July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 1 of 8

FIG. 1

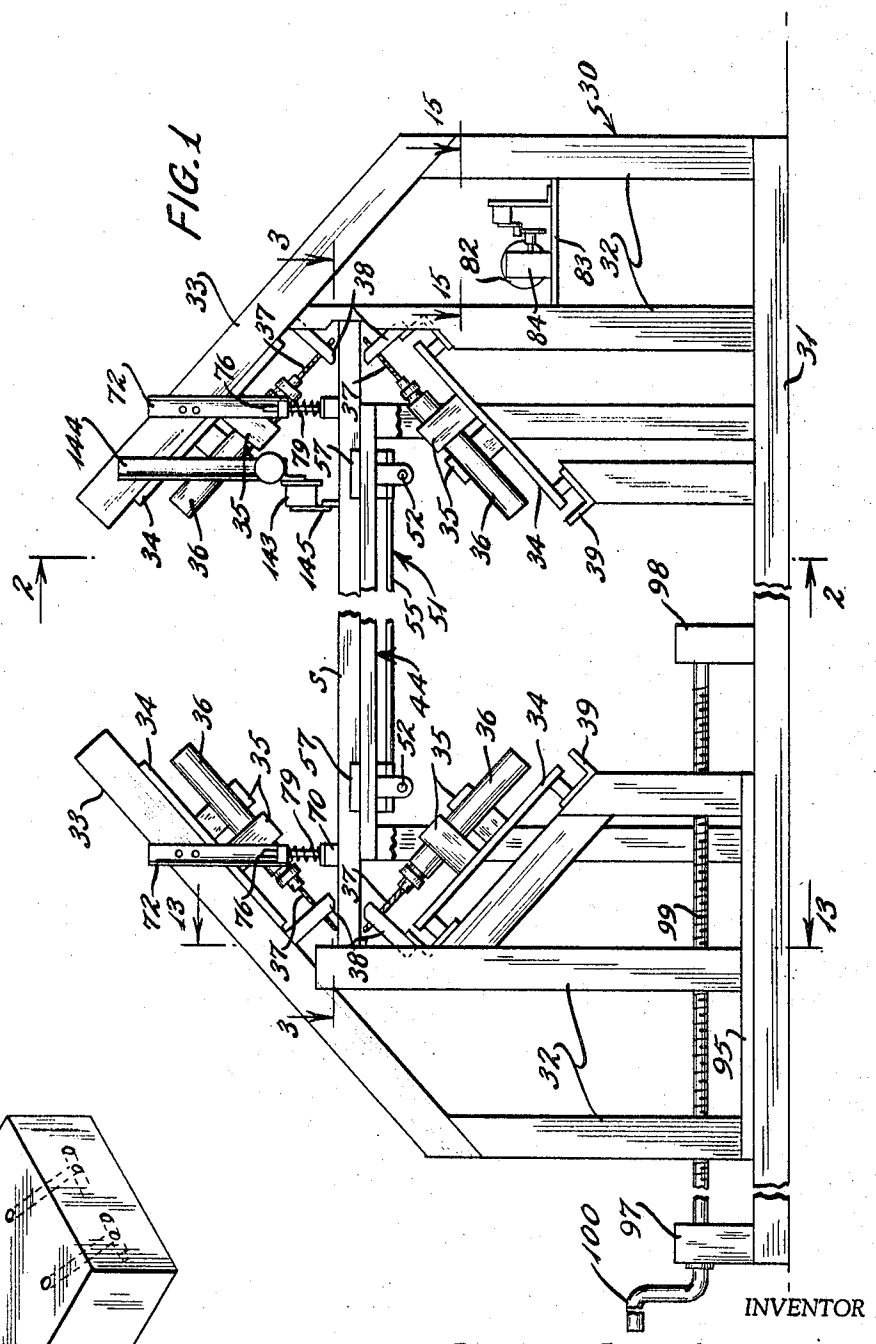
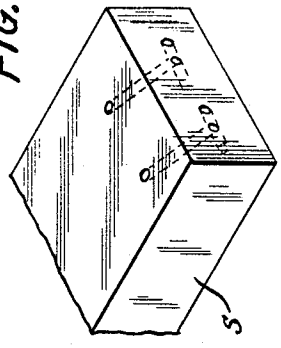


FIG. 5



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July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 2 of 8

