Nov. 9, 1948. H. F. TEMPLE 2,453,681

TUBE PERFORATING MACHINE

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Fig. 1

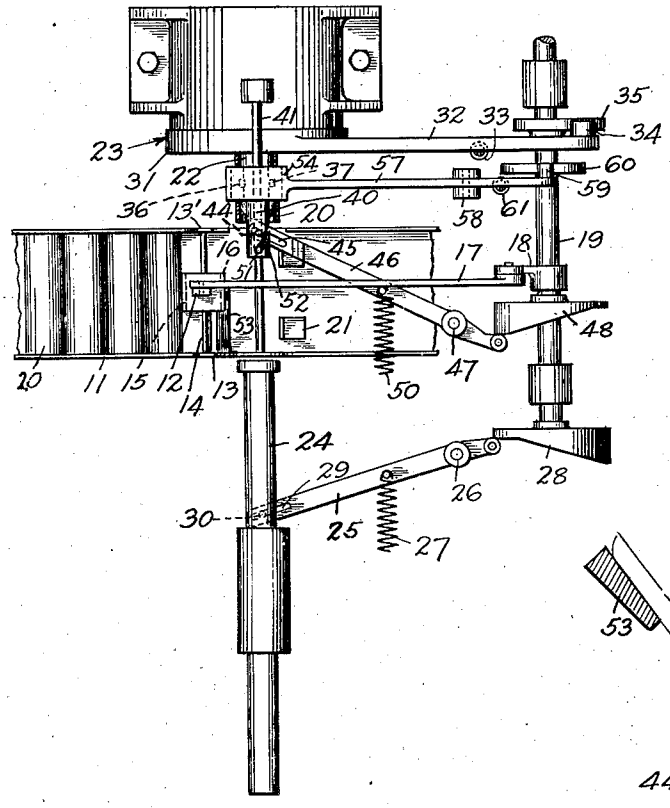


Fig. 2

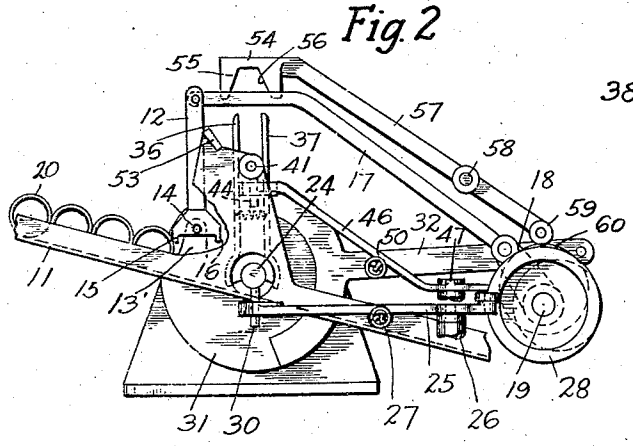


Fig. 3

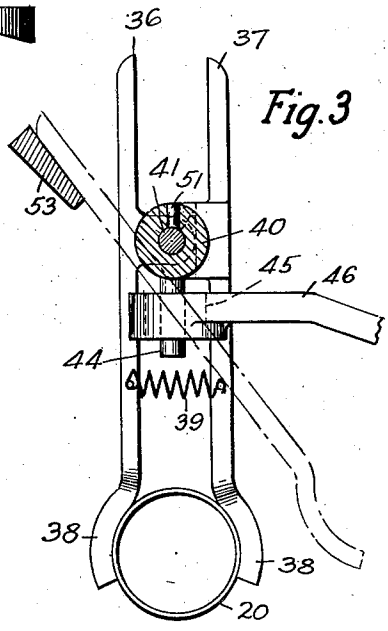
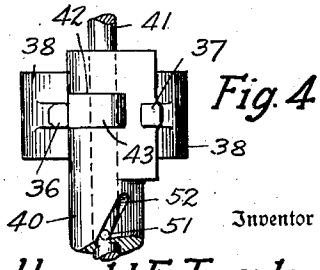


