United States Patent Office 2,933,802 Patented Apr. 26, 1960

2,933,802

GANTRY TYPE PEEN FORMING MACHINE

Henry O. Fuchs, Altadena, Calif., assignor to Wire Abrasives Company, doing business as Metal Improvement Equipment Company, Los Angeles, Calif., a corporation of California

Application March 31, 1958, Serial No. 725,134

19 Claims. (Cl. 29—90)

This invention relates generally to shot peening of extended work surfaces, and more particularly has to do with the provision of apparatus for controlling shot peening of large work pieces without requiring movement of the work during peening, the shot being at all times confined against escape, and the peening operation being conducted in such a way that shot does not collect on the work piece. The invention finds useful application in those instances where an elongated metal surface must be subjected to shot peening, typical work of this nature comprising aircraft wings, elevators, and the like.

It is a major object of the present invention to provide a solution to the problem of successfully peening extended surface areas of work pieces. In the past it was thought necessary to move the work piece relative to shot nozzles during the peening operation, while the work lay flat in a substantially horizontal plane. Such work movement was found generally unsatisfactory since either the peening operation has to be shut down during interrupted movement of the work, or if the work movement were continuous during peening there arose the problem of escape of shot particles from the peening chamber and control of shot recirculation after jetting from the nozzles.

The improved peening apparatus which is the subject of the present invention comprises a longitudinally elongated closure platform that is laterally inclined from the horizontal and a gantry assembly extending laterally over the closure, the assembly including a chamber opening toward the closure and relatively movable longitudinally thereof and over work adapted to be supported above the closure, the latter cooperating with the chamber to confine shot particles for gravitating downwardly and laterally off the work during chamber longitudinal movement. The gantry assembly is supported by tracks extending at opposite sides of the closure platform, and nozzles are carried in the peening chamber and are laterally reciprocable as the gantry assembly moves along the tracks so that the entire work surface facing the nozzles is subjected to the peening action of shot particles.

Since the work is spaced above the closure, all the particles tend to gravitate laterally and downwardly above and below the work and toward a trough at the lower side of the platform carried by the gantry assembly. From the trough the particles are recirculated to a shot hopper generally above the nozzles for subsequent metering and gravity flow to the nozzles, as will be described. Confinement of the shot particles in the traveling peening chamber is assured by the provision of longitudinally spaced sets of overlapping flexible chamber curtains that extend laterally and hang downwardly in engagement with the work surface and the closure, the curtains acting to prevent escape of shot particles. Any of the latter entering the space between the curtain sets tend to be retained therein and also tend to gravitate into the trough which extends longitudinally to communicate with the spaces between the curtain sets, all as will be described.

Additional objects of the invention include the provision of novel universally adjustable clamps for directing the nozzles with respect to the work piece, and then holding the nozzles in directed position for lateral reciprocation, novel supports and adjustable clamps on the supports for holding the extended work piece spaced above the closure and in inclined position for quick removal after peening, means including a screw conveyor and an endless elevator carried by the gantry assembly for collecting and lifting gravitated shot particles during shot recirculation to the nozzles, and finally a two-speed chain drive for moving the gantry assembly along the tracks.

These and other features and objects of the invention, as well as the details of an illustrative embodiment, will be more fully understood from the following detailed description of the drawings, in which:

Fig. 1 is a perspective view of the gantry assembly exterior and the inclined platform closure for the peening cabinet;

Fig. 2 is an elevation taken in section through the peening cabinet and the platform closure, and additionally showing details of the gantry assembly;

Fig. 3 is an enlarged perspective view of the novel adjustable clamp for universally directing each peening nozzle;

Fig. 4 is a view of the clutch portion of the clamp of Fig. 3;

Fig. 5 is a section taken on line 5—5 of Fig. 2, showing longitudinal spacing of the chamber curtain sets in relation to the trough;

Fig. 6 is a fragmentary perspective view of a portion of one set of chamber curtains;

Fig. 7 is a vertical section taken through the platform closure showing a support and a pair of support clamps thereon for holding a work piece in inclined position;

Fig. 8 is an enlarged perspective showing, partly broken away, of a work piece support and a clamp thereon; and

Fig. 9 is a longitudinal elevation illustrating the chain drive mechanism for the gantry assembly.

Referring first to Figs. 1 and 2 the longitudinally extending laterally inclined platform closure 10 for supporting the work is shown mounted on upright frame members 11 carried by members 12 on a concrete floor 13. The work is indicated at 14 as being also longitudinally extended and laterally inclined from the horizontal and spaced above the closure panel 15 that faces upwardly toward the work and the interior 16 of the peening cabinet or chamber generally indicated at 17.