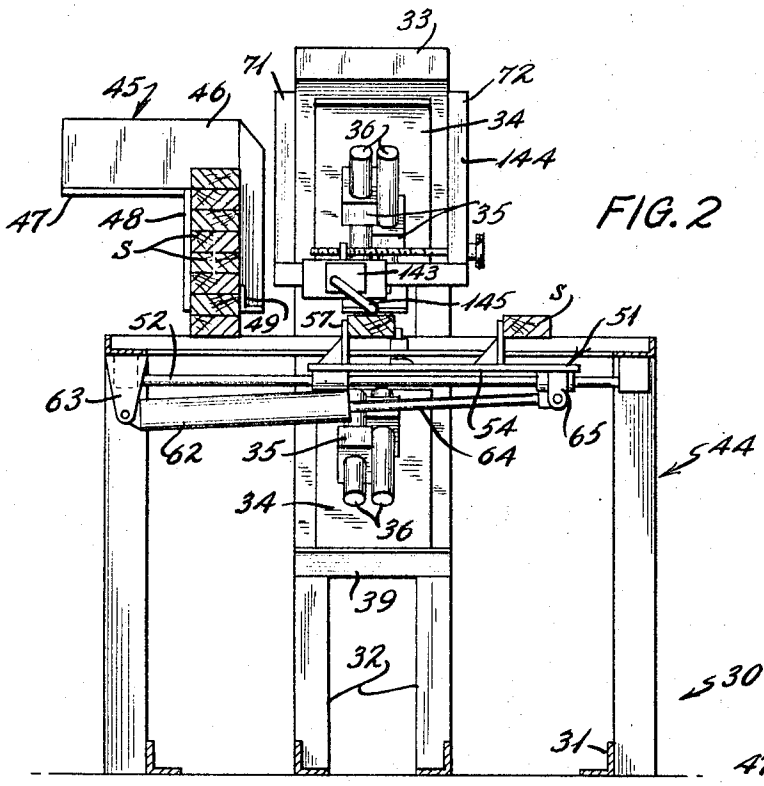


FIG. 2

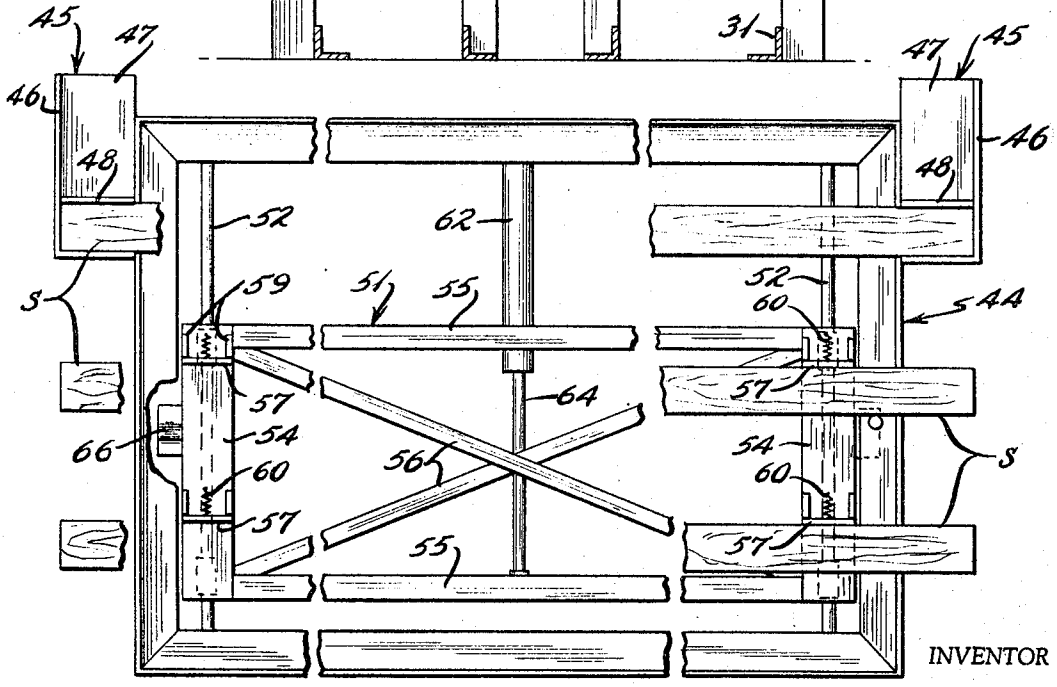


FIG. 3

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STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 3 of 8

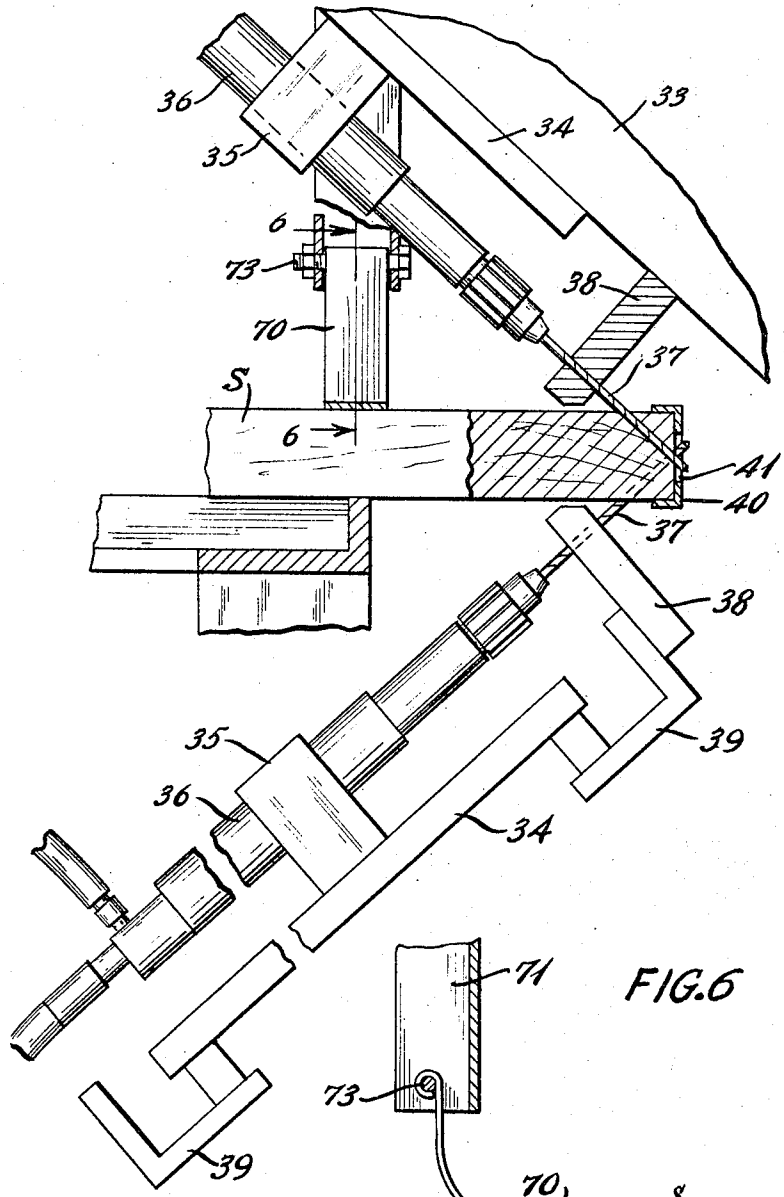


FIG. 4

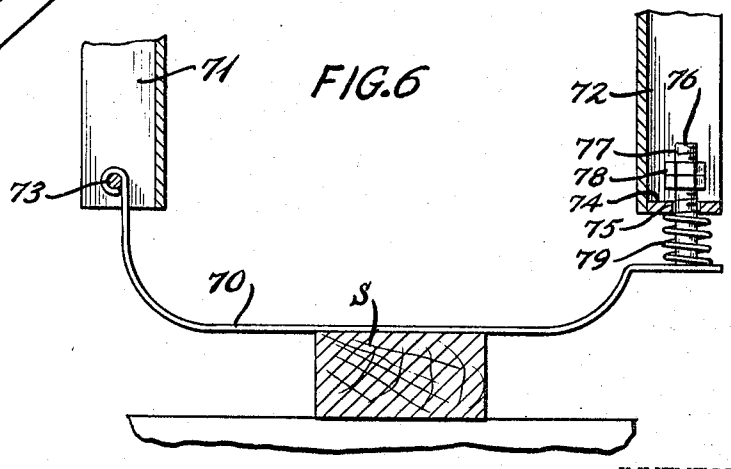


FIG. 6

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July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 4 of 8