Fig. 4



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Fig. 5

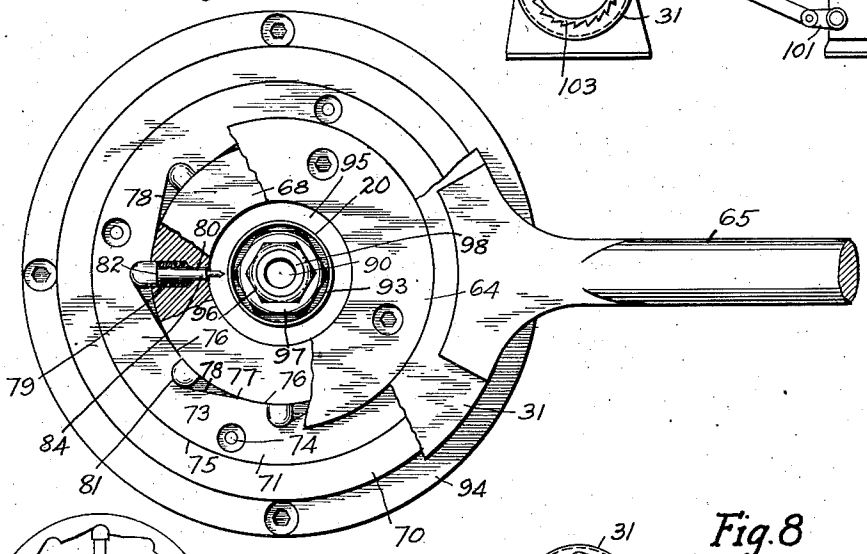


Fig. 9

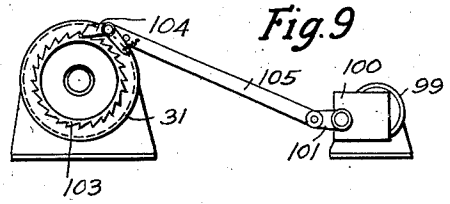


Fig. 10

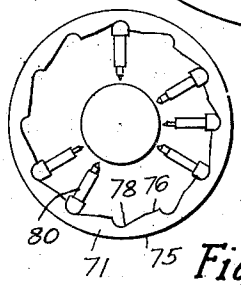


Fig. 8

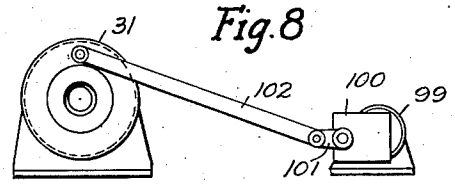


Fig. 6

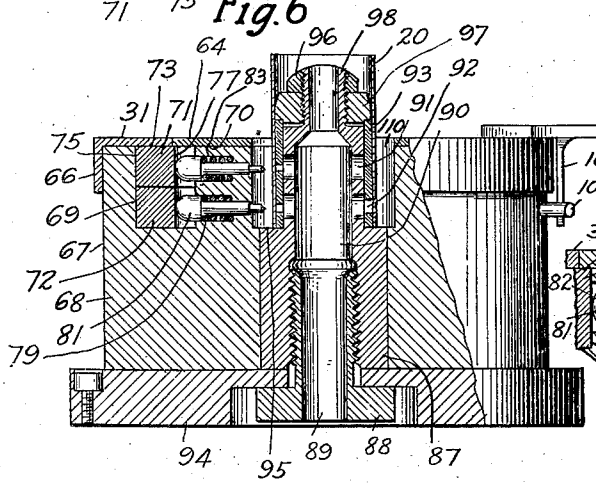
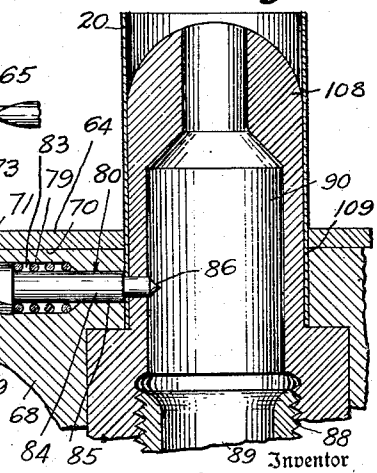


Fig. 7



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UNITED STATES PATENT OFFICE

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TUBE PERFORATING MACHINE

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7 Claims. (Cl. 164—108)

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This invention relates to machines for perforating tubes and particularly to that type of machine in which punches are operated to pierce the tube.

The invention contemplates the provision of a simple tube perforating machine adapted to punch holes in any desired arrangement, number and shape and employing easily replaceable parts to enable changes for different holes to be made conveniently, and to permit the machine to be changed quickly and easily to operate on tubes differing in diameter.

The invention further contemplates the provision of a relatively simple, efficient and high speed fully automatic tube perforating machine designed for long runs, to feed and mount the tubes, to perforate the tubes and to dismount the tubes and discharge them from the machine.