Guide tracks 18 extending longitudinally and horizontally on supporting pads 19 mounted on the concrete floor 13 at opposite sides of the closure 10 are engaged by gantry wheels 20 supporting the frame of the gantry assembly generally indicated at 21. The frame includes uprights 22 at laterally opposite sides of the platform closure 10 and cross members 23 spanning the platform closure so that the gantry assembly is movable longitudinally along the tracks in spanning relation to the work 14 on the platform. Vertically extending longitudinally spaced side panels 24 and laterally spaced side panels 25 and 26, together with a cover panel 27, form the peening cabinet or chamber, the interior 16 of which is closed by the inclined closure panel 15 throughout longitudinal movement of the gantry assembly along the tracks. The side panels 24 are upwardly spaced from the closure panel 15; however, that spacing is closed by longitudinally spaced sets of chamber curtains indicated generally at 28 in Figs. 1, 2 and 5.

The curtain sets 28 include downwardly hanging overlapping curtains 29, as viewed in Figs. 5 and 6, that are held together by inverted L-shaped members 30 extending at opposite sides of the curtains and interconnected so that each curtain set may be inserted downwardly

through laterally and downwardly inclined slots 31 in a cover panel 32 with the members 30 seating on the cover panel and hanging the curtains so that their lower ends engage the work and the closure panel 15 as the gantry assembly is moved along the tracks. The two cover panels 32 extending longitudinally and oppositely away from the peening cabinet side panels 24, together with the end extensions 33 and the curtain sets form enclosed spaces 34 within which shot particles are confined to gravitate downwardly over the closure panel 15 toward the longitudinal extensions 35 of a grate 36 at the lower side of the closure panel 15. Three curtain sets 28 are longitudinally spaced at opposite sides of the peening cabinet in the directions of cabinet movement so as to ensure that no shot particles will escape being gravitated to and through the grate 36 during travel of the gantry assembly along the tracks.

Air entrained shot particles are jetted toward and against the work 14 by a number of peening nozzles 38 held directed toward the work by support rods 39 connected with the nozzles, and adjustable clamps 40 interconnecting the rods 39 with a rod 41 that extends laterally and downwardly generally parallel to the work 14 and the closure panel 15, as viewed in Fig. 2. Rod 41 is pivotally connected at 42 with a pair of parallelogram links 43 in turn suitably pivoted at 44 so that the rod 41 is adapted to reciprocate in the chamber interior 16 while extending parallel to and laterally over the work. Since the links 43 extend substantially perpendicular to rod 41, swinging of the latter and of the nozzles 38 through approximately 30 degree arcs does not appreciably vary the spacing between the ends of the nozzles and the work, whereby the nozzle orientation with respect to the work and the impact force of particles jetted by the nozzles remains substantially the same throughout nozzle reciprocation. The latter is effected by a suitable air cylinder device indicated at 46 in Fig. 1, the device including a piston, not shown, that is reciprocable back and forth in the cylinder by air pressure delivered through lines 47, appropriate valving at 48 controlling the desired reciprocation. A link 49 connected with the device 46 transmits reciprocation to the upper link 43 in the peening chamber. Shot particles are delivered to the nozzles 38 through flexible hoses 50 to which shot is supplied from a hopper 51 for gravity flow to the nozzles, and entraining air is delivered to the latter through air hoses 52. Any dust in the chamber is removed through the ducting indicated at 53 for separation from the air stream in a collector, not shown.

The adjustable clamps 40 interconnecting rods 39 and 41 are shown in detail in Figs. 3 and 4 to comprise a pair of like plates 55 and 56, extending parallel and coaxially, and having arms 57 that generally extend at an angle with respect to one another corresponding to the desired skew relationship as between the axes 58 and 59 of the rods 41 and 39. Extending axially and oppositely from plate 55 are a pair of stub shafts 60 and 61, plate 56 and a sleeve 62 being fitted over the stub shaft 61 to rotate and slide thereon. Stub shafts 63 are also connected to the plate arms 57 and extend generally parallel the stub shafts 60 and 61 in spaced relation thereto, plate brackets 64 extending between and removably fitting over the respective pairs of stub shafts so as to form with the plates 55 and 56, and with the stub shafts, box frames for receiving the rods 39 and 41.

Welded to the plates 55 and 56 and to plate brackets 64 are pairs of spaced channel sections 65 that face one another and thereby form supports for the rods 41 and 39. The ends of the stub shafts projecting beyond the cross plates 64 and away from the plates 55 and 56 are threaded at 61 to receive tightening nuts 66 which when loosened permit endwise sliding of the channels over the rods 39 and 41 received between the channels and relative angular adjustment of the two plates 55 and 56, thereby permitting adjustment of the skew angularity between

the two rods. When the adjustment is completed, the nuts 66 are tightened causing pressing of plate 56 against three projections 70 outstanding from the surface of plate 55 toward plate 56, thereby frictionally locking the plates against relative turning, and fixing the skew angularity between rods 41 and 39. Thus it can be seen that very rapid adjustment may be accomplished merely by loosening nuts 66 and sliding the clamp 40 along one or both of the rods 41 and 39 to achieve proper location and spacing of the nozzles from the work, together with relative turning of the plates 55 and 56 to control the direction of jetting from the nozzles, the nuts then being tightened to fix the nozzles in desired position. It is also seen that the clamps 40 can be rotated about rod 41, and the rods 39 can be rotated in the clamps to produce universal adjustment of the nozzles.