FIG. 7

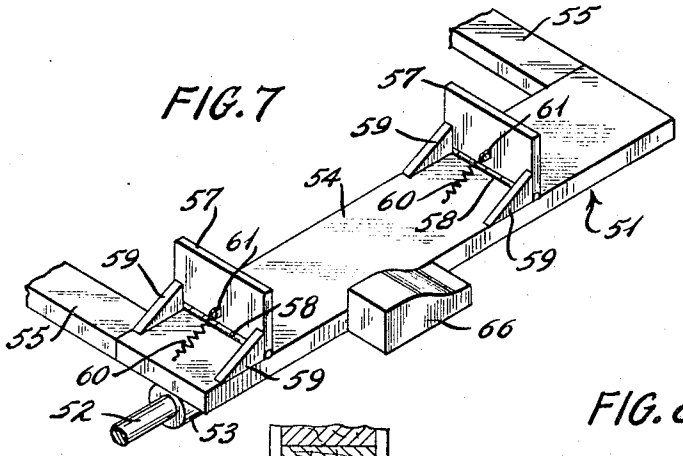


FIG. 8

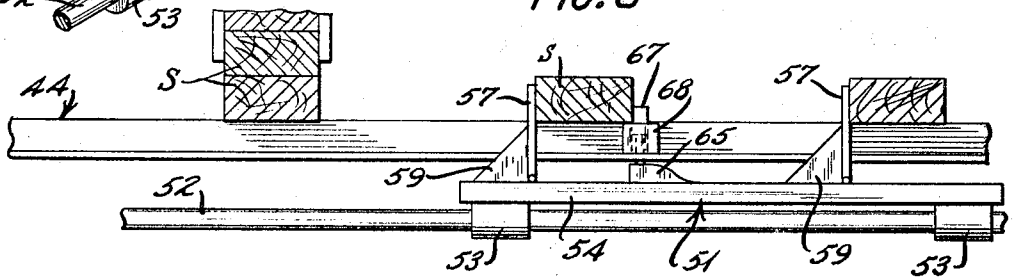


FIG. 9

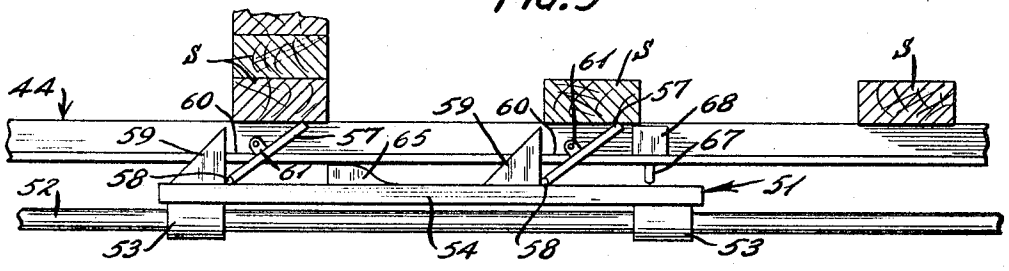


FIG. 10

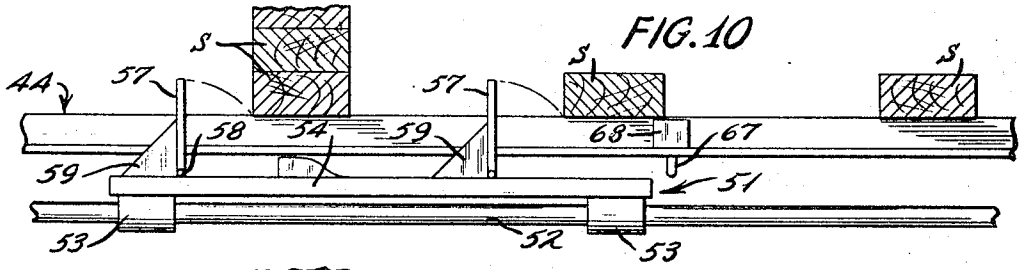
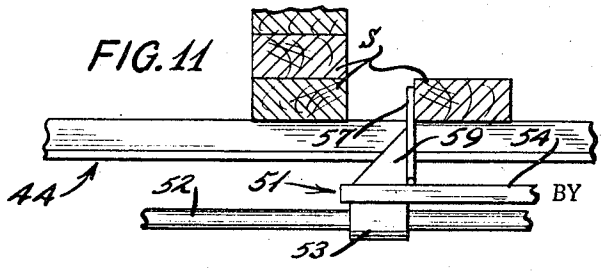


FIG. 11



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July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 5 of 8

