March 3, 1953 W. B. PRIDY 2,629,920

MACHINE FOR PERFORATING PIPE

Filed Nov. 14, 1949 4 Sheets-Sheet 1

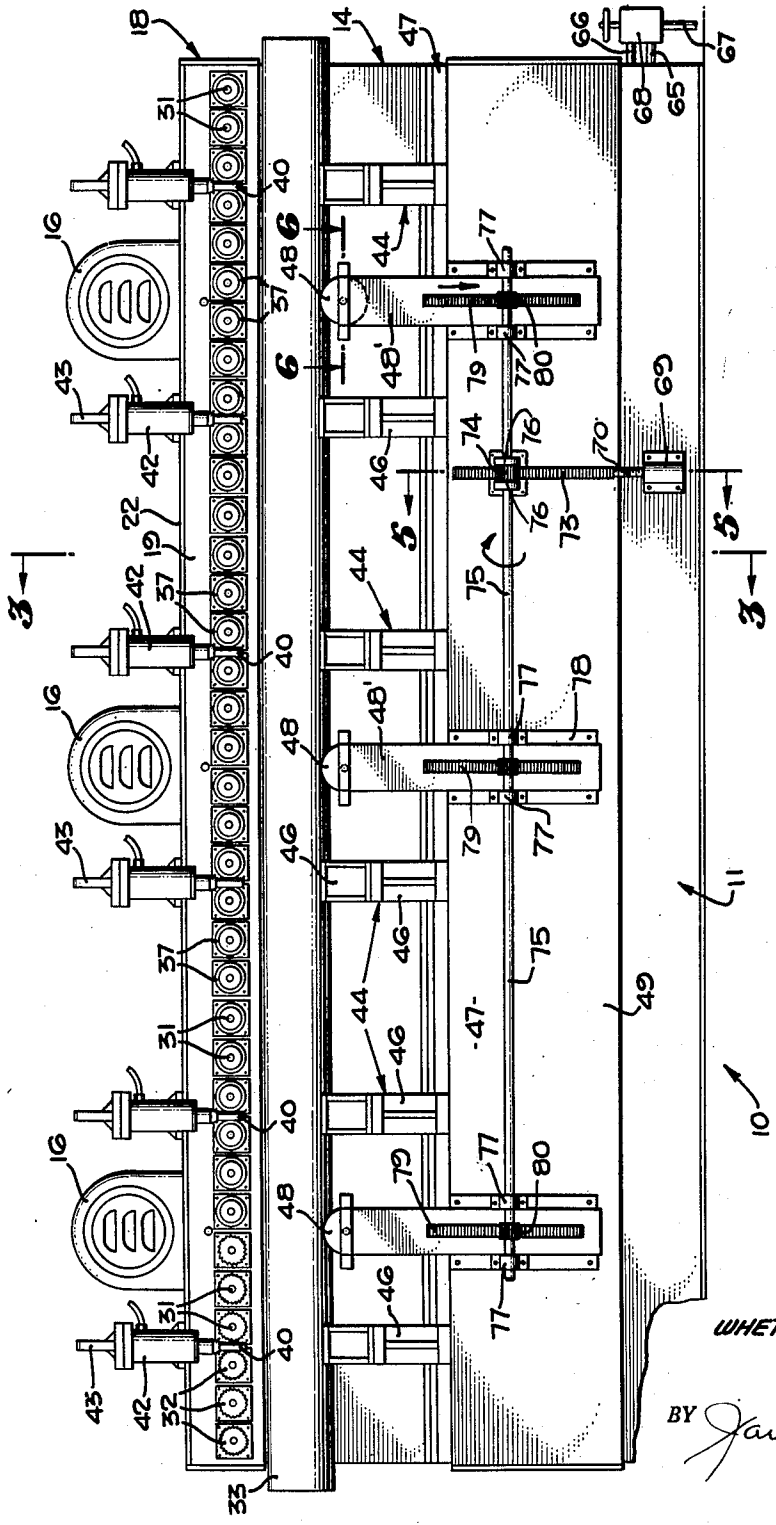

Fig. 1.

