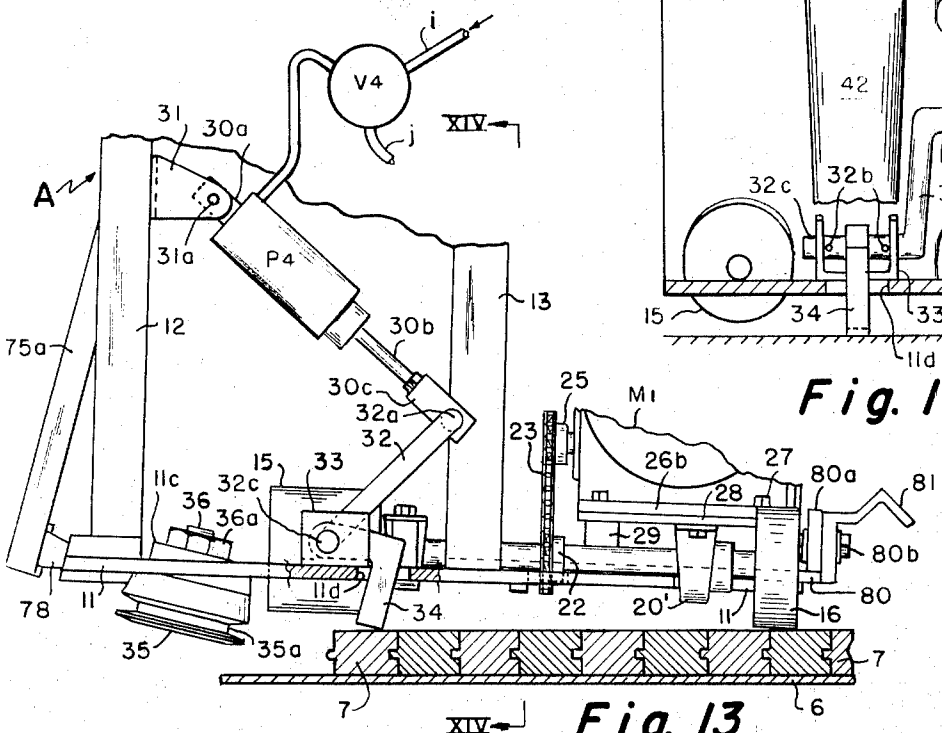


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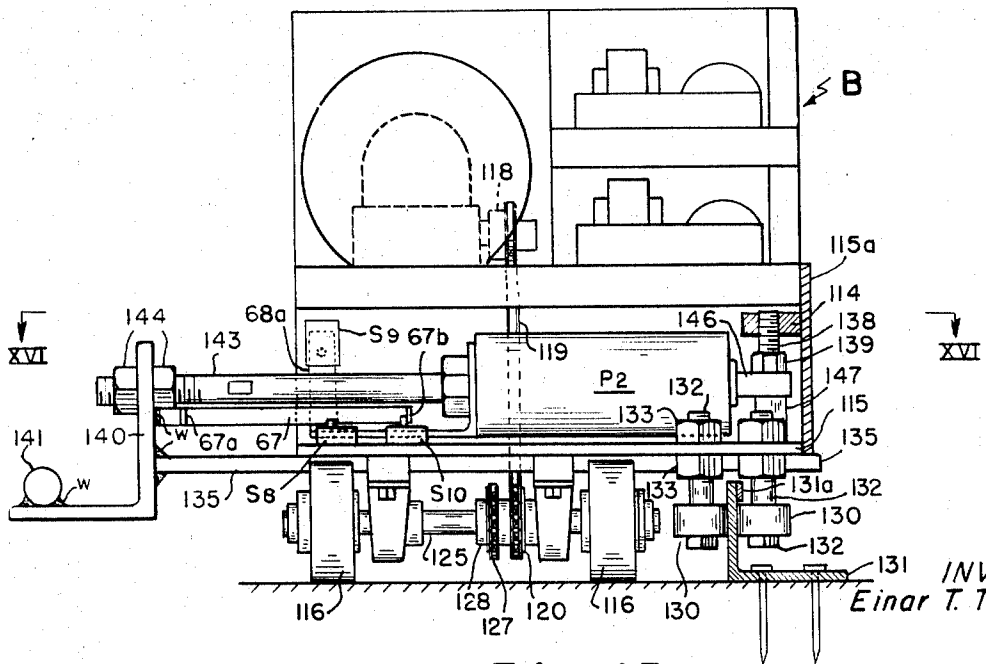


Fig. 15

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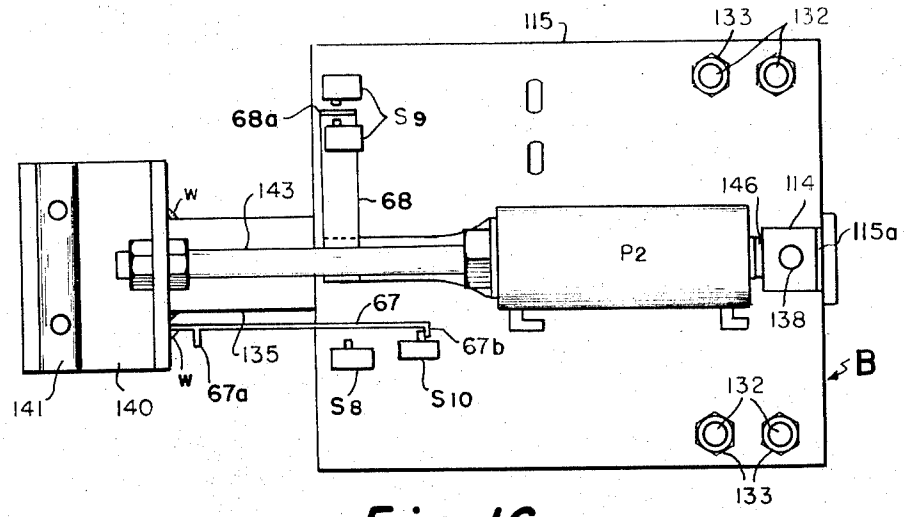


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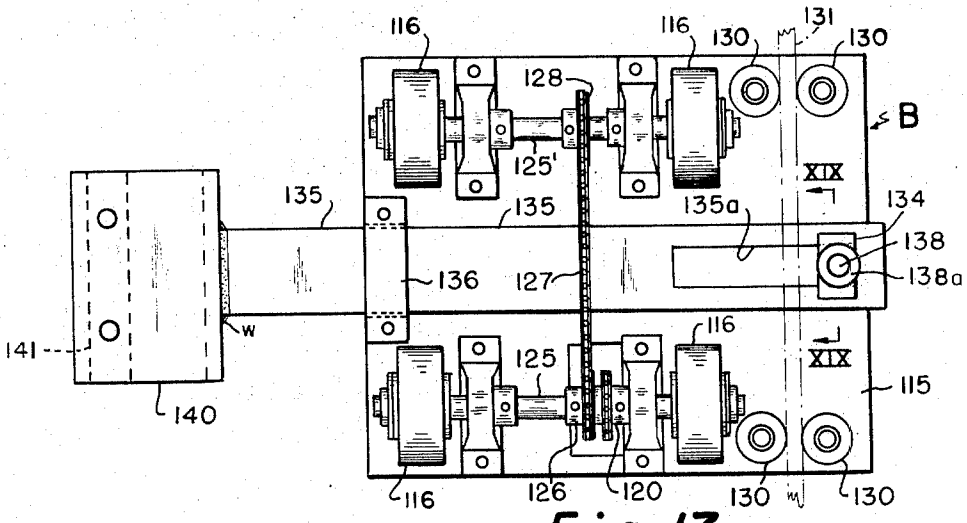


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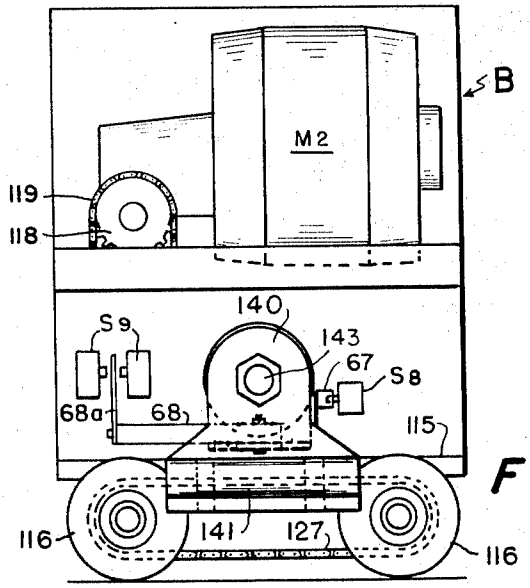


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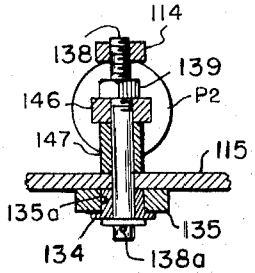


Fig. 19

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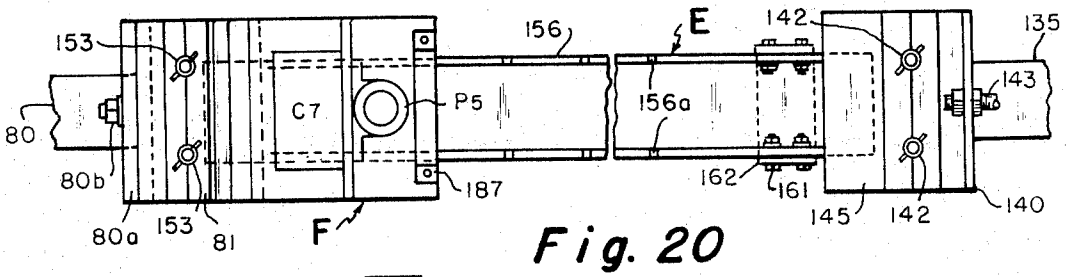


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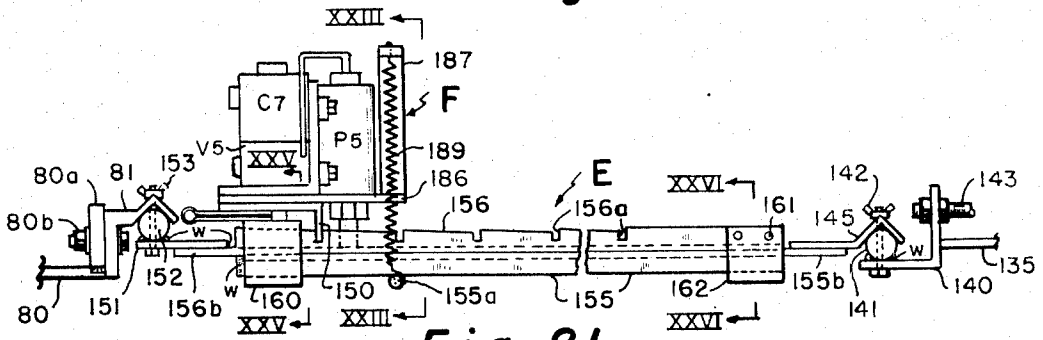