FIG. 12

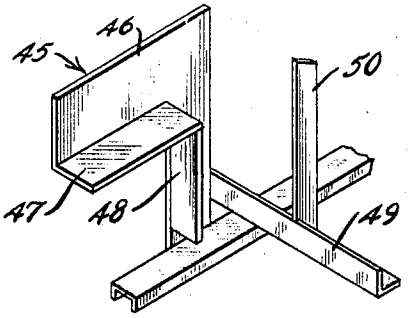


FIG. 13

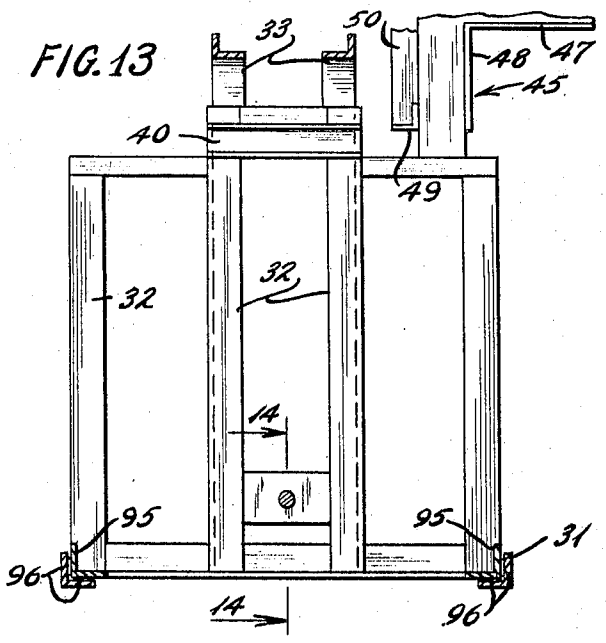


FIG. 14

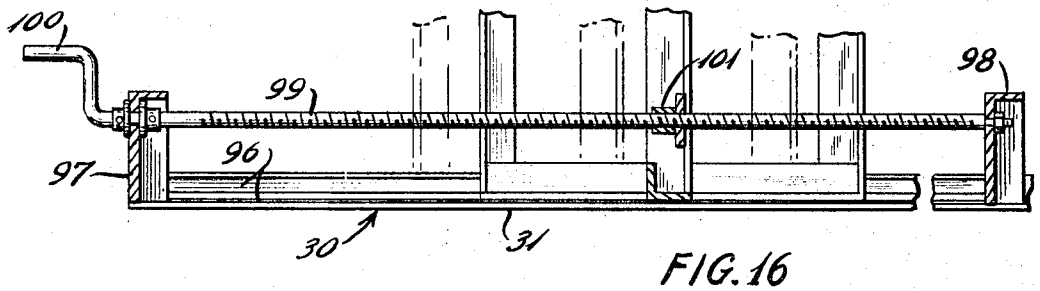


FIG. 15

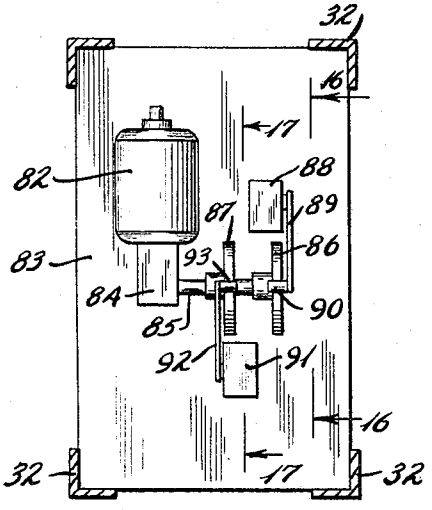


FIG. 16

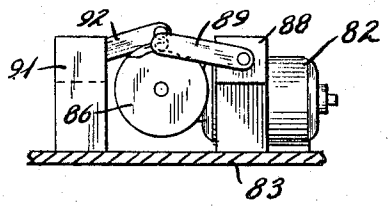
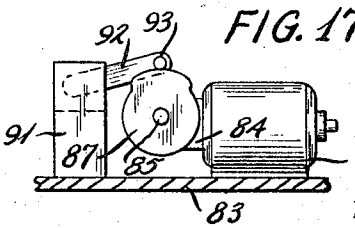


FIG. 17



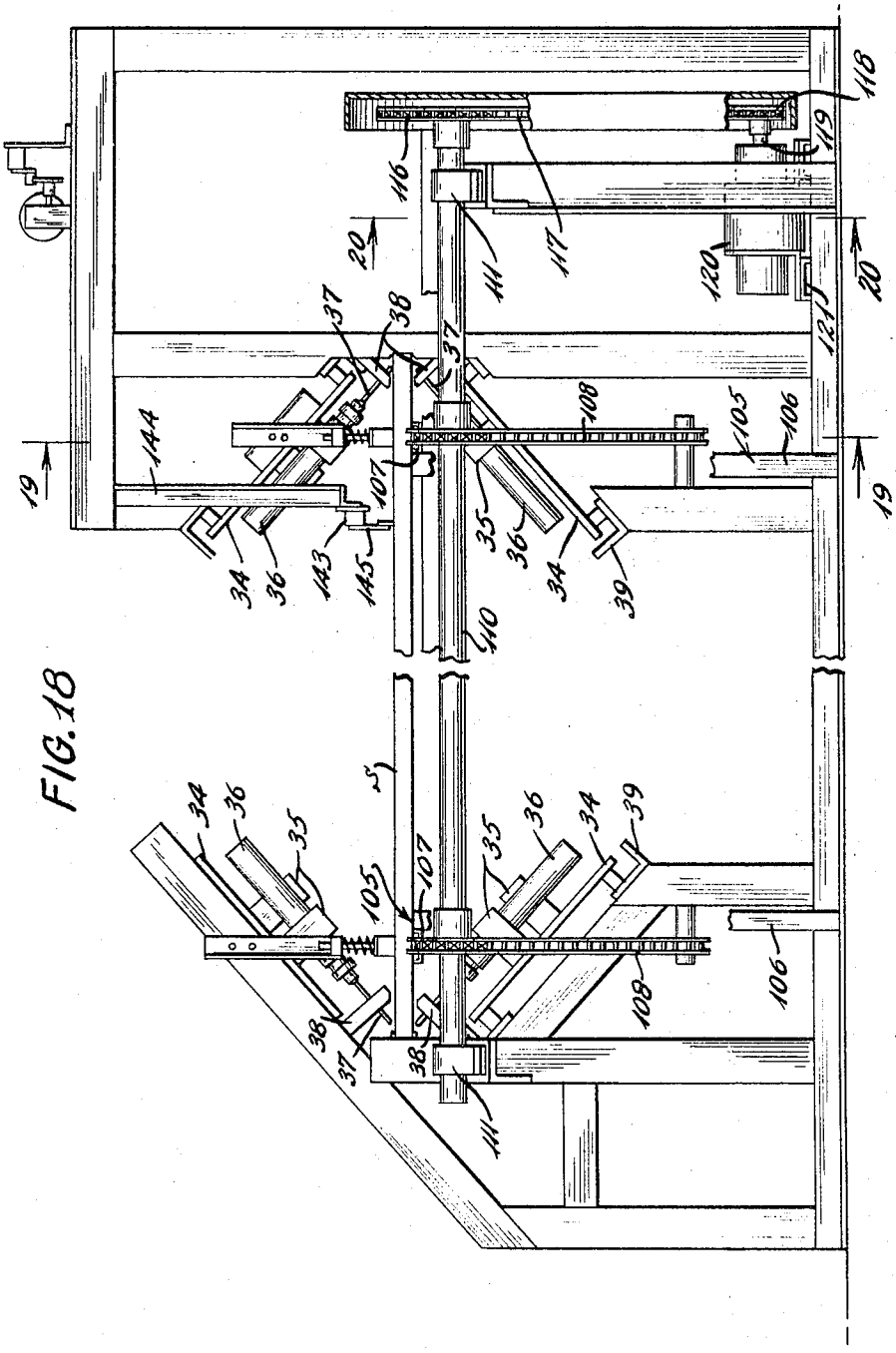
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STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 6 of 8