The invention further contemplates in another embodiment, the provision of a semi-automatic perforating machine wherein the operator feeds the tube to the machine manually, and removes it after it has been perforated, the machine being adapted either for progressive operation in one direction as when the distances between holes are always a multiple of the least distance between holes, or for oscillatory operation in other cases.

The invention further contemplates the provision of a manually or automatically rotatable or oscillatory cam ring provided with any desired number of cam portions for operating one or more punches to make holes at a given level or height.

The various objects of the invention will be clear from the description which follows and from the drawings, in which

Fig. 1 is a top plan view partly in section, of the machine for automatically feeding, mounting, perforating and dismounting the tubes.

Fig. 2 is a front elevational view thereof.

Fig. 3 is an enlarged fragmentary front elevational view of the tube grippers, partly in section, and showing in dash-dot lines, the position assumed by one of the gripping jaws when the tube is being discharged from the machine.

Fig. 4 is a top plan view of the gripping jaws of Fig. 3 and of the supporting means therefor.

Fig. 5 is a top plan view, with certain overlying parts broken away, of a manually operated machine embodying the invention.

Fig. 6 is a vertical sectional view and front elevational view combined of a typical manually operated machine whereby two rows of holes at different levels are punched.

Fig. 7 is a fragmentary vertical sectional view of

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the machine showing a mandrel adapted to receive tubes only of a given diameter and showing a typical punch.

Fig. 8 is a diagrammatic front elevational view of a semi-automatic machine and of the means for oscillating the cam rings.

Fig. 9 is a similar view of another form of the semi-automatic machine wherein the cam rings are rotated intermittently and progressively.

Fig. 10 is a diagrammatic top plan view of the cam ring and of the punches controlled thereby, showing varying spaces between the punches to punch holes variously spaced around the tube and of different sizes and shapes.

In the fully automatic form of the machine shown in Figs. 1 to 4, the tubes 10 to be perforated are fed to the chute or guideway 11 in any suitable manner and roll by gravity down the chute until the lowermost tube of the row is halted by suitable escapement mechanism operative to permit only a single tube at a time to move therepast in proper timed relation to the operation of the tube mounting mechanism. In the form shown, the escapement comprises the rocking member 12 pivoted to the upstanding extensions 13 and 13' of the sides of the chute as by means of the cross rod 14 and provided with the downwardly extending stops 15 and 16. On the movement of the arm 12 in a counterclockwise direction, the stop 15 engages the next to the last tube of the row and holds the row back, while the stop 16 releases the last tube. On movement of the arm clockwise, the stop 16 engages the tube released by the stop 15 and halts the row preparatory to the release of the next tube. The arm 12 is rocked in any suitable manner as by means of the connecting rod 17 and the crank 18 on the drive shaft 19, which is continuously rotated by any suitable means such as a motor, not shown.

The tube 20 released by the escapement, rolls down the chute 11 into engagement with the fixed stops 21 and into axial alignment with the mandrel 22 of the perforating machine, which is designated generally by the numeral 23 and which will be described in detail hereinafter. The sides of the chute are cut away at the mounting position of the tube, the tube being mounted on the mandrel 22 by the reciprocating mounting rod 24. Said rod is reciprocated at the proper time across the chute as by the lever 25 pivoted to any fixed part of the machine or bracket as at 26 and pulled by the spring 27 into engagement with the cam 28 on the shaft 19. A slot 29 in the end of the lever receives the pin 30 projecting from the rod 24, whereby each rotation of the

drive shaft reciprocates the rod sufficiently to advance the tube 20 across the bottom of the chute while in contact with the stops 21 and until the tube is properly mounted on the mandrel as shown in Fig. 1.

Immediately after the mounting operation has been completed, the cover or operating rim 31 of the perforating machine 23 is oscillated, causing operation of the perforating mechanism and perforating the tube. The rim is oscillated as shown, by the arm 32 projecting therefrom and pulled by the spring 33 to carry the roller 34 of the arm into engagement with the cam 35 on the shaft 19. As the mounting rod 24 moves back on its return stroke, the perforated tube is dismounted from the mandrel.