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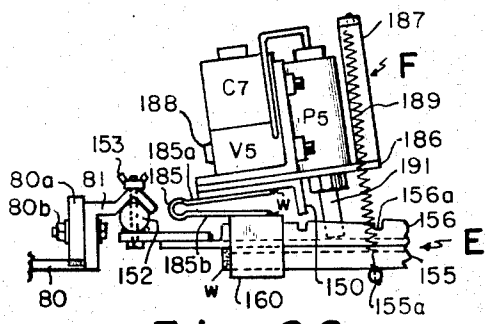


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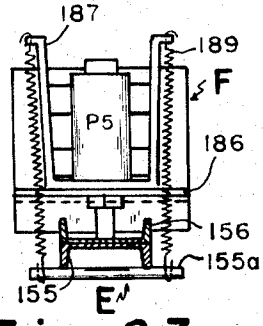


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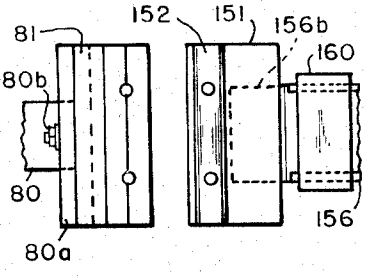


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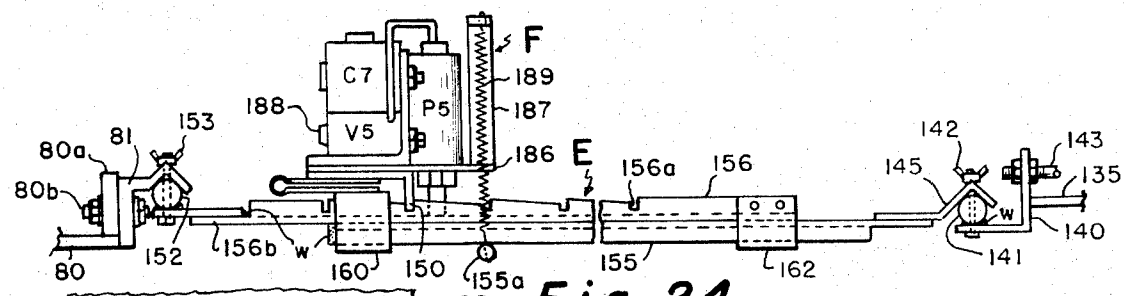


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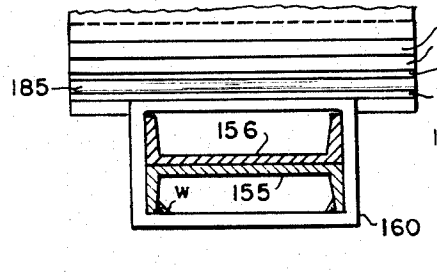


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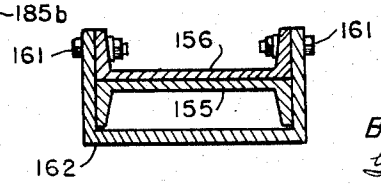


Fig. 26

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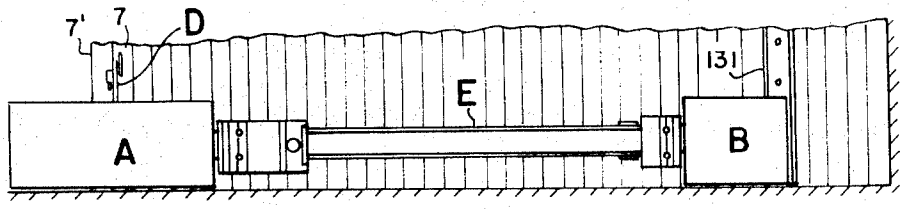


Fig. 30

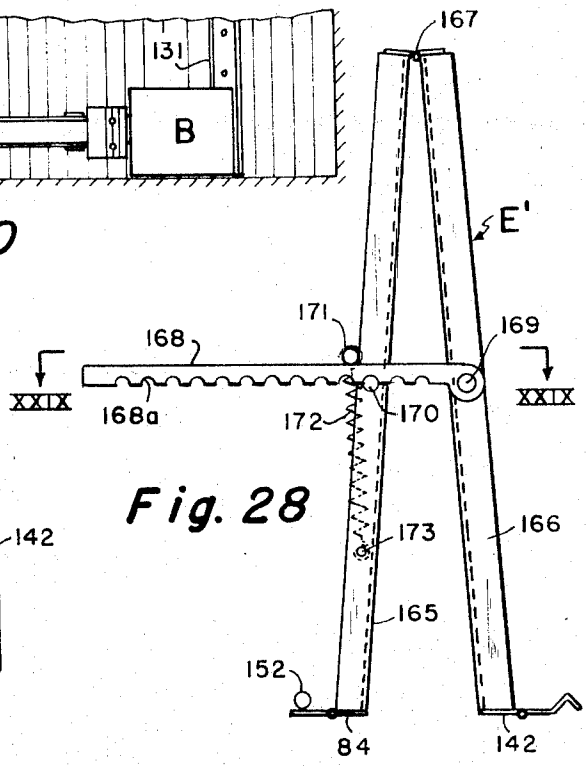


Fig. 28

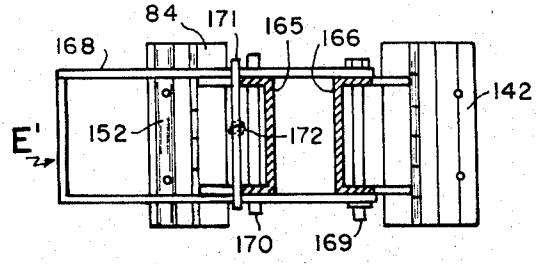


Fig. 29

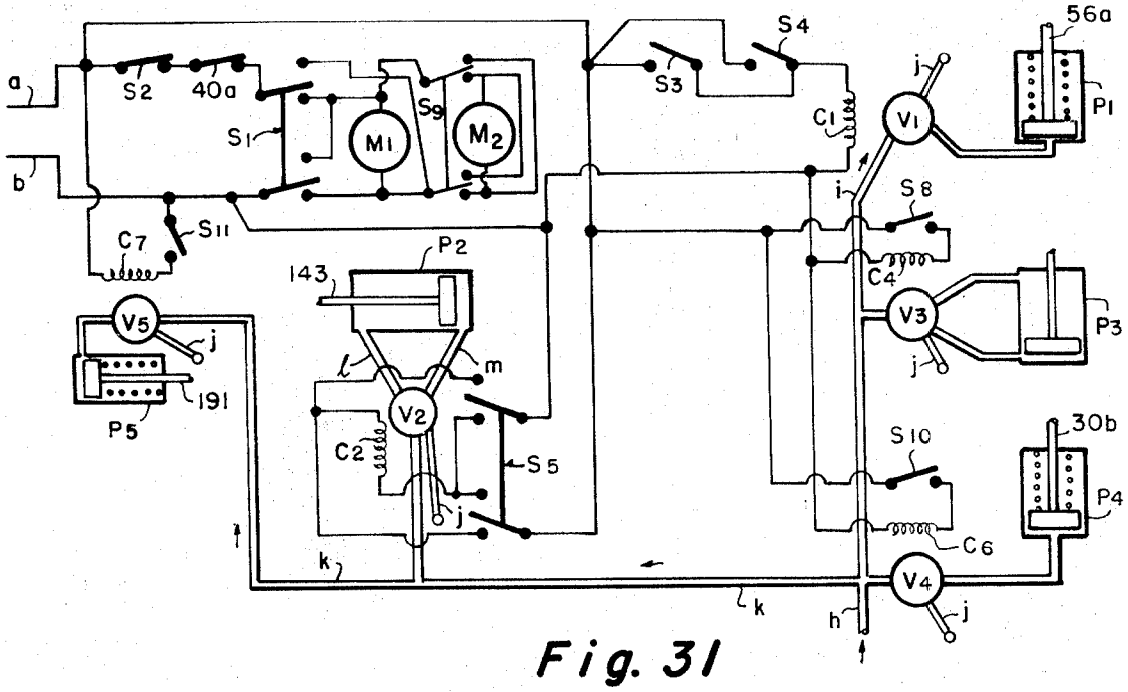


Fig. 31

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AUTOMATIC NAILING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

With reference to representative means for operating nailing and hammering units, a general type of operating circuit arrangement such as illustrated in FIG. 1 of my copending application Ser. No. 824,226, filed May 13, 1969, now U.S. Pat. No. 3,619,895 of Nov. 16, 1971, entitled Nailing Machine for Wood Flooring, may be employed.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an automatic apparatus for quickly and accurately nailing floor members as cross-extending runs to under-positioned supporting members, such as sleepers, joists or a sub-floor and particularly, to an improved nailing machine that can be set and accurately controlled to provide a desired secured relation between a previously laid floor member and a floor member that is in the process of being laid or nailed in place. The machine is particularly suitable for large areas where accurate work is required, such as in gymnasiums, auditoriums, etc.

2. Description of the Prior Art

A power tool such as a nailer that has to be manually carried and used is so heavy that a great amount of fatique is encountered even after a short period of usage. As a result, efficiency of the operator is soon lost as well as accuracy of the operation. Board nailing machines have been devised heretofore, but except for the apparatus of my above-mentioned application, none including those devised specifically for nailing floor members have been commercially paracticable, as indicated by their lack of adoption by those skilled in the art. Such machines have generally been too bulky or complicated for practical utilization.

SUMMARY OF THE INVENTION

A general object of the invention has been to provide an improved floor laying and nailing apparatus or machine.

It has thus been an object of the present invention to provide new and improved automatic nailing equipment or apparatus which will enable a full flexiblity of operation from the standpoint of a desired relationship between a previously laid floor member and one being laid from the standpoint of the closeness of the members with respect to each other, such as to allow clearance expansion and contraction.

Another object has been to provide a machine that will be accurate in its control and relatively simple to operate from the standpoint of the workmen.

Another object of the invention has been to provide a machine that will automatically move and maintain an aligned relationship as it advances across a room and is used to nail a run or course of board members in position on suitable supporting joists, channels, etc.

A further object of the invention has been to provide nailing apparatus in which manual operations are minimized and which enables an automatic, progressively advancing nailing movement in a fully accurate and aligned relationship with respect to the floor area of the room.

A further object has been to devise an apparatus having a control unit whose relationship with a forwardly positioned nailing unit may be adjusted as nailing operations progress.

A still further object of the invention has been to provide a nailing machine that will automatically stop its motor-driven advancing movement in the event that a floor member is not available for nailing.