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July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 7 of 8

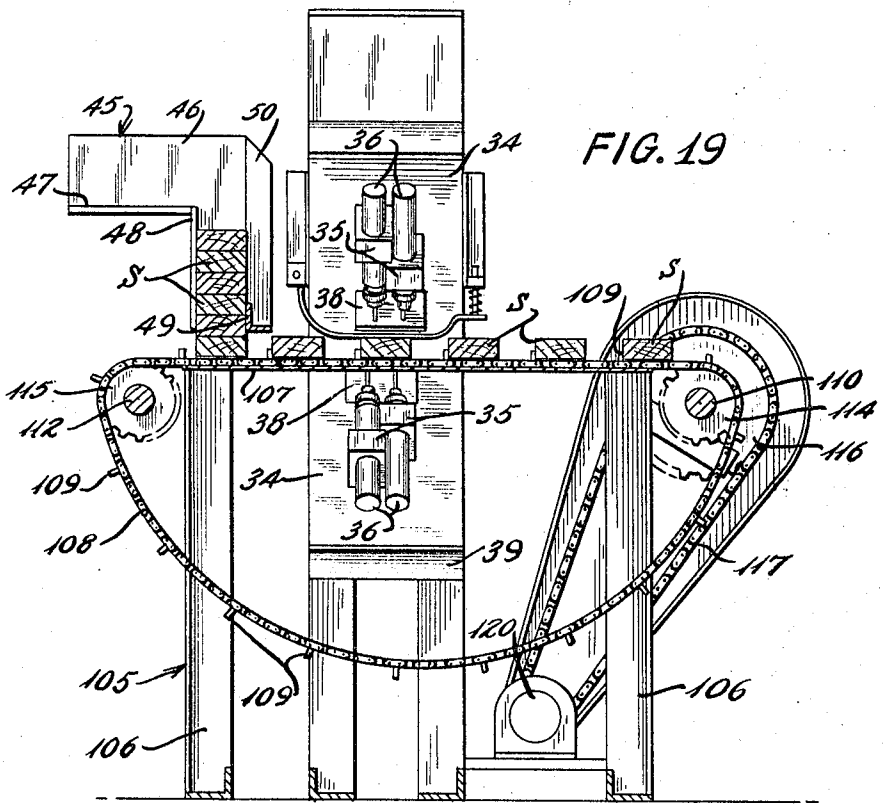


FIG. 19

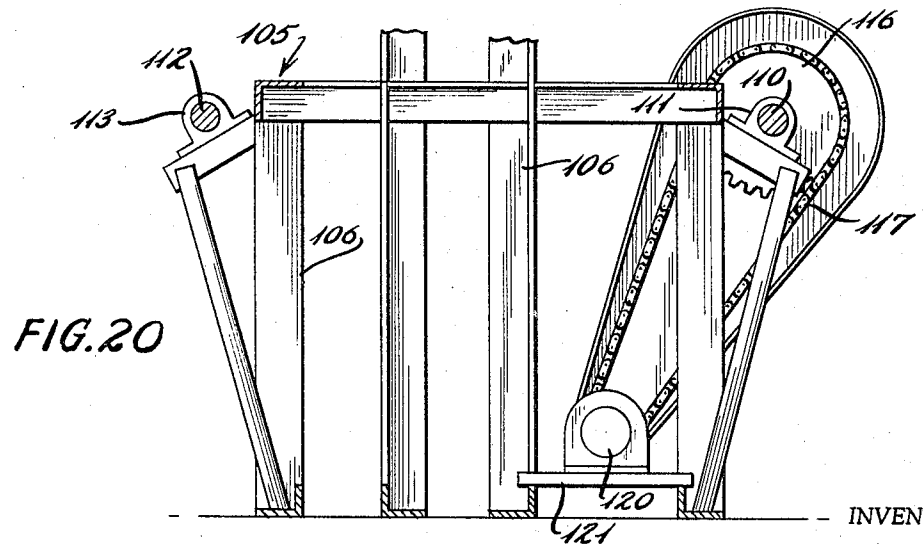


FIG. 20

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July 1, 1969 R. E. FOREMAN 3,452,792