Reference is now made to Figs. 1 and 2 showing the mechanism for recirculating shot gravitating off the platform closure to the hopper 51. For this purpose a trough 72 is provided to extend longitudinally adjacent the lower side of the platform closure to receive shot particles gravitating through the grid 36 and into the trough. A screw conveyor 73 rotating in the trough by a motor not shown advances the gravitated shot particles to discharge into a lower trough reservoir 74 also carried by the gantry assembly. Shot particles in the reservoir are scooped up by buckets 75 carried on an endless chain elevator 76 in vertical housing 77, the elevator being driven by a motor 78. Shot particles lifted by the buckets are dumped into a chute 79 from which the particles discharge into a hopper 51 for delivery to the nozzles, all of the mechanism being carried by the traveling gantry assembly. From the hopper the shot particles are suitably distributed to the nozzle hoses 50.

Referring now to Figs. 7 and 8 the closure panel 15 is shown supporting a series of longitudinally spaced inverted L-shaped supports 80 the upper flanges of which seat elongated rubber tubes 81 extending laterally and downwardly parallel to the panel incline. Plugs 82 carried at the lower ends of the supports 80 and inserted into the lower open ends of the tubes within tubular metal liners 83 therein hold the tubes against downward slippage while permitting their ready removal from the supports 80 and from the U-shaped supports 84 preventing lateral play of the tubes.

The work 14 is shown in broken lines as seated on the rubber tubes and held against downward slippage thereon by a series of eccentrically weighted clamps generally indicated at 85 and better shown in Fig. 8. Each of these clamps comprises a C-shaped plate 86 the arms 186 of which reach under the flanges of the supports 80, and form an opening 87 through which the rubber covered tube 81 extends. A pair of eccentric weights 88 projecting from the downward facing sides of the plate arms 186 tend to overturn the clamp plates and thereby take up the clearance between the clamps, the supports 80 and the rubber covered tube. A wedging force against the tube 81 is thereby created preventing downward slippage of the clamp along the tube and this effect is enhanced by the thrust exerted by the work 14 seating against the upper side of the protective rubber jacket covering the upper portion of the clamp, the rubber jacket being indicated at 90. When it is desired to shift the clamp along the tube, the eccentric weights 88 are manipulated to pivot the weights generally upwardly and thereby restore the clearance between the clamp, the plastic covered tube and the supports 80, permitting sliding of the clamp along the tube to desired position. Two clamps 85 are shown in Fig. 7 as being tilted into wedging relation with the tube 81.

Referring now to Fig. 9, the drive mechanism for the gantry assembly is illustrated to comprise a chain 95 opposite ends of which are connected to turnbuckles 96 through links 97, the turnbuckles in turn being connected to longitudinally spaced opposite end portions of track

18 through springs 98. Overloading of the chain by the drive mechanism to be described is taken up by springs 98, preventing breakage of the chain. Between its opposite ends, the chain meshs with sprockets 100 carried by idler shafts 101, and with a sprocket 102 carried by a drive shaft 103 in a gear reduction unit 104. The latter is mounted on the gantry frame member 105 so that turning of the drive shaft 103 advances the gantry assembly along the track.

Power is alternately transmitted to the gear reduction unit 104 by a high-speed electrical motor 106 and by another motor 107 through a speed reducer 108. The shaft 109 of motor 106 is always connected to the unit 104 through coupling 110; however, motor 107 drives the unit 104 only when a clutch 111 is engaged by counterclockwise rotation of a control lever 112 to the position shown in Fig. 9. At that time contact switch 113 controlling energization of motor 106 is open so that the high-speed motor is de-energized and its shaft is merely rotated by the unit 104. On the other hand, when lever 112 is rotated clockwise, switch 113 is closed and clutch 111 is de-coupled so that the motor 106 then drives the gantry at a higher speed. The operation of both motors is controlled by a single switch, not shown.

Each of the idler shafts 101 is normally engaged by a brake, actuated by brake jaw 115 in turn urged by a spring, not shown, toward the shaft, when the gentry assembly is not traveling on the tracks. However, the brakes are released by compressed air delivery to air cylinders 116 through lines 117, air delivery to the cylinders being controlled by a valve, not shown, which is opened when the gantry assembly motor drive is energized. Flow of compressed air through the peening nozzles is also begun at that time so that peening begins only when travel of the gantry assembly along the tracks is initiated, thereby preventing excess initial peening of the work. Both the motors together can be reversed electrically to permit back and forth movement of the gantry assembly along the tracks under the control of the operator standing on platform 118 shown in Fig. 2.