These and other objects of the invention will appear to those skilled in the art from the illustrated embodiment and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. 1 is a side view in elevation illustrating a board aligning and nailing unit of apparatus incorporating the invention and in an operating position for nailing a floor member in position with respect to a previously laid floor area;

FIG. 2 is a bottom plan view on the scale of and of the apparatus of FIG. 1;

FIG. 3 is a front end view in elevation and FIG. 4 is a rear end view in elevation on the scale of and of the apparatus shown in FIGS. 1 and 2;

FIG. 5 is a fragmental horizontal section on the scale of and taken along the line V—V of FIG. 1; this view particularly illustrates the resilient or flexible mounting of a nailer of the apparatus of FIGS. 1 and 2;

FIG. 6 is a greatly enlarged fragmental side section particularly illustrating the completion of a nailing operation and a partial withdrawal of the nail-driving blade or pusher of the nailer;

FIG. 7 is a side view in elevation on a slightly enlarged scale and FIG. 8 is an end view in elevation on the same scale as FIG. 7 and illustrating a removable rim construction that may be used for wheels of any of the driven units of the present invention to accommodate for different thicknesses of wood flooring members to be laid;

FIG. 9 is a side view in elevation on an enlarged scale with respect to FIGS. 1 and 2 illustrating a side-positioned motor-drive-controlling and travel-area-sensitive wheel unit that may be detachably connected to either side of the apparatus of FIGS. 1 and 2 for controlling the operation of its nailer unit as well as for stopping its floor traversing movement when an additional floor board is required along a floor run;

FIG. 10 is a top plan view in partial section on the scale of and of the apparatus of FIG. 9;

FIG. 11 is an end view in elevation on the scale of and taken in the direction of the arrows XI—XI of FIG. 9;

FIG. 12 is a side view in elevation on the scale of FIGS. 9 to 11, showing a smaller diameter of traveling wheel and a modified form of nailer operating cam construction;

FIG. 13 is a side view in elevation on the scale of FIG. 1, with some parts omitted to better illustrate operational parts of lifting or tilting means; in this view, the nailer unit is shown in a forwardly upwardly raised or tilted position as accomplished by the tilting means;

FIG. 14 is an end section in elevation on the scale of and taken along the line XIV—XIV of FIG. 13;

FIG. 15 is a side view in elevation on the scale of FIG. 1 and illustrating a control unit adapted to be hitched or connected to the unit of FIG. 1 in a backwardly aligned and cooperatively associated relationship with respect thereto; this machine or unit has means for positively guiding it, and thus the connected unit of FIG. 1 across or along the width of a floor area, and also for advancing the machine of FIG. 1 one board forwardly

after a run of flooring members or boards has been nailed in place preparatory to nailing a second run in place;

FIG. **16** is a horizontal section on the scale of and taken along the line XVI—XVI of FIG. **15**; this figure shows a draw bar of the control apparatus or unit in a same forward stroke position as in FIG. **15**; the motor support and chain have been omitted for clarity of showing of other structure of FIG. **15**;

FIG. **17** is a bottom plan view of the unit of FIG. **15**; this view shows the draw bar of the apparatus in the same position as FIG. **16**;

FIG. **18** is a front view in elevation on the scale of and of the control unit or machine of FIG. **15**;

FIG. **19** is a vertical fragmental section on the scale of and taken along the line XIX—XIX of FIG. **17**, particularly illustrating the mounting construction of a slidable draw bar;

FIG. **20** is a top plan view of a position-locking unit and of a channel-shaped connector bar assembly suitable for utilization between the units of FIGS. **1** and **15**; this figure is on a slightly enlarged scale with respect to such figures;

FIG. **21** is a side section in elevation on the scale of FIG. **20** and of the assembly of such figure; these two figures show the connector assembly in its maximized telescopically closed or minimum length relationship, as may be employed when the nailing apparatus of the invention is being started in its floor laying operation;

FIG. **22** is a fragmental side view in elevation on the scale of FIG. **21** and showing the position locking unit in a raised or unlatched position;

FIG. **23** is an end section in elevation on the scale of and taken along the line XXIII—XXIII of FIG. **21**;

FIG. **24** is a view similar to and on the scale of FIG. **21**, but showing channel-shaped connecting bars of the assembly in a one-step expanded relation with respect to each other which may be accomplished after one board run has been nailed and a next succeeding board run is to be nailed;

FIG. **25** is an enlarged end section in elevation along the line XXV-XXV of FIG. **21**, and FIG. **26** is a similar end section on the same scale and along the line XXVI—XXVI of FIG. **21**;

FIG. **27** is a top fragment on the scale of FIG. **20** particularly showing the end connecting means for connecting the bar assembly to the connector bar of the nailing unit;

FIG. **28** is a side view in elevation illustrating a modified form of connecting assembly in the nature of an A-frame between nailing and control units which may be used initially to enable a closer operation with respect to a back wall of a room than the assembly shown in FIGS. **20** and **21**; after the unit of FIG. **28** has been expanded to its maximum expanded relation, then an assembly such as shown in FIGS. **20** and **21** may be utilized to extend the area of coverage;

FIG. **29** is a horizontal section on the scale of and taken along the line XXIX—XXIX of FIG. **28**;

FIG. **30** is a schematic top plan view showing an overall apparatus assembly embodying the assembly of FIG. **20** as utilized in nailing a cross-extending floor member with respect to a previously laid cross-extending run; and

FIG. **31** is a circuit diagram and fluid flow schematic showing an operating system for apparatus of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus illustrated utilizes a forwardly positioned nailing unit A having, as shown in FIGS. **1** and **2**, an upright support frame structure **10** which carries a board-positioning bumper or hammer head **78** and a nailer **42** having a head **50** (see FIG. **6**) for securing a length of wood flooring member **7'** (shown as of a tongue and groove type) on or across floor sleepers, joists or channels **5** or on a sub-floor **6**. In FIG. **1**, the frame **10** is positioned for rolling movement back and forth along a starting area of a floor C that is being laid, or longitudinally of an endwise-aligned run or course of wooden boards or floor members **7'** that are to be properly aligned, positioned and secured with respect to a previously nailed line or run of adjacent floor members **7**. A pair of supporting rollers **15, 16** is mounted on each side of the frame **10** and on opposite ends of an associated one of a pair of forwardly extending, side-positioned drive shafts **17**. The back roller **16** of each pair is shown of narrower width than the associated wide-track front roller **15**; the front roller **15** has a width substantially corresponding to the width of a pair of sidewise-abutting and interfitting floor boards such as **7** and **7'** (see FIG. **1**). Each drive shaft **17** is journaled within a pair of spaced-apart bearings **20, 20'** and is held in operative alignment therewith by a pair of set screw mounted collars **18***a* and **18***b* (see FIG. **2**).

Each drive shaft **17** for an associated pair of rollers **15, 16** carries a chain sprocket **22** centrally thereof for actuating it. A cross-extending electric motor M_1, such as of a geared speed-reducing reversible, direct-current type, has an output shaft **26a** on which a drive sprocket **25** is mounted. As shown particularly in FIGS. **1, 2** and **4**, the drive sprocket **25** interleaves or meshes with a continuous chain **23** that is also interleaved over the sprockets **22** of the side-positioned drive shafts **17**. Thus, the electric motor M_1 may be energized to move the front aligning and nailing unit A of the apparatus in either direction or back and forth along previously laid floor members **7** of a room floor structure C. The support frame **10** for the front unit A has a pair of inclined, transversely spaced-apart, front guide and aligning rollers **35** that are peripherally grooved at **35***a* (see FIG. **1**) to fit over the tongue portion of and along an outer longitudinal side of a floor member **7'** that is being laid. Each guide roller **35** of the pair is journaled on a stub shaft **36** that projects in a forwardly downwardly inclined relation (shown as about 9½° off the vertical from the front end portion of the support frame **10**). The upper end of each shaft **36** is threaded to receive a nut **36***a* for securing it in position on slightly angled mounting portion **11***c* of a platform or floor **11** of the frame **10**. In the figures, **11***a*, **11***b* and **11***d* represent cut-out portions in the platform **11** for accommodating floor rollers **15** and **16**, sprockets **22** and an angle shaped lift member **34** to be described. As shown, the frame structure **10** has spaced-apart front and back pairs of upright members or legs **12** and **13**, respectively. Motor M_1 has a mounting flange **26***b* that is secured on an auxiliary platform **28** by bolts **27**. As shown in FIG. **1**, the auxiliary platform **28** is secured on the main platform **11** by means of spaced-apart, upright lugs or fingers **29**.

The nailer unit **42** which may be of a commercial type, such as manufactured by Pasalode Company Di-

vision of Signode Corporation of Skokie, Ill., as its Bronco 91030, may be used and is shown mounted by a pair of opposed, reinforcing side pieces **43** that carry a pair of pivot pin or stub shafts **44**. The shafts **44** are swingably mounted on a pair of forwardly extending side brackets or wings **45** and **46** to extend or slope backwardly from the frame **10** at the front end of the unit A, between the guide rollers **35**. The nailer unit **42** has been modified to provide its housing with an upper, continuous side flange **52** on which a top cover member **53** is removably secured by peripherally spaced-apart bolts **54**. This facilitates inspection and repair of the nailer **42**. As shown in FIGS. **1** and **3**, four bolts **54** mount the plate **53** on the end of the nailer unit **42**. This allows the lower end of the nailer to move parallel to the run of the flooring and its driving blade **51** to momentarily follow a nail **8** as it is driven into the flooring (see FIG. **6**). This mounting is similar to or corresponds to the mounting of the nailer 27 in my U.S. Pat. No. 3,619,895, in that the nailer unit **42** is permitted to have a follow-through swing on the stud shafts **44** during the driving operation. Feed delivery magazine **40** for nail or clip groups is provided with a side-mounting holder and spring-loaded follower **41**. The follower **41** (see FIG. **1**) carries an angle piece **41***a* thereon to engage and open a spring-loaded slide switch **40***a* when the follower has reached the lower solid line position of FIG. **1**, thereby indicating that the usable supply of nails or staples has been substantially exhausted. The switch **40***a* is normally closed, but when opened to open line *a* of the circuit of FIG. **31**, it immediately stops the operation of drive motors M_1 and M_2. When a new clip of nails or the like is inserted and the follower **41** is at its upper dot and dash position of FIG. **1**, the switch **40***a* will again be in a closed position.

The unit A also has a swingable arm **75** whose lower leg portions **75***a* support and carry the bumper or hammer head **78** which is adapted in its "down" stroke to hit the front end of the support frame **10** to transfer driving force to the front guide rollers **35** and hammer or drive a board member **7'** into a fully aligned and proper tongue and groove interfitting relation with a board member **7**. The hammer head **78** serves as an impact means that is complementary with the cylinder P_2 for assuring that a run of the frontmost floor members **7'** is nailed in a proper interfitting and aligned relation with a run of previously laid and nailed floor members **7**. The operation of the motor or cylinder P_2 provides, in effect, a resilient means which allows take-up movement of the unit A when, for example, the hammer **78** strikes it to assure that an immediate board **7'** to be nailed is in its fully "in" position shown in FIG. **1**. As shown in FIG. **17**, draw bar **135** may be moved the length of slot **135** *a* with the piston of fluid motor P_2 on the platform **115** of unit B.

The nailer unit **42** is resiliently held in a central position on its pair of mounting pivot pins **44** (see FIG. **1**) by a pair of side-positioned coil springs **55** (see FIG. **5**) which are carried in an opposed relation by opposite pairs of mounting cups **12***a*, **42***a*. The cups are respectively carried by upright frame members **12** and by the housing of the nailer unit **42**. This resilient, spring-centered mounting enables the nailer unit **42** to slightly pivot or swing to start and finish its nailing operation, without damage to a nail **8** (see FIG. **6**) that is being driven and without stopping the sidewise movement of the unit A or interfering with its continuous operation. The springs **55** return the unit **42** to its centered positioning after each nailing operation has been completed; about one-fourth of an inch of swing has been found to be the maximum needed when advancing the unit A at a speed of up to about 20 feet per minute.

