Oct. 17, 1950 L. C. SHIPPY ET AL 2,526,163

TRIMMING MACHINE

Filed June 21, 1947 6 Sheets-Sheet 1

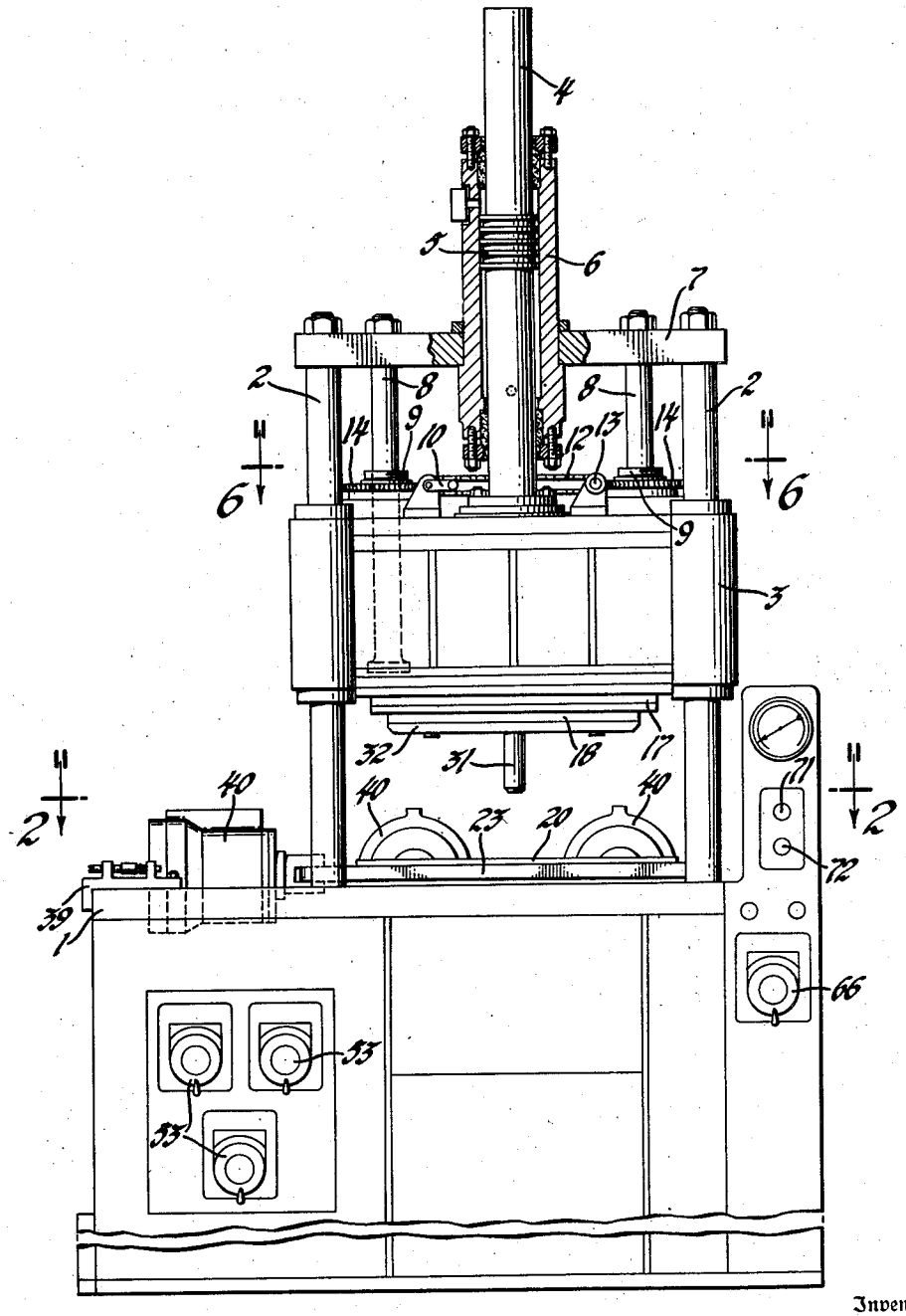


Fig. 1

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