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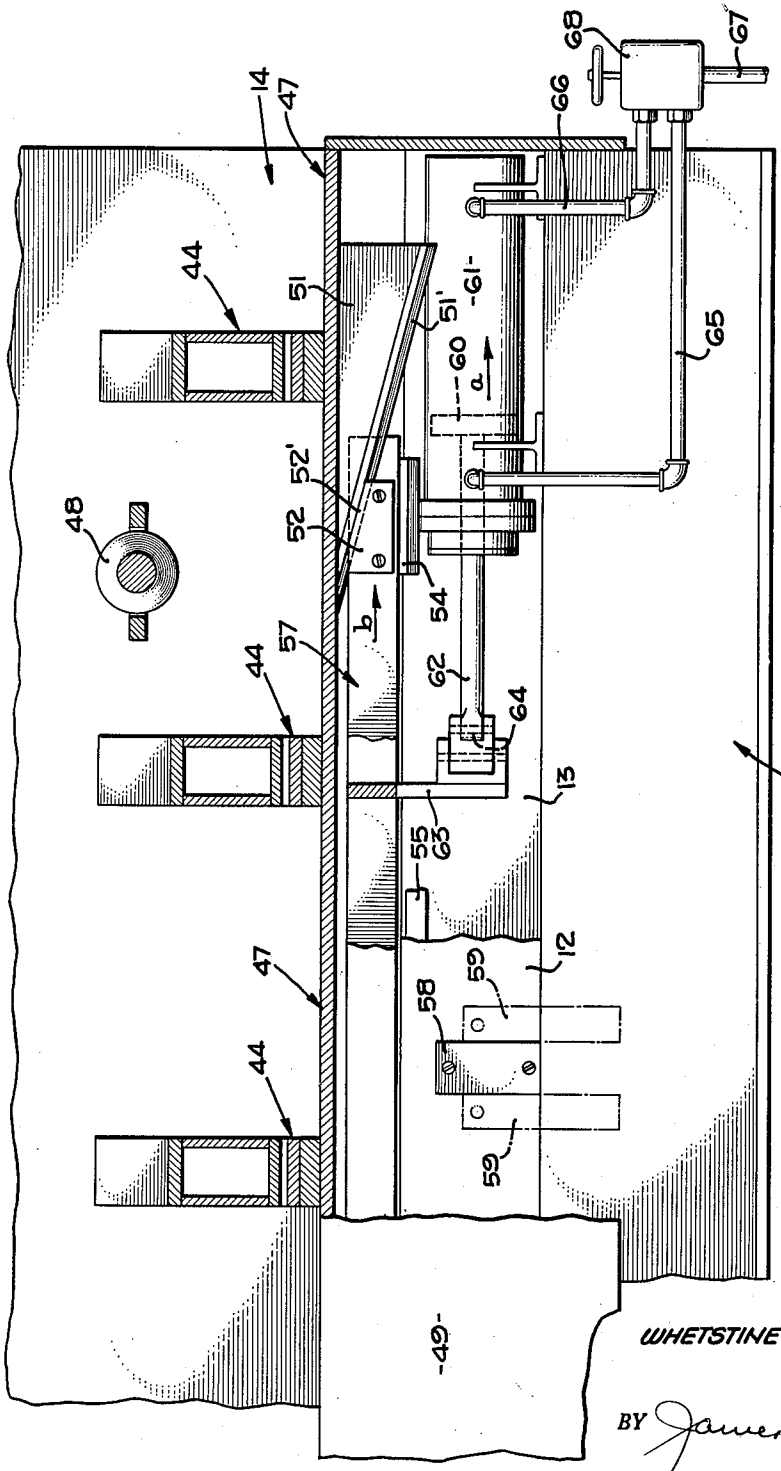

Fig. 2.