The hammer head **78** is positively operated in both its forward and backward strokes by means of a fluid cylinder or pneumatic motor P_3 that is carried by an upper end portion of the support frame **10**. A clevis or bifurcated mount **71** (see FIGS. **1** and **4**) is secured to extend downwardly from the inside of a top cover member **14***a* and pivotally carry the back end of the motor P_3 through the agency of backwardly projecting lug **70***a* and a pivot pin **72**. The motor P_3 has a forwardly extending piston rod **73**. The forward end of the piston rod **73** has a connector portion **74** that connects it to a clevis end **73***a* that is pivotally secured by pin **76** to the upper end of swingable, dog-leg-shaped hammer arm **75**. Lower, longer length leg portion **75***a* of the hammer arm **75** carry transversely-extending bumper or hammer head **78** which may be constructed of hard rubber or other suitable material. The hammer arm **75** is operatively carried by pivot shaft **77** on vertical members **12** of the support frame **10** to extend between the front pair of floor member engaging guide rollers **35**, forwardly thereof.

The nailer **42** extends backwardly within the frame **10** to periodically drive-in a nail **8**, shown particularly in FIG. **6**, that is fed from the nail-carrying magazine **40** that is secured within the frame **10** and extends to a nailing head **50** (see FIG. **6**). Spring-loaded follower **41** is carried by the magazine **40** to automatically feed a nail each time the head **50** and driver blade **51** of the nailer **42** move towards a downward-backward driving position. The switch **40***a* may be opened when only about five or six nails or staples remain in the magazine **40**. As shown in FIG. **31**, switch **40***a* is normally closed.

When exposed beams or joists **5** are present, the operation of the nailer **42** may, as set forth in my U.S. Pat. No. 3,619,895, be controlled automatically by a switch **37** in FIG. **1** that is operated by a feeler finger **37***a* that is positioned forwardly of the unit A on an angle-shaped front cover member **14***b*. The switch **37** may be used instead of the switch S_4 of wheeled control unit D of FIG. **9** to when closed, electrically energize a solenoid (such as C_1) to open control valve V_1 for introducing a positive flow of fluid into fluid-operated cylinder or motor P_1 of the nailer **42**. If desired, also as set forth in my prior patent, a positive fluid flow may be introduced at this time into fluid cylinder or motor P_3 to operate the hammer head **78**. The switch **37** may be closed when the feeler **37a** periodically engages the side of a joist **5**, as the machine or apparatus is being moved transversely along or across the floor area C. However, the employment of a wheeled side-positioned control unit D (see FIGS. **9** to **12**) provides a spaced-apart control of nailing operations irrespective of whether or not a sub-floor **6** is used. Thus, the feeler switch means **37**, **37***a* may be eliminated.

When valve V_1 is opened by the electrical energization of solenoid C_1 by a manual closing of the switch S_3 or an automatic closing of the switch S_4 of FIG. **31** (see also FIG. **37** of FIG. **1**, positive fluid flow is suplied from line *i* to the fluid cylinder or motor P_1 to actuate the nailer **42** to drive a nail **8** fed from the magazine **40**. Piston rod **56***a* of fluid motor P_1 carries a clevis **57** (see FIG. **1**) on its end to which a trigger connector member

58 is pivotally connected by a pivot pin 57a. A spring-pressed trigger member 59 has a finger 59*b* (see FIG. 4), and is pivotally connected by pin 58*a* to the other end of the connector member 58, and carries a shaft portion 59*a*. The shaft portion 59*a* is rotatably carried within a slotted opening 60*a* in a support shelf member 60. The shelf 60 is secured at its inner end to extend outwardly from an L-shaped bracket member 61 that forms a part of the frame structure 10. A platform 62 is secured on leg portions of the member 61 to project upwardly therefrom and mount the fluid motor P_1 thereon. When trigger finger 59 is depressed against spring tension, it closes the valve V_1 and connects the cylinder of the fluid motor P_1 to exhaust line *j;* at this time, spring biasing on the fluid motor P_1 causes it to return to its upper starting position wherein the piston 56*a* is withdrawn and the driver blade 51 50 of the nailer 42 is returned to its upper starting position.

The frequency of the operation of the hammer head 78 may be controlled by a switch S_8 as used in combination with and operated simultaneously with nailer operating switch 37 of FIG. 1 or switch S_4 of FIGS. 9 and 31. Also, the switch S_8 may be manually operated or a purely manual switch may be submitted to provide for manually controlled operation of the hammer if it should be desirable. It will be noted that in the circuit diagram of FIG. 31, S_4 and S_3 represent alternately used switches, in the sense that switch 37 may be used in the circuit at the location of S_4 when the apparatus is being employed to directly lay flooring on exposed joints. A switch S_4 may be used when the apparatus is being employed to lay flooring on a previously laid subfloor. The operation of the hammer may also be effected by a micro switch S_8 when a floor board of a run being nailed has not been properly seated. If the floor boards 7′ to be laid have absorbed an excessive amount of moisture and have accumulated a wider distance than the connector assembly, spacer bar or rod assembly between units A and B will permit, this will force unit A forwardly with respect to unit B, causing piston rod 143 to advance or extend slightly with respect to shifter cylinder P_2 to thereby cause side-projecting finger or lug 67*a* to close or activate the micro switch S_8 (see FIGS. 16 and 31). The operation of the hammer head 78 will force the board 7′ into a proper position, such that it can thereafter be secured by nailing in accordance with the outlined procedure. The cylinder P_2 acts like a shock absorber and returns to its initial position thereafter, thus causing the other parts to assume their normal working positions.

Driving wheel pairs 15 and 16 of the unit A may, for example, be set-up for nailing 25/32 of an inch of floor thickness and then adapted to 33/32 inches of floor thickness by removing one-fourth inch thick steel rim flanges or tires thereon, see particularly FIGS. 7 and 8. The most popular thickness of flooring used is and /b 33/32 of an inch. The tongues and grooves of both thicknesses are the same size and have the same distance from the bottom of the boards. Thus, the nailing head 50 will be in the same position for both thicknesses. The distance from the top of the board 7′ being laid to the bottom of the plate 11 of unit A thus only changes by one-fourth of an inch. The rims are shown as having two semi-circular halves 47 and 47′ that are removably secured together by machine screws 48. The screws 48 are illustrated as entered along slots 47*a* in one rim half 47 and are threaded to fit within threaded bores 47*b*′ of the other rim half 47′. The apparatus can thus be adapted to different thicknesses of wood or floor members by varying the diameter or sizes of the two pairs of driving wheels of the unit A. In this connection, the wheels 15, 16 may have one or more sets of removably clamping tires in order to quickly adapt them without substituting various sizes (diameters) of wheels for this purpose. The width of the rims will preferably correspond to the respective widths of the drive wheels 15, 16.

The nailing operation is accomplished by moving the apparatus from right to left and from left to right across the room or space following the run of the floor boards. That is, the nailer unit A is reversible in its movement along the floor C, as actuated by drive motor M_1 and is operative in nailing a course or run of boards 7′, whether it is moving in one direction or the other across the room. The frequency of the nailing action, instead of being controlled by a micro switch operating whisker or feeler finger 37*a*, may be accomplished by employing an interchangeable cam 97 or 97′ (see FIGS. 9 and 12). Thus, as shown in FIGS. 9 to 11, a cam and feeler-operated switch S_4 may be carried by demountable, side-positioned wheeled control unit D and operated in a position-spaced relation to actuate the nailer 42 each time it reaches an aligned relation with a joist member 5 or has moved a spaced distance along previously laid subflooring.

The control unit D has been provided for detachable or quick demountable mounting on each platelike side wall 14*d* which with top wall 14*a*, front end wall 14*b* and back end wall 14*c*, defines enclosing housing or casing 14 of the nailer unit A. As thus used, the unit D serves as a wheeled leading unit for the nailer unit A in its movement back and forth across the room that is being floored, with its wheel 95 adapted to ride on a completely nailed floor member 7 and its feeler finger 103 adapted to ride on a floor member 7′ that has been newly laid for nailing in position. The feeler 103 is adapted to shut-off the drive motor M_1 of the unit A through the agency of a micro switch S_2 when, as shown by the solid lines of FIG. 9, the feeler finger 103 moves off the end of a board member 7′ that is being laid. The dot and dash lines of this figure show the normal position of the finger 103 when the machine is operating or moving along the floor. In other words, the switch Sserves as stop switch for movement of the nailing unit A when a worker has neglected to insert the next floor member or piece of members 7′ that are to be nailed by one direction of sidewise movement of the apparatus along the width of the floor C. A conventional delay timer may be used with the switch S_2 to give a workman full opportunity to align a new board member 7′ that is being laid. Such delay timer may be of any suitable commercially available type, such as one which requires a short period of heating up current flow to cause full current full current flow to a main element to be energized.

The operator, of course, inserts the board 7′ beneath the feeler 103 and thus causes it to move from the full line position of FIG. 9 to the dot and dash position thereof. This would immediately cause the mechanism to be energized if a timer was not used to provide a slight delay for permitting the proper insertion of the board member.

In operating the nailing unit A with a detachably mounted, side-position, movement and switch control

or operating unit D, a manual forward stop reversing switch means (not shown) may be provided in series with the feeler operated switch S_2 and is opened to stop the drive motor M_1 when the coupled units A and B have approached to within a few feet of a side wall of the room. Then, the unit D to the other side of the unit A and the drive motors are thereafter activated by closing the manual switch means to complete movement of the units close to the side wall. Feeler **107** of a second micro switch S_4 will periodically engage the cam **97** or **97'** during the movement of the unit A to operate the nailer **42** on the basis of the distance transversed by the wheel **95** of the unit D, representing, for example, the distance between a pair of adjacent joists **6**. FIG. **9** shows a double face cam **97** suitable for effecting a nailing switch operation for a ten inch spacing of joists **5** (using a wheel **95** of **20** inches circumference) and FIG. **12** shows a single face cam **97'** suitable for a twelve inch spacing of joists **5**, using a wheel **95** of smaller circumference, compare FIGS. **9** and **12**.

The control unit D of FIGS. **9** to **11** has a pair of spaced-apart slide mounts **90** that are secured on the end of a transverse mounting shaft **92**, as by weld metal *w*. The inner end of each mount **90** is provided with a pair of spaced-apart slide flanges **91** that define a valley therebetween. Each side plate member **14***d* of the unit A has a rectangular, vertically extending pair of slots **85** therein which are enlarged at their upper ends and reduced at their lower ends. The enlarged upper portion is the portion adapted to initially receive the flanged ends of each mount **90**, and the reduced lower portion is adapted to provide a complementary slide fit with the groove between each pair of flanges **91**. To retain the mounts **90** in position, a swing finger or locking dog **86** that is pivoted at **87** on the side wall plate **14***d* is adapted to be swung downwardly by its outwardly projecting grip pin or handle **88** to close-off the upper and wider portion of each slot **85**. When the unit D is to be removed from one side wall plate member **14***d*, then the locking dog **86** is swung upwardly to rest against a pin **89** (see FIG. **11**) and, at this time, the entire unit D can be lifted out of its mounted relation by sliding its back end portion and particularly, its mounts **90** upwardly into the wider portion of each latching slot **85** and then moving the unit outwardly. At this time, the unit D may be moved over to the other side of the nailing unit A and the mounting operation repeated, ready for the movement of the nailing unit A in an opposite direction across the room of the building.