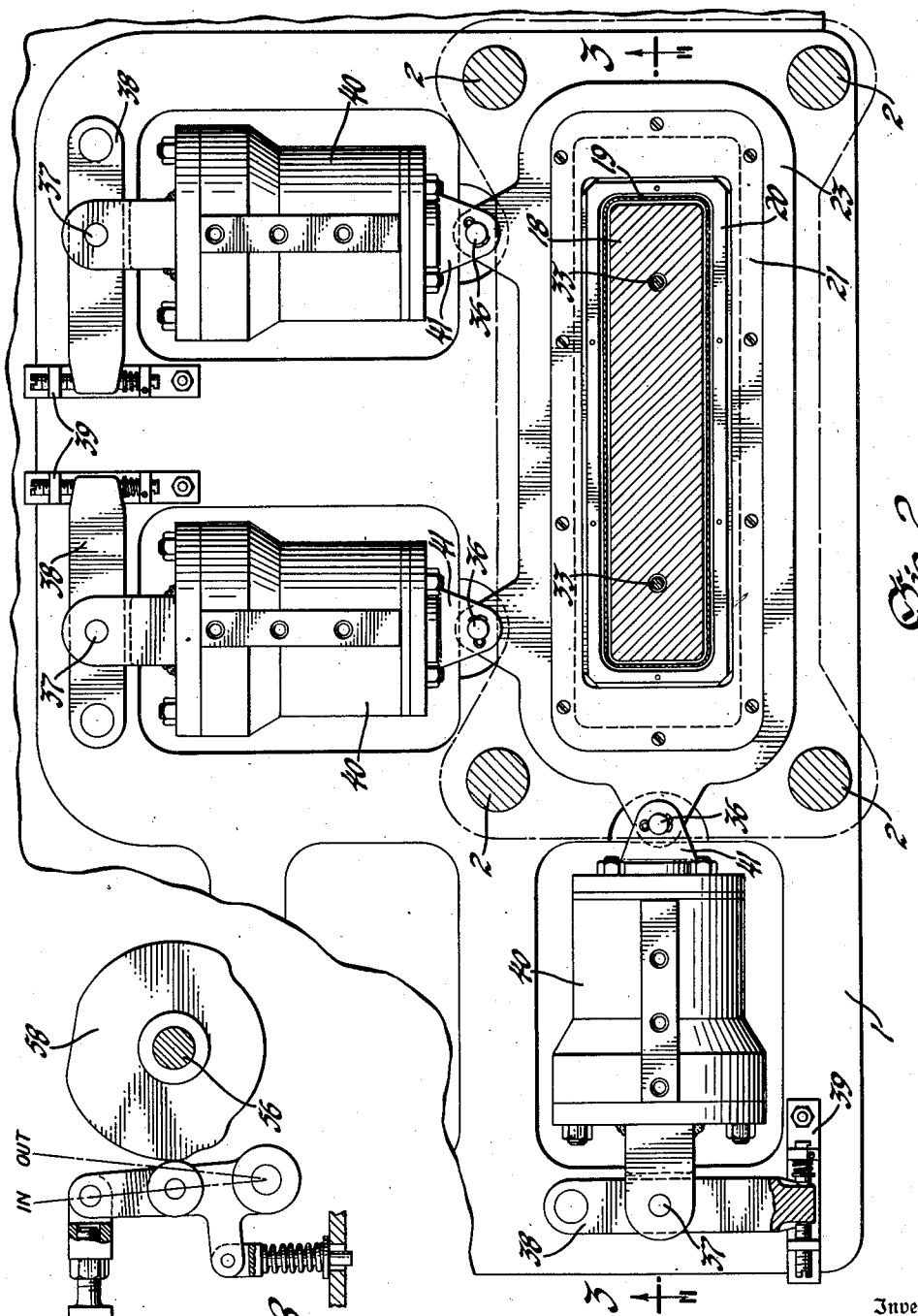


Fig. 2

Fig. 8

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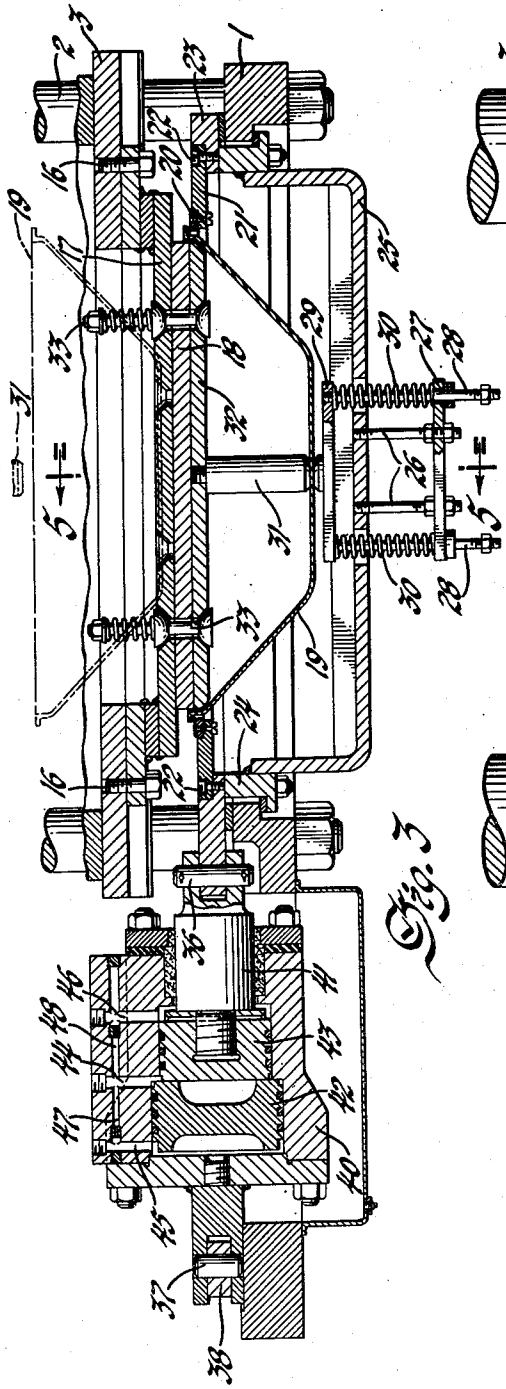