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MACHINE FOR PERFORATING PIPE

Filed Nov. 14, 1949 4 Sheets-Sheet 3

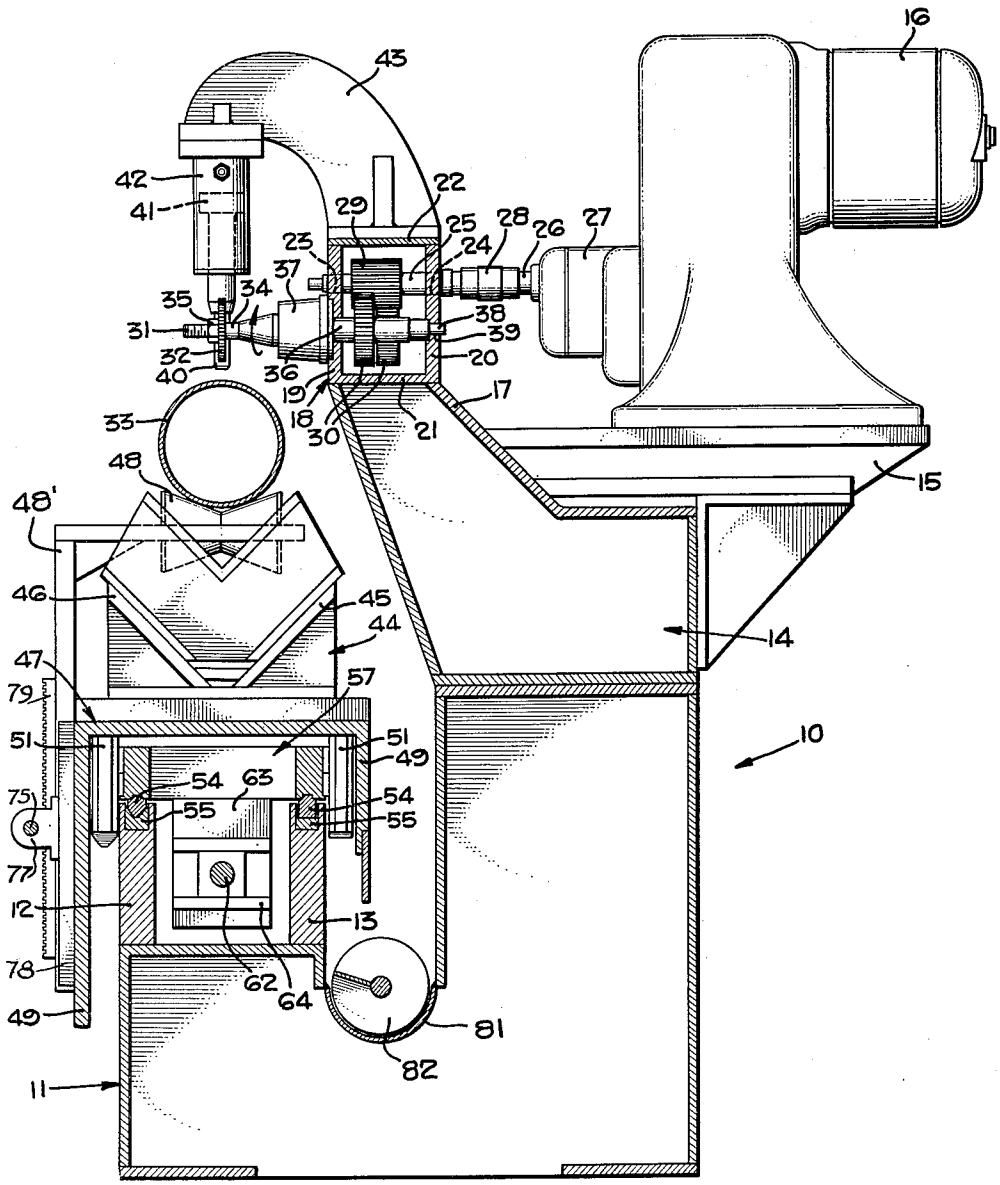

Fig. 3.