Referring back to Fig. 1, bumpers 119 carried by frames 120 pivoted at 121 are adapted to swing back toward the gantry assembly upon striking any foreign object on the track over which the bumpers extend, to thereby actuate switches 122 shutting down or de-energizing the electrical motor drive. Therefore, if a series of the gantry assemblies are mounted on the same tracks for travel therealong, they cannot inadvertently collide to cause injury to the assemblies, since their drives will be shut down and their brakes energized when the bumpers of the two gantry assemblies interengage.

I claim:

1. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a chamber opening toward said closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, said closure cooperating with said chamber to confine shot particles for gravitation downwardly and laterally off the work during said chamber movement, nozzle means in said chamber and directed toward said closure for jetting shot particles against said work during said chamber movement, and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber movement.

2. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a chamber opening toward said closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, said chamber including flexible curtain means engageable with and relatively movable over said closure and work, said closure cooperating with said chamber to confine shot particles for gravitation downwardly and laterally off the work during said chamber movement, nozzle means in said chamber and directed toward said closure for jetting shot particles against said work during said chamber movement, and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber movement.

3. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a chamber opening toward said closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, support means extending above said closure for supporting said work spaced above the closure upper surface, said closure cooperating with said chamber to confine shot particles for gravitation downwardly and laterally above and below the work during said chamber movement, nozzle means in said chamber and directed toward said closure for jetting shot particles against said work during said chamber movement, and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber movement.

4. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a chamber opening toward said closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, said closure cooperating with said chamber to confine shot particles for gravitation downwardly and laterally off the work during said chamber movement, means including a longitudinally extending track supporting said chamber for said movement thereof, nozzle means in said chamber and directed toward said closure for jetting shot particles against said work during said chamber movement, and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber relative movement.

5. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a chamber opening toward said closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, said closure cooperating with said chamber to confine shot particles for gravitation downwardly and laterally off the work during said chamber movement, nozzle means facing the closure in said chamber and movable therewith for jetting shot particles against said work during said chamber movement, said nozzle means being directed toward the closure means for laterally reciprocating said nozzles during longitudinal movement thereof with the chamber so that said particles are jetted over extended surface area of the work, and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber movement.

6. Shot peening apparatus of the character described, comprising a longitudinally elongated stationary closure laterally inclined from the horizontal, a gantry assembly extending laterally over said closure including a chamber opening toward the closure and movable longitudinally thereover and over work adapted to be stationarily supported above said closure, said chamber being shorter than the closure in a longitudinal direction, said closure cooper-

ating with said chamber to confine shot particles for gravitation downwardly and laterally off the work during said chamber movement, longitudinally extending track means supporting said gantry assembly for longitudinal movement over said closure, drive means connected with said gantry assembly for moving the assembly along said track, nozzle means facing said closure in said chamber and movable therewith for jetting shot particles against said work during said chamber movement, said nozzle means being directed toward the closure and means for recirculating gravitated shot particles to said nozzles during said chamber movement, whereby controlled shot peening of said work and continuous shot circulation are maintainable during chamber movement.

7. The invention as defined in claim 6 including a plurality of longitudinally spaced stationary supports extending above said closure for stationarily supporting said work spaced above the closure upper surface, said supports being laterally elongated and inclined from the horizontal, and a plurality of clamps carried by said supports for holding said work against dislodgement laterally and downwardly off the supports.

8. The invention as defined in claim 7 in which said clamp has an opening through which said support extends with clearance when the clamp is manually adjusted to slide along the support and alternately without clearance when the clamp is manually released and tilts to frictionally engage the support.

9. The invention as defined in claim 8 in which said clamp has an eccentric weight for tilting the clamp into frictional locking engagement with the support.

10. The invention as defined in claim 6 in which said assembly includes a trough extending longitudinally along only the lower longitudinal edge of said closure for receiving said gravitating shot particles.

11. The invention as defined in claim 10 in which said shot recirculating means includes a shot conveyor in said trough, a hopper higher than the nozzles for discharging shot particles thereto, and an elevator for receiving shot from said conveyor and lifting said shot for delivery to said hopper.

12. The invention as defined in claim 10 comprising a plurality of laterally spaced nozzles, and means for reciprocating said nozzles substantially parallel to the closure incline.

13. The invention as defined in claim 12 comprising

a pair of support rods respectively connected with a nozzle and laterally movable in the chamber, and a clamp interconnecting said rods and adjustable to vary the direction of jetting from said nozzle.