STUD DRILLING MACHINE

Filed Aug. 19, 1966 Sheet 8 of 8

FIG. 22

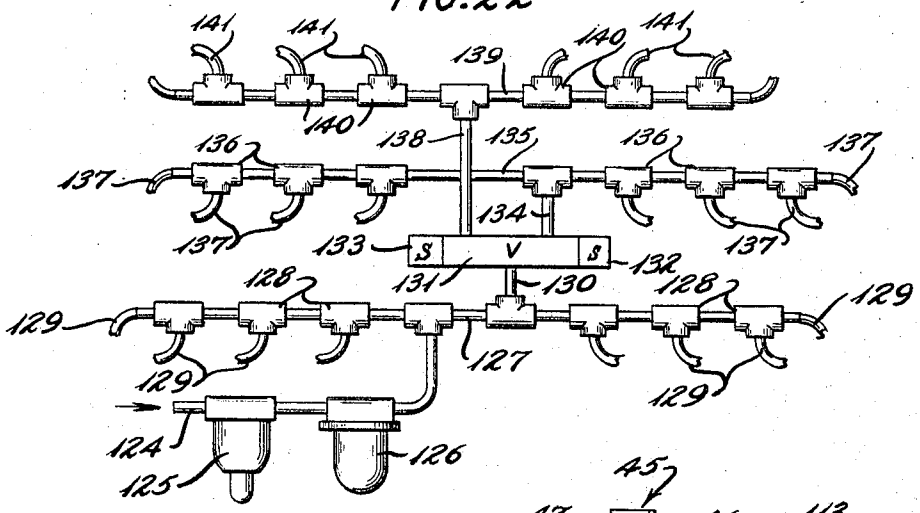
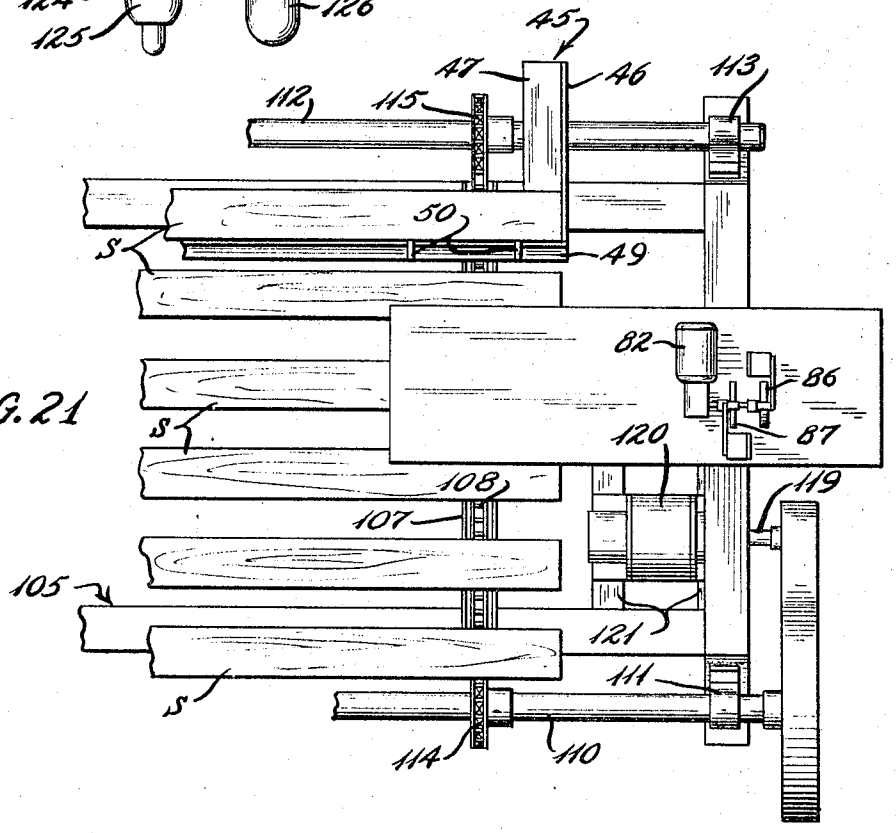


FIG. 21



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United States Patent Office 3,452,792 Patented July 1, 1969

3,452,792

STUD DRILLING MACHINE

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Filed Aug. 19, 1966, Ser. No. 573,536
Int. Cl. B27c 3/00, 3/04
U.S. Cl. 144—93 3 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for drilling a plurality of holes in at least one end of a stud used in the construction of a building. The apparatus includes means for moving the studs from a rack to a drilling station and drilling at least two holes which extend from side surfaces to the end of the stud to facilitate toenailing the studs in predetermined position.

This invention relates to a machine for drilling holes in one or both ends of a wall forming stud used in the construction of a building so that such stud can be mounted on upper and lower plates in predetermined spaced relation and connected thereto by fasteners disposed within the predrilled holes so that the stud does not shift or move laterally when being secured to the plates.

Heretofore in the construction of buildings of various kinds, a plurality of bottom plates have been secured to the flooring of the building and such plates define the position of walls and partitions which separate the building into various rooms and compartments. Normally a plurality of studs are placed on the bottom plates at predetermined spacings in accordance with local building codes, and after the studs have been located in position a plurality of fasteners are toenailed in at an angle of approximately 45° to secure the studs to the plates. In applying the fasteners the initial force of the fastener is against the stud and such force causes the stud to move from the predetermined spacing so that the spacing between adjacent studs varies and quite often the studs themselves are not plumb.

It is an object of the invention to provide a stud drilling machine which will automatically drill a plurality of openings in one or both ends of a stud and from one or both sides of each, so that when the stud is placed in position the fasteners will be received within the openings in such a manner that the initial force against the fastener will be directly against the plate and the tendency to move the stud is eliminated.

Another object of the invention is to provide a stud drilling machine which will automatically drill a plurality of openings in one or both ends of a stud and thereafter will discharge the drilled stud and move an undrilled stud into position for drilling.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a side elevation illustrating one application of the invention;

FIG. 2, a vertical section on the line 2—2 of FIG. 1;

FIG. 3, a horizontal section on the line 3—3 of FIG. 1;

FIG. 4, an enlarged fragmentary detail illustrating the manner in which the drills form holes in one end of a stud;

FIG. 5, an enlarged fragmentary perspective illustrating one end of a stud after it has been drilled;

FIG. 6, a fragmentary section on the line 6—6 of FIG. 4;

FIG. 7, an enlarged fragmentary perspective illustrating one end of a stud moving carriage;

FIGS. 8, 9, 10 and 11, enlarged side elevations illustrating sequential steps in the movement of the stud carriage;

FIG. 12, an enlarged fragmentary perspective of the stud loading rack;

FIG. 13, a section on the line 13—13 of FIG. 1;

FIG. 14, a fragmentary section on the line 14—14 of FIG. 13;

FIG. 15, an enlarged section on the line 15—15 of FIG. 1;

FIG. 16, a section on the line 16—16 of FIG. 15;

FIG. 17, a section on the line 17—17 of FIG. 15;

FIG. 18, a side elevation of a modified form of the invention with portions broken away;

FIG. 19, a section on the line 19—19 of FIG. 18;

FIG. 20, a section on the line 20—20 of FIG. 18;

FIG. 21, a top plan view of one end of the machine of FIG. 18; and,

FIG. 22, a schematic diagram of the hydraulic system of the machine.