The unit D has a swingable arm **94** on which a floor-engaging wheel **95** is mounted. This swing arm **94** is adapted to extend from the side plate **14***d* of the unit A in such a manner that the wheel **95** will move along the floor C in the direction of the board or flooring runs. Of the two feeler-operated micro switches S_2 and S_4, one S_4 projects along the swing arm **94** into the path of rotative movement of cam **97** that is carried for rotation on a wheel shaft **96**. The cam **97** provides an engagement with flexible feeler **107** of the switch S_4 in a timed relation such that the nailer **42** is always at or is immediately adjacent a joist **5** to which a floor board **7'** is to be nailed. The swing arm **94** represents a longitudinally extending central body portion that is provided with a backwardly extending, integral, swing-mounted arm portion **94***a*. The upper end of the arm portion **94***a* has a journaled fit by means of a sleeve bearing **93** centrally of and of the mounting shaft **92**. A pair of limit pins **92***a* retain the arm **94***a* in its central positioning on the shaft **92** for swinging movement with respect thereto.

It will be noted that the switch S_2 is adjustably mounted on an upstanding, wheel-carrying plate member **100** that is pivotally mounted on the forward end of the arm member **94** by cross-extending shaft **96** and a key **99** (see FIGS. **9** and **11**). In this connection, the plate **100** has a pair of enclosed and elongated vertical slots **100***b* and **100***c*. The micro switch S_2 has side mounting tabs **101***a* that adjustably secure it on the face of the upright member **100** by bolt and nut assemblies **102** that fit within the slots **100***b* and **100***c*. This permits a suitable vertical adjustment between the switch S_2 and wheel **95** which is rotatably carried on the shaft **96** for rotation by frictional engagement with the floor.

The cam **97**, as shown in FIG. **9**, is also mounted on the shaft **96** for rotation thereon and is secured to the wheel **95** by pairs of nut and bolt assemblies **97***a*. In this arrangement, each end face of the cam **97** provides a camming action on a switch operating finger or flexible feeler **107** when, for example, one cam face is in abutment therewith, as shown in FIG. **9**. This closes micro switch S_4 to activate electric solenoid C_1 to, in turn, provide positive fluid flow to fluid motor P_1 for driving a nail **8** through a floor board **7'** into a joist member **5**. The micro switch S_4 which is employed to operate the nailing unit **42** is removably secured to the arm **94** by bolts **106** in such a manner that its feeler or operating finger **107** projects in a forwardly downwardly declining direction, such that it will be flexibly bent downwardly to close the switch S_4 each time one of the two operating end faces of the cam **97** engages it.

The upright plate member **100** has a vertically extending, planar edge wall portion **100***a* that is adapted to engage in an abutting relation with either one of a pair of centrally inwardly inclining, sloped, stop edges or shoulders **94***b* and **94***c* that are carried along one side of the arm member **94**. The purpose is to limit a backward swinging movement of the plate member **100** on shaft **96** to a vertical upright position which is resiliently retained by a tension spring **110**. The spring **110** is at its one end secured by a mounting pin **111** on the housing of the switch unit S_2 and, at its other end, within a perforated flange portion of an angle piece **108**. The angle piece **108** is secured by a threaded bolt **109** on a side of the swing arm **94**. It will be apparent that the upright plate member **100** and the switch S_2 carried thereby is thus permitted to flexibly swing to the right of FIG. **9** on the shaft **96** when, for example, the unit D is being changed to the opposite side of the unit A. It will be noted that the motor M_1 will only be actuated to run the unit A when the finger **103** is in an inclined position (see the dot and dash position of FIG. **9**) and is deactivated when the finger **103** is in the solid line vertical position of FIG. **9** or when the finger **103** rides-off the end of a floor member **7'**. The wheel **95** must always be positioned on a previously nailed board and toward the back of the unit A, as used on either side of such unit. The feeler or whisker **103** will run on a board **7'** being nailed and in front of the machine in the direction of its travel, in front of the wheel **95** of FIGS. **9** and **10**, and on either side of the unit A. The unit D is not inverted in the operation, only its part **94**. For example, the part **100** may be held vertically and the part **94** rotated counterclockwise down and around

until the edge **94***c* abuts the opposite side of the part **100**, entailing about 225° of rotation. The spring **110** permits the member **100** to be manually swung clockwise of FIG. **9** about 225° about shaft **96** and to hold it in such a reversed position against abutment **94***b* when the unit D is to be moved from one side of the unit A to the opposite side thereof. The unit D is used in an upside-down position as attached to the opposite side of the unit A.

In FIG. **12**, a modified form of cam **97'** is illustrated as having only one operating cam face, since instead of being mounted centrally on the shaft **96** like the cam **97**, it is mounted at one end portion thereof and it has only one end face.

Maple flooring, such as used in gymnasiums, is required to have a moisture content of between 5 and 7 percent in the state of Arizona. Other places in this country require flooring of higher moisture content and thus, during the installation of maple floor, it has been customary to use spacers or washers between a pair of board runs to give a normal five-eighths expansion to each 6 feet width or transverse dimension of the flooring, measuring across its grain. The highest humidity condition in existing schools in the Pittsburgh area is between 12 to 13 percent. It will be apparent that the insertion and removal of washers is time consuming, may damage the flooring during removal, and is unsightly if the flooring does not expand and close the gaps. In accordance with the present invention, the unit A is so operated by means of the unit B in order to automatically provide a one-step advance of the forward operating position of the unit A that is represented by the width of the wood piece or member **7'**, plus any desired clearance for expansion. For example, the advance may be 2¼ inches plus a fraction of five-eighths of an inch, as determined by dividing five-eighths of an inch by the number of boards contained in 6 feet of flooring width or extent. It will be apparent that the distance is determined by the length of the stroke of the piston P_2 and by the spacing between the latching slots of the draw bar **155**.

Referring particularly to FIGS. **13** and **14**, means is shown for raising the nailing unit A about or on its back end to facilitate the insertion of a run of board members **7'** after a previous run has been nailed in position. This raising or upward swing of the unit in conjunction with a forward stroke of the piston **143** of the shifter fluid motor P_2 of unit B, enables the guide rollers **35** to clear the inner area in front of a previously laid run of floor members **7**, and is effected by a backwardly inclined downstroke of a piston rod **30***b* of a fluid cylinder or motor P_4. As shown, the motor P_4 at the rear end of its housing, has a mounting lug **30***a* that is pivoted by a pin **31***a* on a clevis **31** that is mounted on and extends backwardly from one of the upright frame members **12**. The outer end of the piston rod **30***b* has an operating head **30***c* that is swingably mounted on an upper foot portion **32***a* of a swing crank arm **32** and retained thereon by means of a pair of through-extending pins **32***b* (see particularly FIG. **14**). The crank arm **32** has a lower foot portion **32***c* which is swingably carried within an upwardly projecting bifurcated or forked mounting bracket **33** and retained thereon by means of cross-extending pins **32***b*. The angle or dog-leg shaped lift member or piece **34** is at its upper end secured as by weld metal or a set screw on the foot portion **32***c* to rotate or turn therewith. The lift member **34** is adapted to be swung from a lowermost position of FIG. **13** to an uppermost out-of-the-way position, such that its lower end is above the floor-engaging operating level of the driven rollers or wheels **15, 16**.

As shown in FIG. **31**, the piston rod **30***b* of the motor P_4 may be positively energized in its "down" stroke to move the member **34** to its downmost position. By closing switch S_{10} to energize solenoid C_6, the control valve V_4 is opened to introduce a positive fluid flow from the line *k* to the fluid motor P_4. On the other hand, when the switch S_{10} is opened to de-energize the solenoid C_6, the valve V_4 is closed to exhaust fluid in the motor P_4 through outlet *j*. This permits a spring-induced return of the piston rod **30***b* to its upper position and of the member **34** to its upwardly swung out-of-the-way position. The switch S_{10} is automatically operated and is shown as a micro switch positioned on the platform **115** of the control and guide unit B (see FIGS. **16** and **18**) for closing movement when a side-positioned lug or finger **67***b* engages it during a forward movement of piston rod **143**, draw bar **135** and a backwardly extending switch-operating side arm **67**. The switch S_{10} is opened when the finger **67***b* disengages it during the backward stroke or movement of the piston rod **143**.

A positive and automatic control of the spacing advance of the nailing unit A for each back and forth run across a room is effected by means of back-positioned control and guide unit B (see FIGS. **15** to **18**). The unit B has a support frame and table structure **115** and side-positioned pairs of floor-engaging, motor-driven, wheels or rollers **116**. A reversible, direct-current operated, speed-reducing electric motor unit M_2, similar to the motor unit M_1, is shown carried by the frame **115** and, through the agency of a pair of gear sprockets **118** and **120** and chain **119** (see FIG. **15**), positively drives or activates a pair or side-positioned wheel driving shafts **125** and **125'** (see also FIG. **17**). Each shaft **125**, **125'** has a pair of the floor-engaging wheels or rollers **116** secured thereon. The shaft **125'** is actuated through the agency of sprocket **126** of the shaft **125**, chain **127** and sprocket **128**. The drive motor M_2 for the unit B is operated in substantial synchronism with the drive motor M_1 of the unit A, in the sense that both units should move at the same rate of speed along the floor surface C.

The front end of the unit B has a variable-position draw bar coupling assembly connection with the back end of the unit A. Draw bar **135** and fluid motor or cylinder P_2 are swingably mounted at their back ends to provide a somewhat floating type of horizontal movement and that is operatable to activate and deactivate drive motor M_2 for the unit B, as controlled by a three-way switch S_9.

Although an "in time" or synchronized operation of the motors M_1 and M_2 may be accomplished in a number of ways, I have in FIGS. **16, 18** and **31** shown one form of arrangement which utilizes a three-way switch S_9, as actuated or controlled by the piston rod **143** of the motor unit P_2. When the motor M_1 of the unit A is energized, for example, to move it towards the right-hand side of a room, this causes the fluid motor P_2 to swing on its pivot **138** to thus cause the piston rod **143**, side-extending switch arm **68** and vertically extending switch operating finger **68a** to swing to the right. This closes one contact of the switch S_9 to thus energize motor M_2 in the same direction as motor M_1 and produce movement of the unit B to the right with the unit

A. On the other hand, when movement of the unit A is initiated towards the left-hand side of the room, the lag of the unit B will cause switch finger **68***b* to contact the left contact of the switch S_9 and energize motor M_2 in its reverse direction and move unit B towards the left side of the room. The thus initiated movements of the motor M_2 are continued as long as the motor M_1 is energized to move the unit A in a given direction. Once the unit A stops, then the light switch closing lag with respect to the unit B is obviated and the switch S_9 moves to its central neutral or stop position thus de-energizing the motor M_2 of the unit B. With reference to FIGS. **15, 16** and **18,** transversely extending switch arm **68** is secured at its one end to the housing of the fluid motor P_2 for movement therewith and at its other end carries the vertical or upright switch operating finger **68***a*.

The circuit of FIG. **31** shows a manual primary switch S_1 that may be carried for actuating the motors M_1 and M_2 as of a double pole reversing type, with one set of contacts for energizing the motors to rotate clockwise, with another set for energizing the motor to rotate them counterclockwise. The third position of the switch is an open (braking) position. It will be noted that the electrical connections between motor M_1 which is employed to move the unit A across a room and motor M_2 which is employed to move the unit B are such that the switch S_1 serves to provide a simultaneous reversal of the electrical connections to the motor M_2. Since switches S_2 and **40a** are simple connect and disconnect switches, it is immaterial to which side of the current source *a*, *b* they are connected.