14. The invention as defined in claim 13 in which said clamp includes two relatively rotatable parts each forming a socket receiving one of said rods and means for releasably urging said parts into interengagement to hold the parts against relative rotation.

15. The invention as defined in claim 6 in which said gantry assembly spans said closure and said track means includes a pair of tracks supporting the gantry at laterally opposite sides of the closure.

16. The invention as defined in claim 15 in which said chamber includes flexible curtains spaced longitudinally and oppositely with respect to said nozzles, said curtains being engageable with said closure and work during said gantry movement.

17. The invention as defined in claim 15 including interengaged means carried by said gantry assembly and track means for longitudinally advancing said gantry assembly.

18. The invention as defined in claim 17 comprising a motor means and a motor driven sprocket carried by said assembly, and a chain connected with track and interengaged with said sprocket.

19. The invention as defined in claim 18 comprising a relatively higher speed electric motor remaining coupled to said sprocket, a relatively lower speed motor, and a clutch for coupling said lower speed motor to said sprocket, said lower speed motor being electrically energizable only when said higher speed motor is electrically de-energized.

References Cited in the file of this patent

UNITED STATES PATENTS

575,700	Charbonneau	Jan. 26, 1897
2,104,561	Hughes	Jan. 4, 1938
2,341,674	Wallace	Feb. 15, 1944
2,414,038	Gossard	Jan. 7, 1947
2,482,034	Stevens	Sept. 13, 1949
2,489,877	Fowler	Nov. 29, 1949
2,624,982	Vander Wal	Jan. 13, 1953
2,669,810	Carlson	Feb. 23, 1954
2,681,578	Shields	June 22, 1954
2,701,408	Borger	Feb. 8, 1955

April 26, 1960 H. O. FUCHS 2,933,802

GANTRY TYPE PEEN FORMING MACHINE

Filed March 31, 1958 4 Sheets-Sheet 1

FIG. 1.

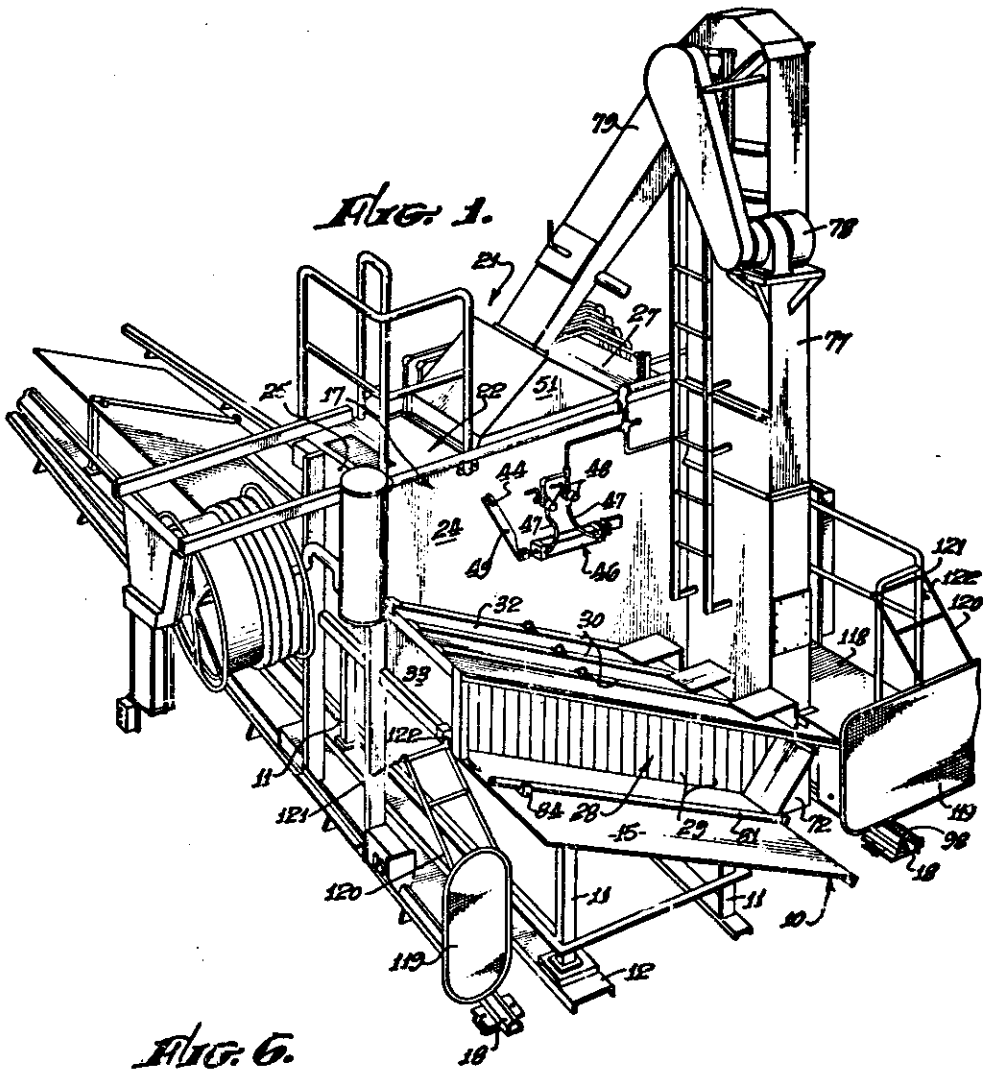
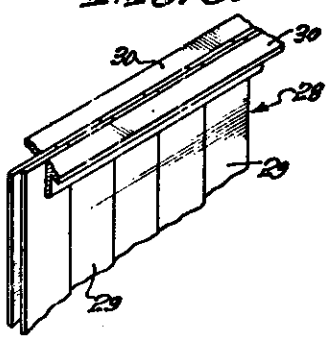