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MACHINE FOR PERFORATING PIPE

Filed Nov. 14, 1949 4 Sheets-Sheet 4

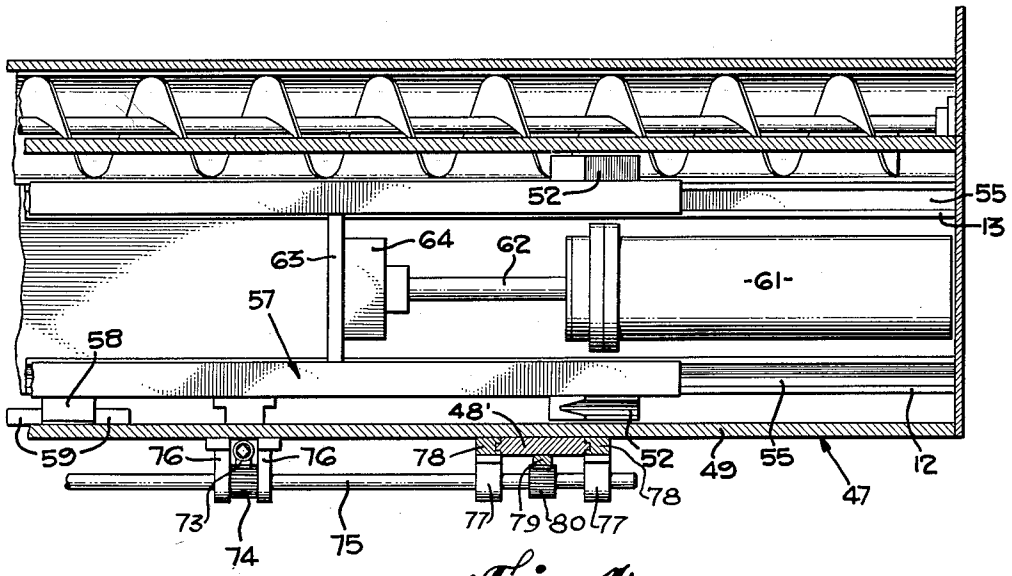

Fig. 4.

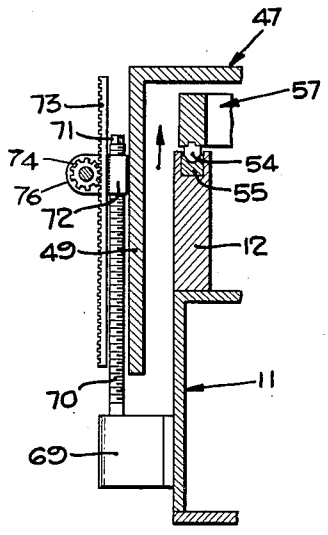

Fig. 5.

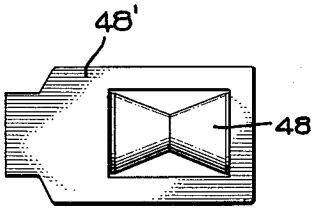

Fig. 6.

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Patented Mar. 3, 1953 2,629,920

UNITED STATES PATENT OFFICE

2,629,920

MACHINE FOR PERFORATING PIPE

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Application November 14, 1949, Serial No. 127,125

7 Claims. (Cl. 29—70)

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This invention relates to pipe perforating, and particularly pertains to a machine for perforating pipe.