The spaced distance between the units A and B may be adjusted manually or by fluid motor P_2 (see FIG. **15**) after a latch member **150** of a position lock unit F of FIG. **22** has been lifted out of locking or latching engagement with respect to an aligned pair of slot portions **156a** in connector channel member **156,** or latch arm **168** of the assembly of FIG. **28** has been lifted out of locking or latching engagement with respect to latching notch or slot portions **168***a* of latching arm **168.** Fluid motor P_2 may be utilized to advance the unit A to a desired operating position for each movement-sweep or board-nailing run across the room.

The unit B is provided with a pair of back-positioned, vertically mounted, opposed, guide rollers **130** which are adapted to engage and ride along a vertical flange of an angular-shaped guide member, rail or piece **131** (see FIG. **15**) that may be bolted or nailed or otherwise temporarily secured to extend along the width of the room within which the apparatus is to operate. Each guide roller **130** is rotatably carried on a boltlike stub shaft **132** that is secured by nuts **133** to extend downwardly from the table **115** and ride below a limit strip **131***a* that is weld-secured to the vertical guide flange of the member **131.** The strip **131a** prevents the back end of the unit B from riding up off the guide flange of the member **131.** A positive stationary guide means is thus provided for the apparatus during the full scope of operation of the nailer unit A within a floor area represented by or proportioned to the available coupling adjustments that may be accomplished in varying the spacing between the units A and B.

In nailing a course or run of floor boards or members **7′**, unit A is advanced to within a few feet of the end of the run adjacent a wall of the room. At this time, the unit A may be stopped by opening manual control switch S_1 which may be mounted on top of the frame of the unit A. The unit B stops automatically in the manner previously explained. At this time, the side-positioned control unit or attachment D is removed from the then leading side of the unit A and its head part **100** is rotated approximately 225°. The control unit D is then in its now upside-down relation attached to the opposite side of the unit A ready for a return movement of the apparatus. The manual switch S_1 is now closed to actuate the motor M_1 in its original direction to complete the nailing of the last few feet, until the unit A reaches the side wall of the room. At this time, the switch S_1 may be opened and shifter switch S_5 manually closed. This activates the fluid motor P_2 to advance the piston rod **143** forwardly. After the piston rod **143** has advanced to its full forward position of FIG. **16,** a switch operating lug or projecting finger **67***b* on the back end of switch operating arm **67** engages and closes micro switch S_{10} of FIGS. **16** and **31** to energize solenoid C_6. It will be noted that the arm **67** is secured at its front end to extend backwardly from the angle-shaped bracket or head member **140.**

Referring particularly to FIG. **31,** the closing actuation of the switch S_{10} causes the solenoid C_6 to open the valve V_4 and, as shown in FIG. **13,** results in a downward-outward actuation of the piston rod **30***b* to raise the front end of the unit A through the agency of the foot of lift member **34.** At this time, the guide rollers **35** are in a forward out-of-the-way position and thus, a new run or course of board members **7′** may be inserted. The forward movement of the piston rod **143** pushes or moves about three inches forwardly to thus cause the same amount of forward movement of connected parts, including the parts **140, 141, 155, 156, 151** and **152** as well as the forward unit A. After a new run of board members **7′** has been inserted, switch S_5 of FIG. **31** is then manually moved to a closed position to energize solenoid C_2 and positively move the shifter piston rod **143** in a back or return stroke. This moves the unit A backwardly. If desired, a mechanical connection (not shown) may be provided between the switches S_5 and S_{11} to cause the switch S_{11} to close first to energize solenoid C_7 and by opening valve V_5, produce a positive unlatching of the connector bar **156** through the agency of a downward movement of the piston rod **191** of the fluid motor P_5, see also FIG. **22.** This is only a momentary action and the switch S_{11} is then opened again as the switch S_5 completes its movement to a fully closed position.

The full closing of the switch S_5 actuates solenoid C_2 and piston rod **143** to move it in its return or back stroke within the motor P_2. During this movement, the latch **150** under the tension of the pair of hold-down springs **189,** then rides into the next or succeeding latching slot **156***a*, see FIG. **24.** It will be apparent that the switch S_{11} may be a separate manual switch and operated in the manner above indicated. The distance between adjacent slots **156***a* is about 2¼ inches, but the pull-back is about three inches. When the latch **150** engages the next adjacent or rearward slot **156***a* in the connector bar **156** and locks in position therein, the cylinder P_2 then pulls the unit A back about three-fourths of an inch to bring guide rollers **35** into an engaging position with respect to a flooring member **7′** of a new run (see FIG. **1**) and, at the same time, bring a board **7′** of the new run tightly against a previously nailed flooring board **7.**

The forward or outward stroke of the piston rod **143** is primarily to advance the machine A for the next succeeding board run. Switch S_5 may be momentarily energized to advance the piston rod **143.** A manual switch (not shown) may be connected in parallel with the switch S_5 for, in the event of a jam, advancing the piston rod **143** of fluid motor or cylinder P_2, and thus the unit A, to enable a repair of jamming without shifting the piston of cylinder P_5. The switch S_8 is normally in a closed position to operate the hammer motor P_3; it is momentarily opened by the forward movement of finger projection **67***a* (see FIG. **16**) as effected to the shifter piston rod and is retained in an open position until the finger **67***a*, on the return stroke of the piston rod **143,** again engages the switch S_8 to close it. The hammer **78** may be de-activated through the de-activation of the solenoid C_4 and control valve V_3 by opening switch S_8 only when the drive motors are de-activated and during parts of the operation in which a new run of board members is being inserted. An additional manual switch (not shown) may be used in parallel with switch S_8 in the circuit diagram of FIG. **31** to enable a separate manual actuation of the hammer if, at any particular time, it is desirable to so do.

When the apparatus is used for nailing-down a single floor or in other words, a floor directly on joists, about 5 to 6 feet of flooring should be laid for initially positioning the units A and B and the guide bar or channel **131.** An adjustable channel type of coupling assembly E, such as illustrated in FIGS. **20** to **26,** will require starting the operation about five feet from the back wall adjacent to and along which the apparatus is adapted to move. On the other hand, an A-frame or scissors structure E′, such as illustrated in FIGS. **28** to **30,** permits starting about four feet from the back wall.

Centrally positioned, forwardly backwardly extending draw bar **135** has a slidable mounting on the frame **115** along the bottom reaches thereof, see particularly FIGS. **15** to **17.** A cross-extending strap member **136** has a central, offset portion or recess slightly wider than the width of the bar **135** to permit this bar to also move horizontally for position control of unit B employing switch S_9 of FIG. **16.** The strap member **136** slidably receives the front end portion of the bar **135** and slidably mounts it in position on the front end portion of the under side of the table of frame **115.** The bar **135** has a closed-end elongated slot **135***a*, (see FIG. **17**) therealong which is engaged by a vertically positioned slide block or element **134** (see also FIG. **19**) that is carried on a vertical stem, stud or pin shaft **138.** The block **134** is carried on the stem **138** by a cotter pin and washer assembly **138***a* adjacent the under side of the frame **115.** The upper end of the stem **138** is threaded to receive a nut **139** and to threadably fit within the bore of a mounting lug **114** that is secured to a vertical extension **115**a of the frame **115,** as by weld metal (see FIGS. **15** and **16**). A clevis **146** is secured to the back end of the housing of the fluid motor P_2 to swingably mount or float it on the stem **138** between the nut **139** and a spacer sleeve **147.** It will be apparent that the bar **135** may be moved longitudinally forwardly and backwardly within the extent of the slot **135***a*, as guided in such movement by the stem **138** and the block **134** that operates within the slotted portion **135***a*.

Like connector bar **80** of the unit A, the draw bar **135** of the unit B also serves as a connector bar and, at its front end, has an angle-shaped mounting bracket or head member **140** on whose bottom flange a cross-extending, rounded, mount or rod piece **141** is secured as by weld metal to extend transversely thereacross. Movement of the bar **135** is effected by a fluid motor, such as reciprocating pneumatic motor P_2 that is mounted on the upper side of the table of the frame **115** and that has a forwardly extending piston rod **143.** As shown particularly in FIG. **15,** the forward end of the rod **143** is threaded and extends through the vertical or upper flange portion of the head member **140** and is secured thereto in an adjustable relation by a pair of nuts **144.**

As shown in FIGS. **1** and **2,** connector bar **80** of the nailer unit A is pivotally secured at its front end on a vertical nut and bolt assembly **82** which extends through the table or platform **11** of the unit. The bar **80** projects backwardly along the upper side of the table **11** through a back end of the unit. A recessed cross-extending straplike bracket or guide member **83** extends across an intermediate portion of the connector bar **80** and is secured to the upper side of the table **11** by bolts **83***a* that also mount inner flange portions of the pair of backwardly positioned bearings **20′**. As noted, the front pair of bearings **20** and the outer feet of the back pair of bearings **20′** are secured on the platform or table **11** by bolts **21.** The recess portion in the bracket **83** has a width greater than the width of the connector bar **80** (see FIG. **2**) to permit the bar **80** to flexibly pivot about the assembly **82.** The back end of the bar **80** has an upright flange portion **80**a secured as by weld metal thereto, and pivotally secured to a back flange of a connector bracket or head member **81** of inverted angular-shape by a bolt and nut assembly **80***b*.

In the adjustable connector assembly represented by FIGS. **20** to **26,** the connector head member **81** is removably and non-twistably secured to one (upper) connector channel or bar **156** by means of a pair of transversely spaced-apart screw and thumb nut assemblies **153,** a cross-extending rodlike piece **152,** a forwardly extending tab member **151,** and a projecting web portion **156**b that is integral with the connector bar **156.** The piece **152** fits within the valley of an angle-shaped portion of bracket part **81** and is weld-secured to the tab member **151.** The tab member **151** is weld-secured on the web portion **156***b* to provide an integral construction therewith. A second (lower), slidably interfitting, channel-shaped connector member or bar **155** cooperates with the member **156** to provide an adjustable assembly E. The forward end of the lower member **155** (see FIG. **25**) has a rectangular-shaped, boxlike, closed-off collar **160** weld-secured thereto to slidably guidably receive the back end of the upper or other cooperating member **156** therein. The upper member **156** has a channel-shaped, upwardly open collar **162** secured on its back end by bolt and nut assemblies **161** to slidably guidably receive the back end of the lower member **155** therein. As particularly shown in FIGS. **25** and **26,** the connector members **155** and **156** have an interfitting, telescopic or complementary endwise slidable relation with respect to each other.

From the above, it will be apparent that the upper connector channel member **156** is secured at its front end **156***b* to the bar member **80** of the front nailing unit A. On the other hand, the lower channel member **155** is connected at its back end **155***b* to the draw bar member **135** of the back or control unit B.

Referring particularly to FIGS. **20** to **26**, inclusive, and FIG. **27**, it will be noted that the upper channel-shaped connector bar member **156** is provided with cross-extending latching notches or recesses **156***a* at spaced locations along its opposed side flanges. At its rear end, the lower member **155** has a backwardly extending web portion **155***b* to which is weld-secured an inverted, angle-shaped, end connector bracket **145** that is weld-secured thereto to project backwardly therefrom and cooperate with a cross-extending or transverse rodlike part or element **141**. As shown particularly in FIGS. **21** and **24**, the part or element **141** is secured by weld metal *w* to rest on a horizontal, forwardly extending, flange portion of an angle-shaped tie member **140** and is removably secured to the inverted connector bracket **145** by a pair of spaced-apart vertically through-extending, thumb nut and bolt assemblies **142**.