FIG. 6.



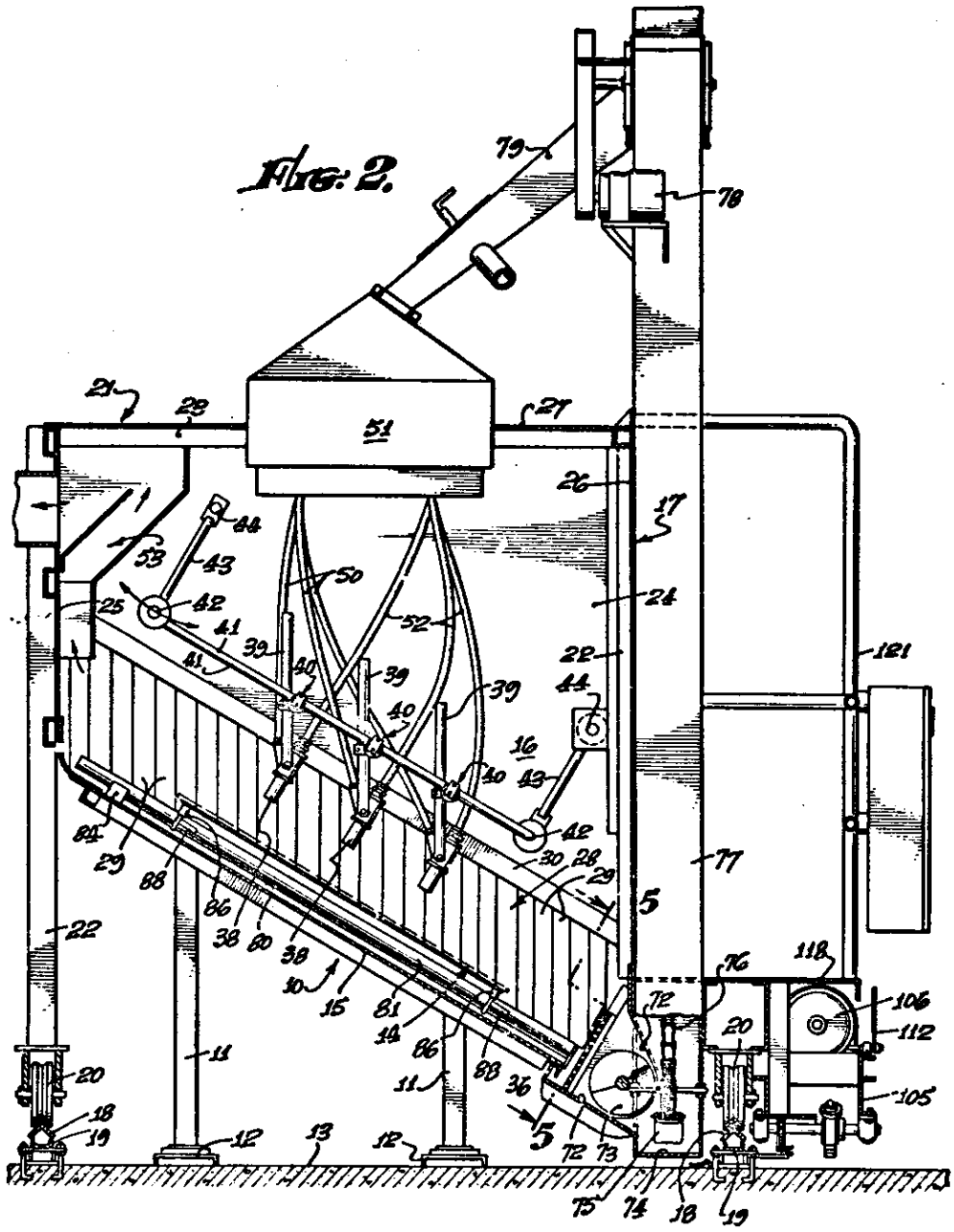
HENRY O. FUCHS,
INVENTOR.
BY Hoskins White
ATTORNEY.