Such dismounting operation is performed by suitable gripping members as 36, 37 each shown as terminating in a suitably shaped jaw 38, the jaws of said members being normally pulled toward each other as by the spring 39. In the form shown, the member 37 is provided with a laterally extending sleeve 40 slidably and pivotally mounted on the fixed guide shaft 41 which is fixed at one end to the side extension 13 of the chute and at the other end to the frame of the perforating machine 23. Fitted loosely into the transverse groove 42 of the sleeve (Fig. 4) and also slidably pivoted on the shaft 41 is the lug 43 of the gripping member 36, whereby the members 36 and 37 are pivoted on the shaft 41 and are also slidable as a unit thereon. For reciprocating said members, a pin 44 projecting from the sleeve enters the slot 45 of the lever 46 which is pivoted at a fixed point 47 and engages the cam 48 on the shaft 19, being pulled into such engagement by the spring 50. In the position of the parts shown in Figs. 1 and 2, the gripping jaws are closed on the tube 20, preparatory to the removal of the tube from the mandrel. As the lever 46 moves in a counterclockwise direction as viewed in Fig. 1, the sleeve 40 and the gripping members together with the gripped tube 20 are moved toward the receding rod 24 to dismount the tube.

Means are provided to separate the jaws 38 and thereby to release the dismounted tube near the end of the dismounting movement of the gripping members. As shown, said means takes the form of a pin 51 fixed to and projecting from the shaft 41 and entering the cam groove 52 of the sleeve 40, in addition to a fixed member 53 in the path of the gripping member 36. It will be seen that as the tube is dismounted, the gripping members turn as a unit on the shaft 41 by reason of the pin 51 moving along the helical cam groove 52. As the dismounted tube is brought over the chute 11, the upper end of the gripping member 36 is brought into a position adjacent the fixed member 53, whereafter continued rotation of the sleeve 40 during the end of the movement of the sleeve along the shaft 41, forces said member 36 against the fixed member 53 to the dash-dot line position thereof shown in Fig. 3, while the member 37 continues to rotate toward said fixed member relatively to the member 36 and against the action of the spring 39 to open the jaws. The perforated tube 20 thus released drops on to the end part of the chute past the stops 21 and rolls out of the machine.

On the return movement of the sleeve 40, the member 36 is removed from the member 53 and the jaws are closed by the spring 39. Means are therefore provided again to open the jaws at the

end of the return movement of the sleeve to permit the next tube to be mounted on the mandrel 22 prior to the mounting movement of the rod 24. As shown, said means takes the form of a double wedge 54 having upwardly converging sides 55 and 56 and which is reciprocated vertically, first to engage the upper ends of the gripping members 36 and 37 and to draw said ends together to open the jaws, and then to release said ends after the tube is mounted on the mandrel thereby permitting the spring 39 to close the jaws on the tube. The arm 57 projecting from the wedge is pivoted at a fixed point 58 and the roller 59 at the end of the arm is pulled into engagement with the cam 60 on the shaft 19 by the spring 61. When the jaws 38 are closed upon the tube and after the tube has been perforated by the operation of the arm 32, the dismounting movement of the gripping members is repeated during the next cycle of operations on the next tube.

It will be seen that in the form of the invention just described, tubes need merely be fed to the chute 11, the remaining operations being automatically performed. It will also be seen that a tube is mounted on the mandrel, then perforated and dismounted on each revolution of the shaft 19.

In that form of the invention shown in Figs. 5 and 6, the handle 65 corresponds to the arm 32 and may be operated manually or mechanically as desired, and the mechanism employed in the perforating machine 23 is shown in detail. Said mechanism comprises the rim or cover 31 previously mentioned and provided with a depending flange 66 in sliding contact with the outer face 67 of the frame 68. The rim is of annular form having a central opening therein for the passage of the mandrel, said opening being enlarged to receive the removable plate 64 fixed to the top of the frame and serving to maintain the underlying parts in position and to protect the interior mechanism from dirt and dust. The rim carries the arm or handle 65 and is rotated or oscillated thereby. Arranged in a suitable annular groove 69 extending downwardly from the top surface 70 of the frame. are one or more cam rings as 71, 72. Preferably, the upper face 73 of the uppermost ring 71 is coplanar with the surface 70 whereby the flat under face of the cover or rim 31 may rest on the surfaces 70 and 73 and leave no space for the entrance therebetween of punchings which might interfere with the operation of the mechanism. The cover 31 is removably secured to the cam rings for movement therewith as a unit and relatively to the frame 68, as by means of suitable screws passing into the threaded holes 74 of the rings.