The connector channel members or bars **155, 156** are adapted to be adjusted telescopically "in" and "out" with respect to each other, longitudinally between nailing unit A and control unit B. The connector bar members will at the start of a floor laying operation preferably be in their longitudinally minimized extending relationship. The distance between the notches **156***a* will be such as to permit a step by step increase in spacing between members **155** and **156** and thus, between the units A and B, that will substantially correspond to the width of a run or course of board members **7** that has been laid and nailed-down by a previous across-the-room operation. This step by step increase in the elongation of the members or, in other words, in the spacing between the units A and B may be accomplished manually or more or less automatically. In this connection, latching, position change and locator unit F and assembly E shown in FIGS. **20** to **24**, inclusive, may be employed for a substantially automatic adjustment of the latched or extended relationship between the members **155** and **156**. On the other hand, FIGS. **27** to **29**, inclusive, illustrate a simple manual type of assembly E′ for effecting adjustment between such members.

The latching, position change and locator unit F is shown in FIGS. **20** to **24** as securely mounted on an upper leaf **185***a* of a hingelike mounting means or member assembly **185**, as by weld metal *w*. The other or lower leaf **185***b* of the hinge member **185** is shown secured, as by weld metal *w*, to the top face of the box-like collar **160**. Unit F has a table or platform **186** which rests on the upper leaf **185***a* and which carries a fluid motor P_5, an electric solenoid C_7, a control valve V_5, and a positive pressure fluid supply inlet **188**. A vertical frame portion **187** of the platform **186**, at its upper end, mounts one end of a tension spring **189** thereon. The spring **189** is mounted at its lower end on the under side of the lower, channel-shaped connector **155** by an eyelet in a floating steel dowel or cross-extending rod **155***a* that is suspended beneath the channel **155** by the spring. As shown in FIG. **23**, a pair of springs **189** thus urge the platform or table **186** downwardly towards the assembly E to thus maintain angle-shaped latching finger member **150** within aligned latching slots **156***a* of the upper connector bar member **156**.

The latching finger **150** is weld-secured to the platform **186** and has a downwardly projecting flange that is lifted out of an aligned pair of cooperating slots **156***a* when positive fluid pressure is applied to the upper end of the air cylinder or fluid motor P_5 to thus move its piston rod **191** downwardly and tilt the table, as shown in FIG. **22**, about the hinge **185**. This permits the slide adjustment between the cooperating connector bar members **155** and **156**, as effected by slide bar **135** and piston **143** of the unit B (see FIG. **15**) and the backward stroke of fluid motor P_2.

The embodiment of FIGS. **28** and **29** shows an "A" or scissors frame type of connecting assembly E′ that is particularly suited for a shorter overall extent or area of runs. It employs a pair of channel-shaped, upright, leg members **165** and **166** that, at their lower ends, are weld-mounted on hinged connector brackets or parts **84** and **142** and, at their upper ends, are pivotally connected by a hinge **167**. The bracket **84** will take the place of bracket **151** of FIG. **21** and the bracket **142** will take the place of the bracket **145** of the same figure. A rectangular latch arm assembly **168** is shown (see FIG. **29**) that is pivotally mounted substantially intermediate the vertical height of the leg member **166** by a cross-extending bolt and pin assembly **169**. The other leg member **165** is shown provided with a latch retention pin **170** that extends across between its side flanges and is adapted to fit within one of a series of undercut slot pairs **168***a* in side members of the arm assembly **168**. A tension spring **172** is shown connected at its upper end on a cross-extending loose pin **171** and at its lower end to a cross-extending pin **173** that is positioned between the flanges of the leg member **165**. It will be apparent that the pin **171** resiliently resists the raising of the latch arm **168**, but permits its manual raising to enable the latch pin **170** to be latched within a selected one of the slot pairs **168***a*.

The spacer assembly represented by the A-frame of FIG. **28** is particularly suitable for use when starting a nailing operation, in that it permits the nailing unit A to be operated after about four feet of board runs have been manually nailed in position. Thereafter, the double channel system or assembly E of FIGS. **20** and **21** or additional double or single channel spacer bars may be used for obtaining a maximum extent of board run coverage before it becomes necessary to lift the guide rail **131** and secure it in a new, advanced position.

The operation involved in advancing the nailing unit A for approximately a board width, e.g., about 3 inches as applied to the assembly of FIGS. **20** and **21**, involves manual movement of electric switch S_5 to one closed position (FIG. **31**), energization of solenoid C_2 in one direction, opening of valve V_2 to one position and a forward, one-step, positive movement of the piston rod **143** of the fluid motor P_2. The forward movement of the piston rod **143** causes the lug **67***b* of the switch arm **67** to close the switch S_{10} and thus energize solenoid C_6, opening valve V_4, and positively activating the lifter piston rod **30***b*. This results in the unit A and the assembly E being moved forwardly with respect to the unit B about 3 inches, with the unit B being backwardly tilted off the working floor surface **7** (see FIG. **13**). At this time, there is a gap of about 3 inches between the leading floor board **7** and the guide rollers **35**. Assuming the use of 2¼ inch face floor boards, although other face boards may be used by employing a different spacing of the slots **156***a* in the assembly E, a new floor board run **7′** is now inserted between the guide rollers **35** and the last laid run **7** to leave about three-fourths inch remaining space in the area.

After the board run 7' is inserted in position, switch S_5 is moved to a second closed, current-flow, reversing position to energize solenoid C_2 in an opposite direction, to shift valve V_2 for supplying air to the opposite side of the cylinder P_2 and thereby initiate a 3 inch back stroke of the piston rod **143**. At the same time, switch S_{11} is momentarily closed to energize solenoid C_7, open valve V_5, and give a positive fluid pressure upward movement to the spacer bar lifter piston rod **191** to thus lift or raise the latch **150** out of a cooperating slot **156***a*. When the piston rod **143** is moved in its back stroke by the fluid motor P_2, it thus draws the assembly E and the unit A backwardly. The latch shift of **150** with respect to the slots **156***a* will occur first becuase it presents the least resistance. A drawing back of the unit A will occur last becuase of the greater resistance to its movement. It will be noted that the motor or cylinder P_2, the control valve V_2 and the solenoid C_2 are identical with the motor P_3, the valve V_3 and the solenoid C_4, except that the motor P_2 may have a larger cylinder than the motor P_3. The latch **150** slides to the right on the connector bar **156** on the backwardly declining portion thereof (see FIGS. **21** and **24**) to move into abutment with the shoulder of the next adjoining slot **156***a*. At this time, the latch **150** is then drawn into full engagement within the slot by the tension pull of the pair of springs **189** to positively lock the connector bars **155** and **156** together. Since the cylinder P_2 has a remaining three-fourths of an inch to move the piston rod **143** backwardly, it thereafter pulls the unit A back this same distance, causing the guide rollers **35** to engage the board 7' and the board 7' to engage the previously laid board **7**. All of this is accomplished while the unit B is held stationary by the track rail **131** (see FIGS. **15** and **17**).

The schematic of FIG. **31** diagrammatically shows a suitable operating system for apparatus of the disclosure. A source of electrical energy or power such as direct current may be supplied by lines *a* and *b* to a circuit and through a reversing switch S_1 to motors M_1 and M_2 which respectively are employed to move the units A and B in step across the room or along a course or run of board members 7' that is being laid. Switches S_1 and S_2 are employed for alternately energizing both motors M_1 and M_2. In this connection, S_1 may be a manual switch mounted on either the unit A or B, and S_2 may be an automatic switch such as the micro switch (shown in FIGS. **9, 10** and **11**) that is operated during the movment of the wheeled, side-positioned, movement-controlling unit D. Switches S_2 and **40***a* may be normally closed with switch S_2 (of FIG. **9**) or alternately switch **37** of FIG. **1**, and switch **40***a* being opened under previously explained operating conditions. Switches S_3 and S_4 are alternate (manual and automatic) switches that may be used for electrically energizing solenoid C_1 for moving control valve V_1 from a closed-off position, from the standpoint of positive fluid pressure flow from line *i*, to an open position for energizing fluid cylinder or motor P_1.

When solenoid C_1 is energized, it moves the valve V_1 to an "open" position and actuates fluid motor P_1 to provide a positive "down" stroke of the nailer head **50**. When the valve V_1 is closed by de-energization of the solenoid C_1, the head **50** is returned to its upper or starting position by spring loading of the motor P_1, and fluid from the motor is exhausted through the outlet *j*. The positive "down" stroke drives a nail such as **8** of FIG. **6** into a board member 7' that is being laid. S_3 represents a manual switch that may be used at any time by the operator and particularly, when the control unit D has been removed from a side of the nailing unit A to finish a nailing operation closely adjacent to one side of a room. The switch S_4 may be an automatically operated micro switch, as shown in FIG. **9**, that is periodically closed by cam means **97** or **97'** of the control unit D. The operation of the cam **97** or **97'** is such as to time the closing of stud switch S_4 at positions at which the unit A has its nailer head **50** in alignment with a sJud or support member, such as **5** of the floor assembly. Where a subfloor is used, the closing of the switch S_9 may be set to occur at any desired spaced-apart positions therealong.

After a line of board members 7' has been secured or nailed in position with respect to a previously nailed and laid row of floor members **7**, then the nailing unit A may be tilted backwardly by the mechanism shown in FIGS. **13** and **14**, and as operated by fluid motor P_4 of FIG. **31**. This operation, as previously indicated, may be effected by automatically closing switch S_{10} to energize solenoid C_6 and move control valve V_4 from a closed and fluid exhausting position (through outlet *j*) to a preliminary position at which positive fluid flow from line *k* is introduced to one side of the fluid motor or cylinder P_4 to move its piston rod **30***b* outwardly and cause its lift part or member **34** to tilt the unit A, as shown in FIG. **13**. This facilitates the insertion of or the preliminary manual laying of the next succeeding row, course or line of board members 7', while the guide rollers **35** are in a raised out-of-the-way position. Thereafter, the switch S_{10} may be opened in order that the spring loading of the motor P_4 may withdraw the piston **30***b* and cause the unit A to fully rest on the floor assembly C. At this time, peripheral groove portions **35***a* of the guide rollers **35** will be moved by fluid motor P_2 into engagement with the forward, longitudinally extending tongue portions of the course or run of board members 7' that are to be laid.

Before the above operations are accomplished, it is desirable to carry-out the previously described one-step forward advance or extension of either the assembly E of FIGS. **20** to **26** or the assembly E' of FIGS. **29** and **30**. It will be noted that a four-way valve V_2 is used for controlling the operation of the fluid motor P_2 under positive fluid pressure as to both the backward and forward movements of its piston rod **143** through the agency of the solenoid C_2 and a dual-pole current-flow-reversing electric switch S_5. The logical sequence of operation is for the assembly E to be expanded or extended one notch after each cross-nailing operation has been accomplished on a run of board members 7'. An important feature is the fact that, as shown in FIG. **15**, the unit B serves as a positive guide unit for the nailing unit A, while a run of floor members of a suitable width is being nailed to form part of a floor assembly C.