April 26, 1960 H. O. FUCHS 2,933,802

GANTRY TYPE PEEN FORMING MACHINE

Filed March 31, 1958 4 Sheets-Sheet 2

Fig. 2.



INVENTOR.
HENRY O. FUCHS,
BY Valerius White
ATTORNEY

April 26, 1960 H. O. FUCHS 2,933,802

GANTRY TYPE PEEN FORMING MACHINE

Filed March 31, 1958 4 Sheets-Sheet 3

Fig. 3.

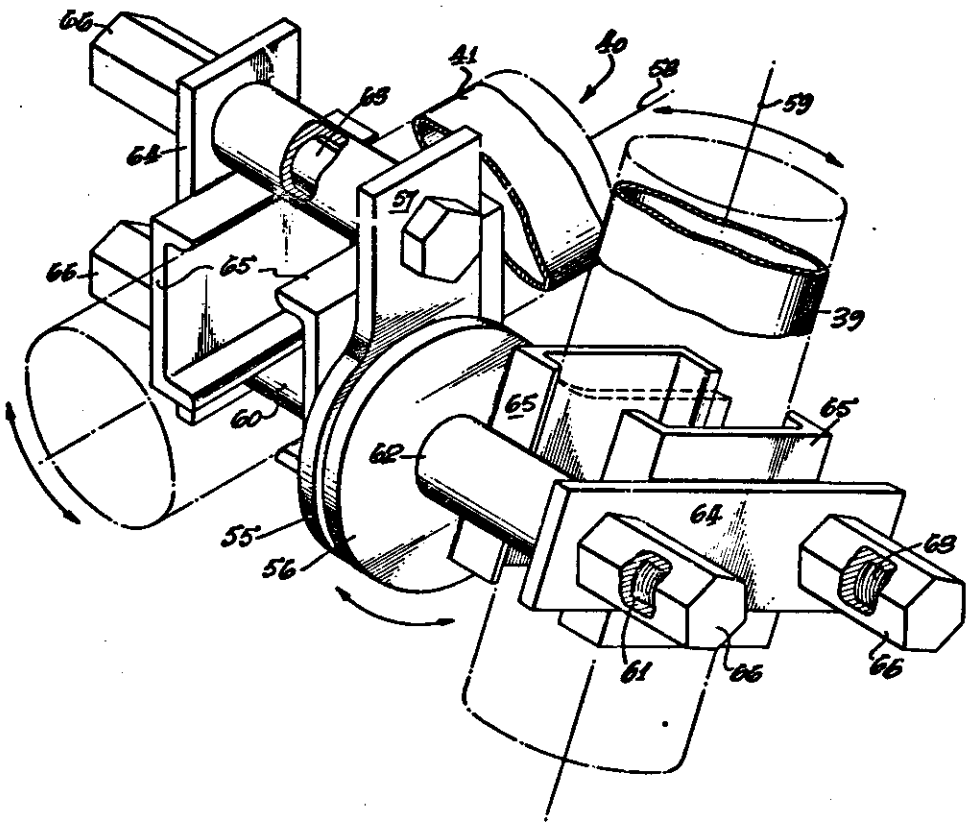
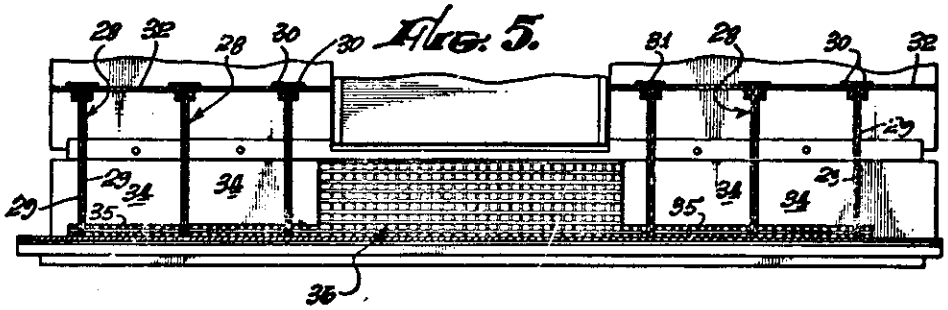


Fig. 5.