At the present time it is common practice to perforate or slit pipe which is used as casing in oil well production operations. A common practice is to support a length of pipe or casing on a bed and then to slot it by the use of slotting cutters which are carried by a head and which move vertically. Due to the length of the slots required it is common practice to select a cutter which will form a slot through the wall of a pipe without the necessity that there shall be any relative movement between the cutter and the pipe save for the purpose of moving the pipe in order to space the slots throughout the length of the pipe but not for the purpose of determining the length of the slot. In machinery of this type the bed usually supports the pipe in a horizontal position and the gang of cutters are supported in a manner to overhang the pipe and to move up and down relative to the wall thereof. The cutters used are of course metal cutters and operate at high speed. There is a tendency for these cutters to chatter and vibrate the supporting head due to the fact that the head is mounted to move vertically. It is desirable to provide some means whereby the gang of cutters and the head supporting them shall be held rigidly and with a minimum amount of vibration. In actual practice it has been found that vibration and chatter of the machine, and particularly the cutting head, can be eliminated to a great extent if the cutting head structure is mounted rigidly so that it does not require vertical adjustment, and at the same time the bed supporting the pipe is mounted to move vertically and its longitudinal axis is in a constant horizontal plane as movement takes place. It is the principal object of the present invention, therefore, to provide a pipe slotter or the like rigidly supporting a slotting head and holding it against vertical movement while horizontally supporting a piece of work, such as a pipe, and causing the piece of work to move toward and away from the slotting head as the slitting operation takes place.

The present invention contemplates the provision of a fixed base providing a horizontal runway and a horizontally movable carriage, said carriage being also designed to be lifted vertically, the base further serving as a mounting to which an overhanging cutter head is fixed.

The invention is illustrated by way of example in the accompanying drawing in which:

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Figure 1 is a view in elevation showing the assembled machine.

Fig. 2 is a view in side elevation showing the assembled machine with parts broken away to more clearly show the carriage lifting and operating mechanism.

Fig. 3 is a view in vertical section as seen on the line 3—3 of Fig. 1 and shows details of the carriage lifting structure.

Fig. 4 is a view in plan with parts broken away showing the relationship of the carriage and the trackways and the means whereby the carriage is lifted relative to the trackways.

Fig. 5 is a view in vertical section as seen on the line 5—5 of Figure 1 and shows a detail of the table adjustment.

Fig. 6 is a fragmentary view in plan as seen on the line 6—6 of Fig. 1 and shows the details of one of the pipe supporting rollers.

Referring more particularly to the drawings, 10 indicates a base structure which is designed to provide the main support for the machine. Associated with the base structure is a track base 11 upon which trackways 12 and 13 are supported. Mounted upon the base 10 is a cutter head 14. This head is formed with a supporting bracket 15 to carry a spindle driving motor 16. The head is also formed with an upwardly and outwardly extending arm portion 17 which overhangs the track base 11. The arm structure carries a longitudinally extending gear box 18 having a front wall 19, a parallel rear wall 20, a bottom wall 21, and a top 22. Aligned bearing openings 23 and 24 provide rotatable supports for a gear shaft 25. This shaft is connected by the shaft 26 of a reduction gear 27 by a coupling 28. As will be understood the reduction gear 27 is driven from the motor 16. Mounted upon the gear shaft 25 is a driving gear 29. The driving gear 29 is in mesh with pinions 30. A series of these pinions is in turn in mesh so that twelve cutting spindles 31 may be simultaneously driven from a motor 16. The spindles rotate alternately in opposite directions so that the driving strain on the pipe will be counterbalanced. By reference to Fig. 1 it will be seen that a plurality of motors 16 are mounted in spaced relation to each other upon the bracket 15 so that a series of metal saws 32 may be driven to slit a pipe 33 along the upper side thereof and longitudinally of the pipe. It is to be understood that the metal saws are held in position upon the spindles 31 by collars 34 and nuts 35. Each of the spindles has an enlarged portion 36 mounted within a bearing 37. The

bearings 37 are in turn mounted in the forward wall 19 of the gear box 18. At the rear end of the spindles 31 there is a reduced portion 38 which extends through an opening 39 in the back wall 20 of the gear box and also acts as a bearing to rotatably support the spindles.