Each of the cam rings bears against both cylindrical sides of the frame groove 69. The outer face 75 of the ring bears against the outer face of the groove while the unmutilated part 76 of the inner face 77 of the ring bears against the inner face or edge of the groove. The ring is thereby held accurately for rotation within the groove. For the widest range of adaptability of the machine, the combined circumferential length of each cam part 78 and its bearing part 76 should be the same as that of the other cam parts and is determined by the least circumferential distance between any two holes to be punched in the tube regardless of the size or shape of the hole or the difference in spacing between the holes. However, for progressive operation of the cam rings (Figs. 9 and 10) the distance between any two

holes should be a whole number multiple of the distance between the closest holes. For oscillation of the rings, this limitation does not apply and the holes may be spaced any desired distance apart. Where holes are to be punched at different levels, a separate cam ring is preferably used for each level and the length of the cam part 78 plus its bearing part is determined again by the distance between the two holes which are closest together circumferentially of the tube.

On the rotation or oscillation of the cam rings, the radially arranged punches 80 are moved inwardly to punch the holes. Each of the punches preferably has a rounded outer end 81 pressed into engagement with the cam part 78 by a suitable spring 79 abutting at one end against the shoulder 82 of the punch and at the other end abutting against the inner end of the hole 83 in the frame into which the spring is removably inserted, the reduced intermediate body portion 84 of the punch being slidably supported in the smaller radial hole 85 in the frame 68. While the body portions 84 and the outer end portions 81 of the punches may all be identical, the inner end portion of the punch is ground to the exact diameter and shape required to punch a hole of the selected size and shape, and terminates in a tapered point 86. As best seen in Fig. 10, punches may be omitted where necessary to attain varying spaces between holes, though for progressive intermittent rotation of the rings, the cam parts are all of the same length and the punch ends 81 drop into the deepest portions of the cam parts successively, each movement of the rings being of the same angular amount required for that purpose and serving to complete a perforating operation on a tube.

In the form of the machine shown in Figs. 5 and 6, the tube holding mandrel comprises a number of parts, only certain of which need be replaced when tubes of different diameters are to be perforated. The hollow mandrel support 87 (Fig. 6) is removably secured in the central opening of the frame 68 as by means of the hollow screw bolt 88 having the longitudinal opening 89 therethrough communicating with the longitudinal opening 90 of the support 87. A series of radial holes 91 in the support communicate with the opening 90 and with the radial holes 92 of the removable mandrel sleeve 93. The holes 92 in the sleeve receive the respective punch ends and cooperate therewith to punch the holes cleanly in the tube, the punchings dropping through the holes 91, 90 and 89 out through the base 94 of the machine. A shoulder as 95 is made on the mandrel support to engage the lower end of the mandrel sleeve 93, the sleeve being held in place firmly by the nuts 96, 97 screwed on the reduced upper end 98 of the mandrel support. The nuts are preferably rounded at their upper parts to permit easy insertion of the tube 20 on the mandrel preparatory to the perforating operation on the tube.

It will be seen that by this arrangement, the mandrel sleeve 93 and its support 87 are readily removable and replaceable by others of a different diameter having a different arrangement of radial holes. Normally, only the sleeve need be replaced by one having the same inner diameter and a different outer diameter when the tube size is to be changed. If the spacing, sizes or shapes of the holes, or the number of holes are to be changed, it may be necessary also to add, remove or replace punches where required as well as to change the sleeve.

To operate the machine mechanically after the proper cam rings, punches and mandrel sleeve have been supplied, the machine may be set up with the axis of the mandrel substantially horizontal and the arm or handle 65 oscillated by any suitable mechanism such as that shown in Fig. 1. The operator merely inserts a tube around the mandrel and removes it after it has been perforated. Oscillation of the cover 31 may also be accomplished as shown in Fig. 8 by the continuously operating motor 99 through the reduction gearing 100, the crank 101 and the connecting rod 102 connected at one end to the crank and at the other end to the cover 31.

As shown in Fig. 9, progressive rotation of the cover 31 may be attained through the ratchet wheel 103 thereon, the pawl 104 carried by the connecting rod 105 and the crank 101, reduction gearing 100 and motor 99.

For manual oscillation of the cover 31 through a definite predetermined angle, a stop pin 106 projects from the frame 68 (Fig. 6) into the path of the lug 107 extending from the handle 65. Said pin limits the movement of the cover in the punch-operating direction, to rotate the cam rings just enough to force the punches inwardly by movement of the cam parts 78 along the punch ends 81, the movement being insufficient to move the unmutilated parts 76 which are adjacent the cam parts, into engagement with the punch ends. On the return movement of the handle 65, the punch ends finally drop into the deepest portions of the respective cam parts 78 and prevent further movement of the handle in the same direction.