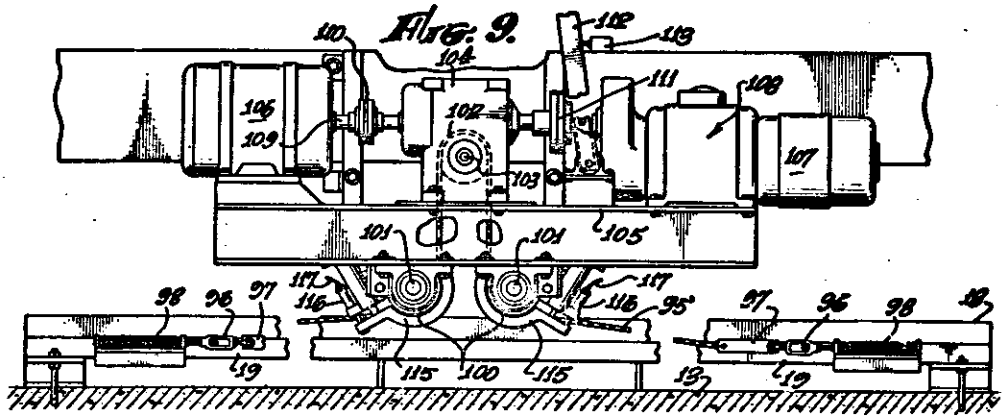
INVENTOR.
HENRY O. FUCHS,
BY Harbison White
ATTORNEY.

April 26, 1960 H. O. FUCHS 2,933,802

GANTRY TYPE PEEN FORMING MACHINE

Filed March 31, 1958 4 Sheets-Sheet 4

Fig. 9.



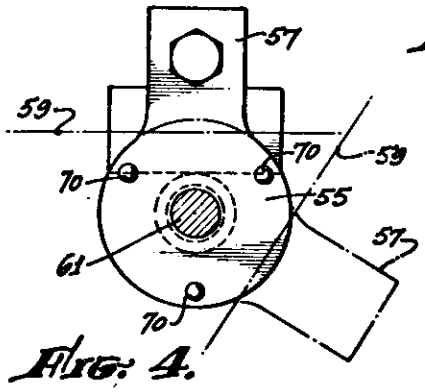
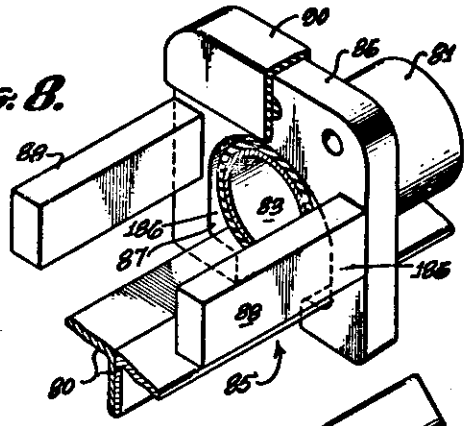


Fig. 4.

Fig. 8.



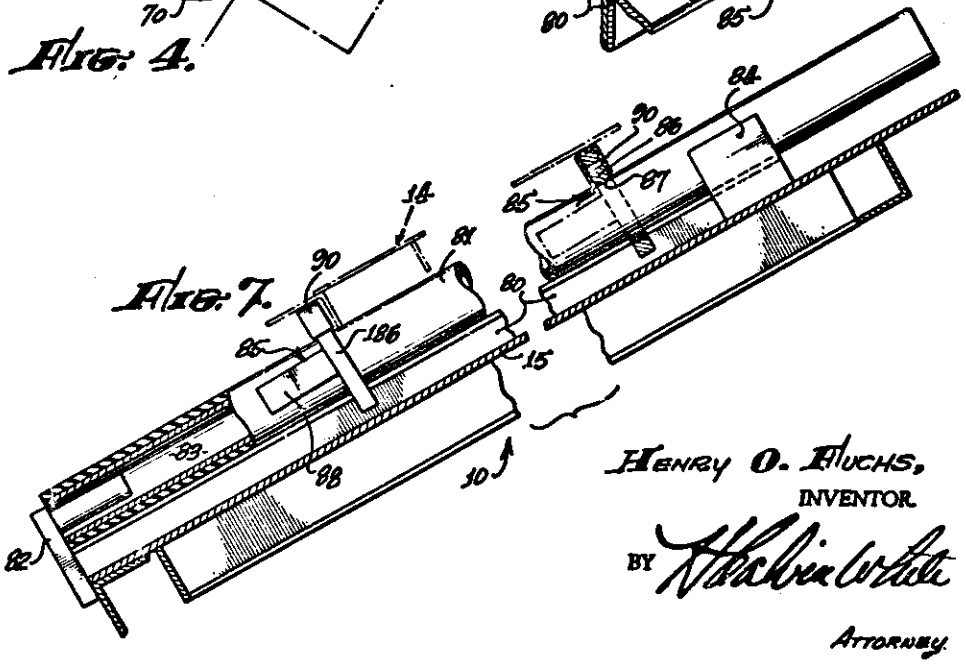


Fig. 7.

HENRY O. FUCHS,
INVENTOR.

BY

ATTORNEY.