For the purpose of holding a pipe 33 firmly, a plurality of air clamps are interposed at intervals throughout the length of the pipe. These clamps comprise a plunger 40 associated with a piston 41 and reciprocally mounted in cylinders 42. The cylinders are supported by arms 43 which in turn are fastened to the gear box 18. Air under substantial pressure is delivered to the cylinders 42 from the suitable source of supply as controlled by suitable valves and used in a manner hereinafter set forth. The slitting saws 32 are designed to slit or perforate the pipe 33 at intervals throughout the length of the pipe as the pipe is held in cradles 44. The cradles comprise opposite inclined members 45 and 46 which are supported upon a table 47. The angles of the inclined members 45 and 46 are such as to insure that cradles will be provided to accommodate casing 33 of different diameters. In the trough formed by the cradle 44 are rollers 48 which are of their smallest diameter intermediate the ends of the rollers and thus provide frusto-conical sections upon which the smaller sizes of casing may rest. The rollers 48 are mounted upon uprights 48' which are moved vertically with relation to the table by a structure to be hereinafter described. This makes it possible for the pipes to be loaded easily onto the cradles in various longitudinal positions with relation to the slitting saws. The table 47 overhangs the trackways 12 and 13 and extends downwardly over the sides thereof as indicated at 49. As shown in Fig. 2, the table is fitted with a plurality of inclined wedges 51 which bear against complementary wedges 52. The complementary faces of the wedges 51 and 52 are formed with V-shaped grooves 51' and 52' which tend to steady the table against lateral movement. The wedges 52 are mounted upon a carriage 57 which has opposite rails in substantially vertical alignment with the trackways 12 and 13. Guide bars 54 are pitted to the lower faces of the carriage 57 and are tapered to fit within guide members 55 complementary thereto and carried in grooves at the upper edges of the trackways 12 and 13. By this arrangement the carriage 57 may move horizontally with relation to the trackways 12 and 13 without appreciable friction and will hold against lateral movement. It is obvious that when the wedges 52 move horizontally with the carriage 57, they will engage the wedges 51 upon the table and will tend to cause movement of the table vertically. In the drawings the set of wedges 51 and 52 is shown only. It is obvious, however, that any desired number of sets of wedges may be used consistent with good engineering practice. The table 47 is restrained from horizontal movement by members 58 which are secured to the table and extend between guides 59 which guides are fixed to the trackways 12 and 13. A plurality of sets of members 58 and 59 may be used throughout the length of the structure. The carriage 57 is shifted horizontally by movement of a piston 60 mounted within a cylinder 61. The piston 60 carries a piston rod 62 which reciprocates horizontally and is connected to a bracket 63 by a pin and shackle structure 64. The bracket 63 is secured to the carriage 57 and extends downwardly therefrom. The piston 60 is moved by a fluid under pressure delivered at opposite ends of the cylinder 61 through pipes 65 and 66 which connect with the valve 68. The valve is in connection with a source of fluid supplied by means of a conduit 67. The valve 68 is a two-way valve and may direct fluid under pressure alternately to the opposite end of the cylinder 61, through pipes 65 and 66. It will be seen that by this arrangement the movement of the piston 60 will cause the table 47 to move bodily and in a vertical direction. At the same time, of course, it will lift the cradle 44 and the casing 33 toward and away from the sliting saws 32.