With continued reference to the drawings the stud drilling machine of the present invention may be adapted to drill a plurality of holes in one or both ends of a stud S as such stud is moved automatically through the machine. If desired the machine may have one end fixed and the opposite end movable to accommodate studs of various lengths, as illustrated in FIG. 1, or both ends of the machine may be fixed to accommodate studs of a predetermined length.

The machine includes a main frame 30 having base members 31 on which a plurality of upright support members 32 are mounted. Upper members 33 are carried by the support members 32 and such upper members may be disposed at an angle to the base members 31 or may be generally parallel therewith. A mounting plate or member 34 is fixed to the lower surface of the upper members 33 in any desired manner so that such mounting member is located at a predetermined angle relative to the horizontal. A pair of mounting blocks 35 are carried by the member 34 and each of such mounting blocks supports a drill 36 which may be hydraulically or electrically operated. Each mounting member is adapted to have a pair of drills mounted thereon in spaced parallel relation to each other. Each drill has a bit 37 on one end and means is provided for rotating the drill bit as well as for extending and retracting the same relative to the stud S. If desired the drill bits may be retained within guides 38 disposed adjacent to the stud S which are adapted to guide the drill bits and prevent breakage thereof when the bits penetrate the stud.

As illustrated in FIG. 1 a pair of drills 36 are carried by the upper members 33 and a cooperating pair of drills 36 are carried by mounting blocks 35 on a member 34 which in turn is supported on structural members 39 fixed to the support members 32. The upper and lower pairs of drills are staggered relative to each other, as illustrated in FIGS. 2, 4 and 5, so that when the drills are advanced to cause the bits to penetrate the stud S, the bits of the upper drills will not engage the bits of the lower drills.

During the drilling operation the stud S is held in fixed position in a manner which will be described later, and the ends of the stud are retained within slideways 40 carried by the upright support members 32 (FIG. 4). In order for the drill bits 37 to pass completely through the stud, the slideways 40 are provided with openings 41 in the backplate which permits the drill bits to pass through the stud and the slideways.

In order to supply studs to the drilling station an auxiliary frame 44 is provided mounted on the base members 31 adapted to move studs from one side of the machine to the other in intermittent steps. In order to do this a rack 45 is mounted at one side on the auxiliary frame 44

and such rack includes an end member **46** at each end of such auxiliary frame. Each of the end members includes a generally horizontally disposed flange **47** and a generally vertically disposed flange **48**. An angle member **49** connects the end members **46** and such angle member is adapted to support one or more vertical guides **50**. The studs S initially are placed on the horizontal flange **47** between the end members **46** and then are moved so that they are confined between the vertical flange **48** and the guides **50** and are arranged in a stack with one stud on top of another. The angle member **49** is connected to the end members **46** at an elevation great enough to permit the studs to pass one at a time therebeneath.

In order to move the studs the auxiliary frame **44** may have a stud moving carriage **51** mounted on rails **52** supported by blocks **53** at opposite sides of the auxiliary frame **44**. The carriage **51** includes a pair of plates **54** arranged in parallel relation to each other and connected by braces **55** and **56** to make certain that the plates **54** remain parallel with each other at all times. Each of the plates **54** is mounted on the rails **52** by a sliding connection such as a pair of ball bearing type bushings which permit movement of the carriage with minimum friction. Each of the plates **54** is provided with a pair of spaced stud engaging fingers **57** mounted on the upper surface of plates **54** by means of hinges **58**. The fingers **57** normally are retained against a pair of stops **59** by means of a spring **60** connected at one end to the plate **54** and connected at the opposite end to a lug **61** carried by the fingers **57**. The carriage **51** is adapted to be moved from side to side of the auxiliary frame by a fluid cylinder **62** pivotally connected at one end to lugs **63** carried by the auxiliary frame **44**. The cylinder **62** is provided with a piston rod **64** connected to lugs **65** carried by the carriage **51** so that when the piston rod is extended the carriage will be moved to one side of the auxiliary frame, and when the piston rod is retracted the carriage will be moved to the opposite side of such frame.

With reference to FIGS. 7–11, when a stud is being drilled the piston rod **64** is in extended position and the stud is held in fixed position. After the drill bits have been retracted fluid is introduced into the cylinder to retract the piston rod **64** and cause the carriage **51** to move to the opposite side of the auxiliary frame **44**. During the movement of the carriage one of the fingers **57** will engage the stud which has just been drilled and the other finger will engage a stud carried by the rack **45**. Continued retraction of the piston rod will cause the fingers to pivot downwardly against the tension of the springs **60** until the fingers pass underneath the studs which they are engaging. As soon as the fingers have cleared the studs the springs **60** will return the fingers to upright position against the stops **59**. The fluid being introduced into the cylinder **62** then is reversed to cause the piston rod to be extended. During the outward movement of the piston rod one of the fingers will engage the stud which has previously been drilled and the other finger will engage the lowermost stud carried by the rack **45** to move one stud away from the drilling station and to move another stud into position at the drilling station.

In order to stop the stud at a predetermined position at the drilling station, each of the plates **54** is provided with a cam **66** adapted to engage a stop pin **67** mounted in a holder **68** on the auxiliary frame **44** in such a manner that when the carriage approaches the end of its travel the cam **66** will raise the stop pin **67** so that the stud will be confined between the fingers **57** on one side and the stop pin **67** on the opposite side. When the carriage is retracted the cam is removed from beneath the stop pin which permits the stop pin to return to the holder **68** so that the other fingers **57** can remove the stud after it has been drilled.

During the drilling operation it is desirable to prevent up and down movement of the stud and this is accomplished by suspending a strap member **70** from a pair of depending members **71** and **72** attached at their upper ends to the upper members **33**. The lower end of the depending member **71** has a pivot pin **73** about which one end of the strap **70** is rotatably mounted. The lower end of the depending member **72** has a guide block **74** having an opening **75**. The opposite end of the strap member **70** is provided with an upstanding pin **76** having threads **77**, and such pin extends through the opening **75** and receives a nut **78** to prevent the return of the pin through the opening. A spring **79** is disposed about the pin **76** between the guide block **75** and the end of the strap member **70** in a position to exert a downward force against the strap member until the nut **78** engages the guide block **74**. When a stud S is moved to the drilling station such stud will engage the strap member **70** and force the same upwardly against the tension of the spring **79** to hold the stud in fixed position.