In the simplified form of the invention shown in Fig. 7, a single cam ring is shown and a single punch, the mandrel 108 being also shown integral with the mandrel support to operate upon a tube of a given diameter only. In that case, the annular opening 109 between the mandrel and the frame is just sufficient to receive the tube, whereas in the form shown in Figs. 5 and 6, the diameter of the corresponding opening 110 is much greater, for obvious reasons, than that required to receive the smallest tube.

It will be understood that the tube may be of any cross sectional shape such as for example, square, polygonal, elliptical and the like, and that the mandrel and the other operating parts may be proportioned accordingly; that the operative parts of the punches may be of any desired shapes such as square, rectangular, elliptical or key-slotted or the like to punch holes of the corresponding size and shape; that when such shape is other than circular, the body portions 84 of the punch are preferably square and slide in square holes in the frame to punch the holes in the proper upright positions; that any combination of holes may be punched of different spacings, sizes and shapes; that any number of cam rings may be used to punch the corresponding number of circumferential rows of holes and that if the cam rings are properly designed, the machine can operate by progressive movement of the cover regardless of the number of holes to be punched in any row or the spacing thereof within certain limits.

Various other obvious changes may be made from the specific forms of the invention illustrated without departing from the spirit of the invention defined in the appended claims.

I claim:

1. A perforating machine comprising an annular cam ring having a cam portion on its inner edge, a punch mounted for radial movement

relatively to the cam ring and spring-pressed into engagement with the cam portion, means for rotating the ring, and a hollow mandrel arranged axially of the ring and in the path of movement of the punch and comprising a support, a removable perforated sleeve and means for removably securing the sleeve around the support.

2. A perforating machine comprising an annular cam ring having a cam portion on its inner edge, a punch mounted for radial movement relatively to the cam ring and spring-pressed into engagement with the cam portion, means for rotating the ring, a hollow mandrel arranged axially of the ring and in the path of movement of the punch, and a hollow threaded member removably fixing the mandrel in place and communicating with the interior of the mandrel.

3. A perforating machine comprising an annular cam ring having a cam portion on its inner edge, a punch mounted for radial movement relatively to the cam ring and spring-pressed into engagement with the cam portion, means for rotating the ring, and a hollow mandrel arranged axially of the ring and in the path of movement of the punch and comprising a support, a removable outer sleeve and means for securing the sleeve removably to the mandrel, the machine including a frame having a central opening therethrough receiving the mandrel and having an annular groove receiving the cam ring, and a hollow bolt entering the mandrel and engaging the frame to fix the mandrel to the frame.

4. A perforating machine comprising an annular cam ring having a cam portion on its inner edge, a punch mounted for radial movement relatively to the cam ring and spring-pressed into engagement with the cam portion, means for rotating the ring, a hollow mandrel arranged axially of the ring and in the path of movement of the punch, the means for rotating the ring comprising an annular cover for the ring having a central opening therein for the passage of the mandrel therethrough and means securing the cover removably to the ring, said cover having a depending outer flange, and a frame engaging and guiding the flange, the ring and the punch in the respective movements thereof, said frame supporting the mandrel.

5. A tube perforating machine comprising a perforated mandrel, tube-mounting means to mount a tube on the mandrel, tube-perforating means including a punch mounted for movement

radially of the tube and means moving the punch into a perforation of the mandrel, and tube-dismounting means to dismount the tube from the mandrel comprising a pair of spring-pulled tube-gripping jaws and means for opening the jaws.

6. A tube perforating machine comprising a perforated mandrel, tube-mounting means to mount a tube on the mandrel, tube-perforating means including a punch mounted for movement radially of the tube and means moving the punch into a perforation of the mandrel, and tube-dismounting means to dismount the tube from the mandrel comprising a pair of spring-pulled jaws, means for reciprocating the jaws as a unit axially of the mandrel, means for opening the jaws temporarily at one end of the movement of the jaws and means for again opening the jaws at the other end of the movement thereof.

7. A tube perforating machine comprising a perforated mandrel, tube-mounting means to mount a tube on the mandrel, tube-perforating means including a punch mounted for movement radially of the tube and means moving the punch into a perforation of the mandrel, tube-dismounting means to dismount the tube from the mandrel, the mounting means comprising a reciprocating rod aligned with the mandrel, the tube dismounting means comprising a pair of reciprocatory jaws and means to open the jaws at each end of the stroke thereof, and the punch-moving means comprising a cam ring concentric with the mandrel and engaging the outer end of the punch.

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