In order to insure that the rollers 48 are in proper adjusted position relative to the cradles at all times so that the casing 33 may be readily moved into position where the cradle will engage the casing to raise and lower the same, a mechanism is provided as shown particularly in Figures 1, 3 and 5 of the drawings. The base at 11 is there shown as fitted with a fastening bracket 69 which receives the lower end of an adjusting screw 70. This screw extends vertically along the outer side of a member 49 forming a part of the table 47. The upper end of the screw is fitted with a squared head 71 which may be engaged by a wrench to rotate the screw. The screw 70 is threaded through a fitting 72, to which a gear rack 73 is fixed. The gear rack extends vertically and parallel to the portion 49 of the table 47. The rack is in mesh with a pinion 74 carried upon a horizontally extending pinion shaft 75. The shaft 75 is rotatably supported at opposite sides of the pinion 74 by bearings 76 which are mounted on member 49. The shaft 75 extends longitudinally of the table and is supported at intervals in bearings 77 which are associated with vertical guides 78. These guides slidably receive uprights 48' which carry the rollers 48. The uprights may move vertically between the guides 78 and are each fitted with a gear rack 79 secured vertically thereon, these racks meshing with gear pinions 80 which are keyed to the shaft 75.

Attention is directed to the fact that a trough 81 is formed in the base portion of the machine to receive cutting chips which may fall from the work. In order to carry the chips to a point of discharge, a screw conveyor 82 is placed in the trough and will move the chips along the trough as it rotates.

In the operation of the present invention the screw 70 is adjusted so that the uprights 48' will support the rollers 48 at any desired level above the cradles 44 when the latter are lowered. The casing 33 may then be moved longitudinally into the machine. When it is desired to slit the casing the motor is started and fluid under compression is delivered to the cylinders 61 through the valve 68. This will pull the piston 60 in the direction of the arrow *a*, Fig. 2. This will draw the carriage 57 in the direction of the arrow *b* as indicated in Fig. 2 and will force the wedges 52 beneath the wedges 51 to lift the table 47 bodily. This will cause the casing 33 to be lifted into cutting relation with the slitting saws 32. The lifting action will continue until slits have been made to a desired length longitudinally of the casing. Attention is directed to the fact that as the table 47 and the cradles 44 rise they lift the casing 33 out of engagement with the rollers 48. This does not, however, change the adjusted position of the rollers even though the table raises. In this particular action the table lifts

and causes the pinion 74 to be lifted with the table. At this time the pinion will roll along the fixed gear rack 73 and will rotate the shaft 75. At the same time the shaft 75 will rotate gears 80 as the racks 79 move in unison with the vertical movement of the table. The racks 73 are fixed with relation to the screws 70 and these in turn are secured to the lower end of the base 11. The supporting positions of the rollers 43 will not be changed during the slitting operation. After the slitting operation has been completed the valve 68 is actuated causing the piston 60 to move in a counter-direction to the arrow *a* whereby the pipe 33 is lowered. As the casing is lowered with the cradles it is deposited on the rollers 43 and may then be rolled longitudinally away from over the table and onto other rollers (not shown) by which it is carried away from the machine.

After the casing 33 has been elevated, upon the cradles 44, to a desired height above the supporting rolls 43 air under pressure is supplied to the cylinders 42 to force the plungers 40 downwardly and hold the casing in a firm position while the table 47 is being elevated, and the plungers 40 have been correspondingly protracted.

It will thus be seen that the structure here disclosed makes it possible for a piece of pipe of considerable length to be slit at simultaneous positions throughout the length of the pipe while the pipe is being moved toward and away from a plurality of slitting saws and while the pipe and the slitting head have been held against any material vibration. The plungers are limited in their downstroke and are yieldably held by the compressed fluid under pressure which tends to hold them in their lowermost positions. With this arrangement the plungers will accommodate themselves to upward movement of the casing.