The movement of the studs across the machine and the in-and-out movement of the drill bits are synchronized so that the drill bits can only be extended when the studs remain in fixed position. This is done by providing a relatively small electric motor **82** mounted on a platform **83** carried by the upright support members **32** and such motor is provided with a gear reduction **84**. The gear reduction drives an output shaft **85** on which a pair of cams **86** and **87** are mounted and are rotated when the motor **82** is operated. A micro-switch **88** is mounted on the platform **83** and has an operating arm **89** with a follower **90** on the free end thereof and such follower is in engagement with the cam **86**. The microswitch **88** controls the flow of fluid to the fluid cylinder **62** which causes the carriage **51** to move back and forth and advance the studs to the drilling station. As soon as a stud is in the drilling station the micro-switch **88** is de-energized and a second micro-switch **91** having an operating arm **92** with a follower **93** on the free end adapted to engage the cam **87** is energized to cause the drills to be extended so that the bits **37** penetrate the ends of the stud and thereafter are retracted.

As illustrated in FIGS. **1**, 13 and 14, one end of the machine may be movable to accommodate studs of varying lengths. In order to do this the support members **32** at one end of the machine are mounted on slidable base members **95** which rest on wear strips **96** carried by the base members **31**. The base members **31** at opposite sides of the machine are connected by an end member **97** and an intermediate member **98**. The members **97** and **98** rotatably support a threaded rod **99** having an operating handle **100** at one end. An internally threaded hub **101** is mounted on the movable end of the machine and such hub is adapted to receive the threaded rod **99** so that when the rod is rotated in one direction the movable end will be moved away from the fixed end by the screw threads, and when the rod is rotated in the opposite direction the movable end will be moved toward the fixed end.

With reference to FIG. 18 a modified form of the invention is illustrated in which the auxiliary frame **44** has been replaced by an auxiliary frame **105** which includes generally upright support members **106** connected by upwardly opening channel members **107** extending across the width of the machine. An endless chain **108** is disposed within each of the channel members **107** and such chain is provided with a plurality of spaced upstanding lugs **109** adapted to engage the studs S and move the studs across the auxiliary frame **105** when the chains are operated. In order to operate the chains **108** a drive shaft **110** mounted in bearings **111** is disposed along one side of the auxiliary frame **105** and an idler shaft **112** is mounted in bearings **113** on the opposite side of the auxiliary frame. Sprockets **114** and **115** are mounted on the drive and idler shafts, respectively, and the drive shaft **110** is provided with a drive sprocket **116** driven by a chain **117** from a sprocket **118** mounted on the shaft **119** of a drive motor **120**. The motor **120** is supported

by cross members **121** extending between th base members **31** and such motor is controlled by the cam **86** driven by the motor **82**.

With reference to FIG. 22 a schematic of the hydraulic system of the machine is illustrated and includes an inlet pipe **124** connected to a source of fluid under pressure (not shown) and if desired such inlet pipe may be provided with conventional oil and water separators **125** and **126**, respectively. The fluid under pressure enters a first header **127** having a plurality of connections **128** each of which is connected by a fluid line **129** to one of the drills **36** to rotate the drills. Fluid under pressure is discharged from the header **127** through a line **130** to a distributor valve **131** controlled by solenoids **132** and **133**. When solenoid **132** is energized fluid under pressure will pass through the distributor valve **131** and through a fluid line **134** to a header **135** having a plurality of connections **136** each of which is connected by a fluid line **137** to one of the drills to cause the drill to be extended. When the drill is fully extended a limit switch (not shown) will de-energize solenoid **132** and energize solenoid **133** to move the distributor valve and direct fluid through the fluid line **138** to a header **139** having a plurality of connections **140** each of which is connected by a fluid line **141** to the drills **36** to cause such drills to be retracted.

In the operation of the device a plurality of studs of substantially the same length are placed within the rack **45** after which the stud moving means in the form of a carriage **51** or endless chains **108** is operated to move the lowermost stud from the rack and to move such stud to the drilling station. After the stud is in position the transverse movement of the stud is interrupted after which the drills **36** are extended to bore holes in at least one end of the stud. At the completion of their stroke the drills are retracted and the stud which has been drilled is removed from the drilling station while a new stud is moved into position to be drilled.

If desired one or more safety features could be built into the machine, such as a time delay after the drills have been retracted to make certain that all of the drills have cleared the stud before the stud is moved to the next position. Also an interlock switch **143** may be mounted on braces **144** and have an operating arm **145** extending downwardly into the path of travel of the studs to prevent the machine from operating when a stud is not positioned at the drilling station.

It will be apparent that a stud drilling machine has been provided which will automatically move a stud to a predetermined drilling station and thereafter drill one or a plurality of openings in the end of such stud and thereafter discharge the stud from the machine.

It will be obvious to one skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is illustrated in the drawings and described in the specification, but only as indicated in the accompanying claims.

What is claimed is:

1. A stud drilling machine for drilling a plurality of holes in at least one end of a stud, said machine comprising a base, a frame mounted on said base, rack means located at one side of said frame and adapted to receive a plurality of studs disposed in stacked substantially vertical relation to each other, a drilling station spaced a predetermined distance from said rack, means for moving a stud from said rack across said frame to said drilling station, means for maintaining said stud in fixed position at said drilling station, upper and lower mounting members carried by said frame at said drilling station, at leaast one drill having a drill bit carried by each mounting member substantially in a vertical plane with the stud to be drilled, each of said drills being disposed at an angle less than 90° to the plane of movement of said studs, one of said drills being offset laterally from the other drill, means for extending and retracting said drill bits to drill a hole extending from one side through the end of the stud at said drilling station, and means for moving said studs from said drilling station after the holes have been drilled therein.

2. The structure of claim **1** in which said means for moving said studs to a drilling station includes a carriage, fluid means for extending and retracting said carriage, and means on said carriage for engaging and bypassing said stud when the carriage is moved in one direction and for moving the stud when the carriage is moved in the other direction.

3. The structure of claim **1** in which one end of said frame is slidably mounted on said base to accommodate studs of different lengths.

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