The hammer **78** may be operated by an air cylinder or motor having about a two inch stroke and of a type such as manufactured and sold by Bimba of Monee, Ill., see the double-acting, pivot type; see No. 170–DP of page 16 of catalog No. 1266–B. It has a piston providing a positive forward or "down" stroke movement and a positive return or "upper" stroke. Four way control valve V_3 is opened by closing automatic switch S_8 to energize solenoid C_4. The automatic switch S_8 may be closed (see FIGS. **15, 16** and **18**) when, for example,

the piston rod **143** is extended, indicating that a board member 7' that has been manually laid in position does not have its tongue portion in a proper interfitting relation with the groove portion of previously laid floor member **7** and thus, it is necessary to hammer it in place. The switch S_8 remains closed until a hammer blow corrects the condition.

Again referring to FIG. **31**, switch S_5 may be manually closed to energize solenoid C_2 and move four-way control valve V_2 to a position at which positive fluid flow is introduced from line *k* through branch line 1 to one end of the cylinder P_2 to move the piston rod **143** to the right hand position shown in FIG. **31**. On the other hand, when the piston rod **143** is to be advanced forwardly (to the left of FIG. **31**), the solenoid C_2 is de-energized or energized by an opposite direction of current flow as effected by the switch S_5 to thus cause a positive fluid flow from line *k* through branch line *m* into the other end of the cylinder P_2. The outlet *j* exhausts fluid from ends of the motor P_2 that are opposite to the ends at which positive fluid pressure is being applied. Although apparatus of the invention has been shown as utilizing nail assemblies that are moved down the feed chute to present one drive-in element at each nailing stroke, it will be appreciated that the so-called nailer or board securing unit may be any suitable unit or means for securing board members in place and including a unit or means for feeding and manipulating metal clips and the like. The unit B in combination with the switch means S_8 serves to sense an improper alignment of a board member 7' and to effect a correction thereof through the agency of the hammer. It will be apparent that a conventional flexible electric cable may be plugged-in or connected at one end to a wall receptacle or other suitable source of electric current and at its other end connected to leads *a* and *b* of the units. Also, a flexible hydraluic hose may be connected at one end to a pump system and at its other end to the line *h* of the units. By way of example, see the cable 53 and the hose 50 of my U.S. Pat. No. 3,619,895.

I claim:

1. In a mobile floor laying apparatus for back and forth movement on a previously laid floor area along an adjacent run of endwise-positioned floor members for progressively securing the floor members of the run on under-support members in an aligned-sidewise-engaging complementary-fitting relation along outer side edges of a previously laid floor member run of the floor area, a mobile floor member securing unit for back and forth movement along the adjacent line across the floor area, means cooperating with said securing unit for positively guiding it in an aligned relation during its back and forth movement, motor means carried by said securing unit for periodically moving it back and forth across the floor area while aligned by said guiding means, means carried by said securing unit for periodically securing floor members of the adjacent run on the under-support members in an aligned fitted relation along the outer side edges of the previously laid floor member run of the floor area, and means actuated in a timed relation to the back and forth movement of said securing unit for periodically actuating said securing means.

2. In an apparatus as defined in claim **1**, said means for positively guiding said securing unit being a backwardly positioned control unit, connector means connecting said securing unit in a forwardly spaced relation to said control unit, a guide rail secured on and extending along the previously laid floor area, and means carried by said control unit and having a rolling-guided relation with said guide rail for positively guiding said control unit during the back and forth movement of said securing unit.

3. In an apparatus as defined in claim **2**, motor means carried by said control unit for moving it back and forth across the floor area with said securing unit, and means operating the motor means of said securing unit in a timed relation with respect to the motor means for said control unit.

4. In an apparatus as defined in claim **3**, means for automatically stopping said respective motor means when an end of a floor member of the adjacent run is reached.

5. In an apparatus as defined in claim **1**, means cooperating with said securing unit for tilting it backwardly to allow insertion of a new run of floor members along a previously laid run.

6. In an apparatus as defined in claim **2**, said connector means having means for advancing the spacing between said units one step for each back and forth movement of said units to accommodate said securing unit to a new lengthwise run of floor members to be laid.

7. In apparatus as defined in claim **6**, said means for advancing the spacing constituting a pair of longitudinal members, and latch means and spaced-apart latch-receiving slot portions adjustably connecting said members together with respect to each other.

8. In an apparatus as defined in claim **7**, said latch means having a fluid motor for moving it into and out of latching engagement with aligned slot portions.

9. In an apparatus as defined in claim **6**, means associated with said space advancing means for sensing an improperly positioned floor member of a run to be secured in position.

10. In an apparatus as defined in claim **9**, hammer means carried by said securing unit and actuated by said sensing means for driving the improperly positioned floor member into a properly aligned position.

11. In apparatus as defined in claim **1**, said periodic actuating means comprising wheel means that is rotated during the back and forth movement of said securing unit, and said wheel means carrying a cam-operated electrical switch that is adapted to energize said floor member securing means when it is closed.

12. In apparatus as defined in claim **1**, a control unit for back and forth movement across the floor area in a backwardly positioned aligned relation with said securing unit, a telescopic connecting bar member assembly between a rear end of said securing unit and said control unit, a motor-driven reciprocating bar member carried by said control unit and connected to a rear end of said connector bar assembly, a first member of said connector bar assembly defining latching recess portions in a spaced relation therealong, and latching means operatively positioned on a second member of said connecting bar assembly and adapted to selectively latch-engage with said latching recess portions of said first member.

13. In apparatus as defined in claim **12**, a latch actuating unit operatively carried by said second member of said bar assembly and adapted to move said latching means into and out of engagement with aligned latching recess portions of said first member, said reciprocating bar member of said control unit being adapted

to advance said first and second members one additional space with respect to each other when said securing unit has made one traversal of the floor area, and said latch actuating unit being adapted to move said latching means out of engagement with an aligned recess portion before said reciprocating bar member advances said first and second members one additional space and thereafter to move said latching means into engagement with a successive recess portion when said first and second members of said assembly have been advanced in spacing one space with respect to each other.

14. In a mobile floor securing apparatus for back and forth movement on a previously laid floor area along a lengthwise run of floor board members being laid endwise for progressively securing the floor board members of the run on spaced-apart support members in an aligned-sidewise-engaging complementary-fitting relation along an outer side edge of a previously laid floor board member run that is secured on the support members, a mobile board securing frame unit unit, means for actuating said securing frame unit for back and forth movement along the floor area, and means carried by said unit for de-energizing said motor means when said securing frame unit approaches the end of a board member of the run being laid.

15. In an apparatus as defined in claim **14,** board securing means and hammer means operatively carried by said securing frame unit, cam means carried by said securing frame unit and controlled by the back and forth movement of said unit for periodically actuating said board securing means when said frame unit reaches a properly aligned relation with respect to a support member on which a board member of the run is to be secured, and said hammer means having a hammer head to deliver a blow to a floor board member of the run being laid for properly aligning it with respect to the outer side edge of a floor board member of the previously laid run.

16. In a mobile floor laying apparatus for back and forth movement on a previously laid floor area long a lengthwise run of floor board members being laid endwise for progressively securing the floor board members of the run on spaced-apart cross-extending support members in an aligned-sidewise-engaging complementary-fitting relation along an outer side edge of a previously laid floor board member run that is secured on the cross-extending support members, a mobile board securing frame unit and a mobile guide frame unit, means coupling said units respectively in a front and back aligned relation with respect to each other for coordinated back and forth movement along the floor area, motor means for actuating each of said frame units for synchronous back and forth movement along the floor area, and means carried by one of said units for de-energizing said motor means when said nailer frame unit approaches the end of a board member of the run being laid.

17. In an apparatus as defined in claim **16,** said means for de-energizing said motor means being operatively carried by said board securing frame unit in an extending relation from a side thereof in the direction of movement of said frame units along the floor area.

18. In an apparatus as defined in claim **16,** means for advancing said board securing frame unit in a step-by-step manner forwardly with respect to said guide frame unit after each completed movement of said frame units across the floor area.

19. In an apparatus as defined in claim **18,** said coupling means having a pair of cooperating slide bar members one of which is connected to extend backwardly from said board securing frame unit and the other of which is connected to extend forwardly from said guide frame unit, latch and slot means between said slide bar members, and said means for advancing said board securing frame unit cooperating with said latch and slot means for at each step advancing said board securing frame unit about the width of a board member that is to be nailed in position.

20. In an apparatus as defined in claim **18,** said coupling means having a complementary slidably interfitting pair of connector members between said board securing frame unit and said guide frame unit, latch and slot means for retaining said connector members in a preset cooperating position with respect to each other, means for releasing said latch and slot means from retention of said connector members, means carried by said guide frame unit for thereafter drawing back one of said connector members with respect to the other, said latch and slot means being adapted to then connect said connector members in a new advanced relation with respect to each other, and said drawing means being adapted to then move said board securing frame unit forwardly a distance corresponding to the distance of the previous draw back of said one connector member.

21. In an apparatus as defined in claim **16,** a wheeled control unit adapted to be detachably mounted to alternatively extend sidewise from opposite sides of said board securing frame unit, said board securing frame unit having a nailer carried thereon for periodically nailing advanced portions of a board member of the run being laid to the cross-extending support members while the apparatus is being moved back and forth along the floor area, and means carried by said control unit for energizing said nailer at periodic intervals corresponding to the location of the support members.

22. In an apparatus as defined in claim **21,** means carried by said control unit for energizing and de-energizing said motor means in accordance with the presence or absence of an endwise-extending floor member to be nailed in position.

23. In a mobile floor laying apparatus for back and forth movement on a previously laid floor area along an adjacent run of floor board members being laid endwise for progressively securing the floor board members on under-support members in an aligned-sidewise-engaging complementary fitting relation along outer side edges of a previously laid floor member run of the floor area, a mobile floor member securing unit and a mobile guide frame unit for back and forth movement across the floor area, coupling means connecting a back end of said securing unit to a front end of said guide unit in a swingably maintained spaced-apart relation with respect to each other, means cooperating with the previously laid floor area for positively guiding said mobile guide unit across the room, reversible motor means on said mobile securing unit for alternately moving it back and forth along the floor area, reversible motor means on said guide unit for alternately moving it back and forth along the floor area, switch means operatively carried by said mobile guide unit for actuating its said motor means in the same direction as said

motor means of said securing unit, said switch means having an open central position and right and left hand closed positions, and means cooperating with said coupling means for closing said switch means after said securing unit has moved a short distance to the right or left and for moving said switch means to its open central position when said securing unit has stopped in its movement.

24. In an apparatus as defined in claim **23,** nailing means operatively carried by said securing unit for periodically nailing the floor members in position, hammer means on said securing unit for hammering floor members to be laid into an aligned closely fitting relation with outer side edges of the floor members of the previously laid run, locating means carried by said guide unit and cooperating with said coupling means for advancing said securing unit forwardly with respect to said guide unit for operating on a new run of floor members to be laid, and switch means carried by said guide unit and cooperating with said locating means for actuating said hammer.

25. In an apparatus as defined in claim **24,** said locating means cooperating with said coupling means for expanding it by one position each time said securing unit has moved in one direction across the floor area, and said coupling means having latching means cooperating with said locating means for advancing said securing unit one step with respect to said guide unit after each across-the-floor movement of said securing unit.

26. In an apparatus as defined in claim **24,** said locating means comprising a reciprocating fluid motor swingably secured on said guide unit and operatively connected to said coupling means.

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