While I have shown the preferred method of perforating pipe or the like and the preferred machine for performing the same, it is understood that various changes in the steps of the method and the combination of the parts of the machine may be made by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a machine for slotting the wall of a length of pipe, the combination of: a rigid frame structure including an elevator base disposed at a relatively low level and an overhanging cutter base extending to a relatively high level; a gear box rigidly secured to said cutter base; a series of bearings rigidly secured to said gear box, the axes of said bearings being parallel and lying in the same horizontal plane; cutter saw spindles rotatably journalled in said bearings; gear train means mounted in said gear box for rotating said spindles; a series of circular slotting saws fixed on said spindles in a common vertical plane which approximately longitudinally bisects said elevator base; a series of arms rigidly fixed on said gear box and overhanging said elevator base; air clamps mounted in said vertical plane on said arms and including cylinders fixed on said arms, pistons in said cylinders, and plungers extending downwardly from said pistons to a level below said saws; a vertically reciprocable work elevator symmetrical with said vertical plane and mounted on said elevator base, said elevator having V-shaped cradles symmetrical with said plane for supporting a length of pipe at spaced intervals along the latter with the axis of said pipe disposed horizontally in said plane; power means for actuating said gear train to rotate said saws; and power means for actuating said air clamps and said elevator to yieldably press said plungers against said pipe to maintain substantially yieldable downward pressure against said pipe and to elevate said pipe against said air clamps and said rotating saws to cause the latter to form a series of slots in said pipe in said plane, said clamp plungers smoothly stripping said pipe from said saws when said elevator returns downwardly.

2. A combination as in claim 1 in which said elevator includes a table; means on said table and said elevator base for guiding said table vertically; a carriage horizontally slidable between said elevator base and said table; spaced tracks on said elevator base for slidably supporting said carriage; a series of pairs of wedges on said table on opposite sides of said elevator base; a second series of pairs of wedges on said carriage on opposite sides of said elevator base and cooperating with said first series of pairs of wedges to cause vertical reciprocation of said table when said carriage is shifted horizontally on said tracks; a series of V-shaped pipe supporting cradles mounted on said table at spaced intervals therealong; and power means for shifting said carriage horizontally to cause the vertical reciprocation of a length of pipe supported on said cradles.

3. A combination as in claim 2 in which a series of pipe supporting rollers are mounted on said table to be vertically movable relative to the latter; and means for automatically vertically shifting said rollers relative to said table when the latter is lowered to cause said rollers to assume the support of said length of pipe whereby said pipe may be repositioned for a subsequent slotting operation prior to the beginning of the next vertical reciprocation of said table to accomplish said subsequent slotting operation.

4. A combination as in claim 3 in which the means for mounting said rollers on said table includes a series of uprights, on the upper end of each of which, one of said rollers is mounted; guide means on said table in which said uprights slide vertically; a vertical rack provided on each of said uprights; a vertically disposed control rack mounted on said elevator base for vertical adjustment relative thereto, said control rack facing in the same direction and having its pitch line in the same plane as the racks previously recited; horizontally aligned bearings on said table; a shaft journaled in said bearings; and a series of like pinions fixed on said shaft and meshing with said gear racks.

5. In a pipe slotting machine, the combination of a rigid frame including a relatively low elevator base and a relatively high overhanging cutter base; a series of bearings rigidly mounted on said cutter base with their axes parallel and in a given horizontal plane; spindles journalling in said bearings; cutter saws fixed on said spindles in a given vertical plane; power means for rotating said spindles and saws; a pipe elevator mounted on said elevator base and having cradles in which a pipe nests, when so elevated, with the axis of said pipe lying horizontally in said vertical plane; means to reciprocate said elevator and a pipe resting thereon vertically

to cause said saws to cut a series of slots in said pipe; and a series of yieldable pipe restraining devices mounted on said cutter base, said devices extending downwardly in said vertical plane below the lower extremities of said cutter saws, said restraining devices yieldably resisting the upward movement of said pipe into engagement with said says and independently forcing said pipe downwardly, when the latter is lowered with said elevator, to strip said pipe from said saws.

6. A combination as in claim 5 in which a series of rollers are mounted on said elevator; and means causing relative vertical movement between said rollers and said elevator when said pipe is being lowered to cause said rollers to assume the support of said pipe whereby said pipe may be shifted on said rollers to a new position for a succeeding slotting operation.

7. A combination as in claim 6 in which means

is provided for adjusting the means for causing relative vertical movement between said elevator and said rollers to vary the level at which said rollers assume support of said pipe.

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