Fig. 3

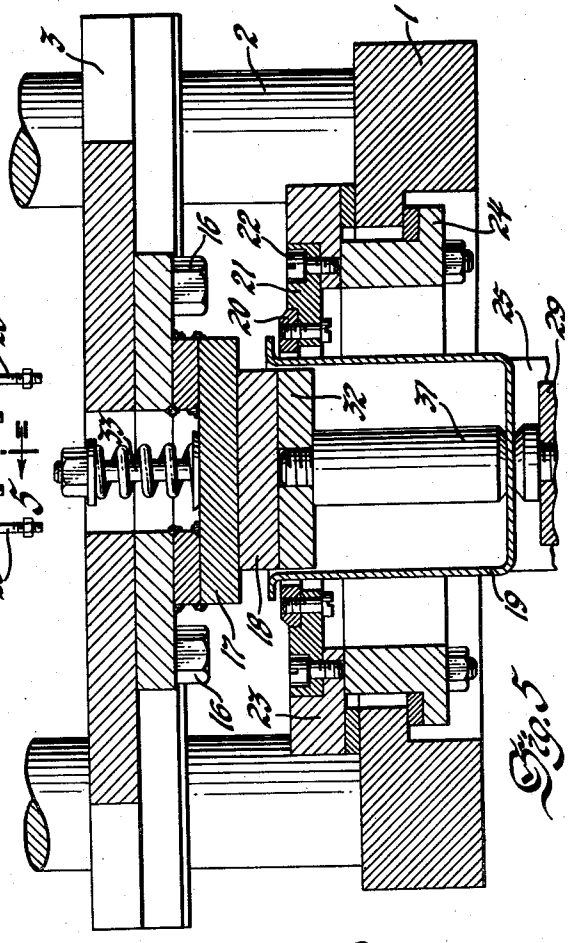


Fig. 5

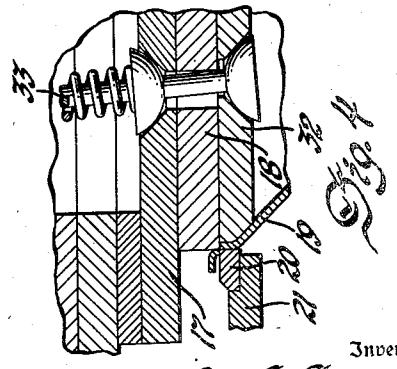


Fig. 4

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TRIMMING MACHINE

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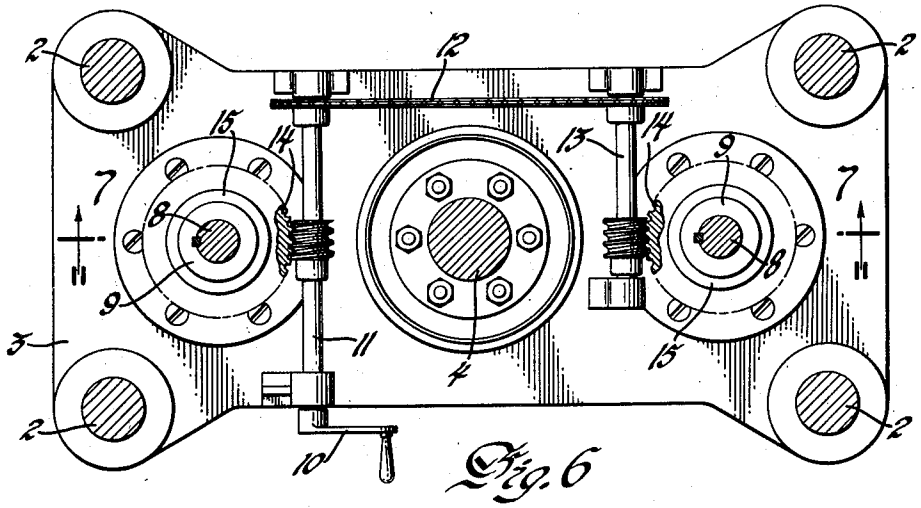


Fig. 6

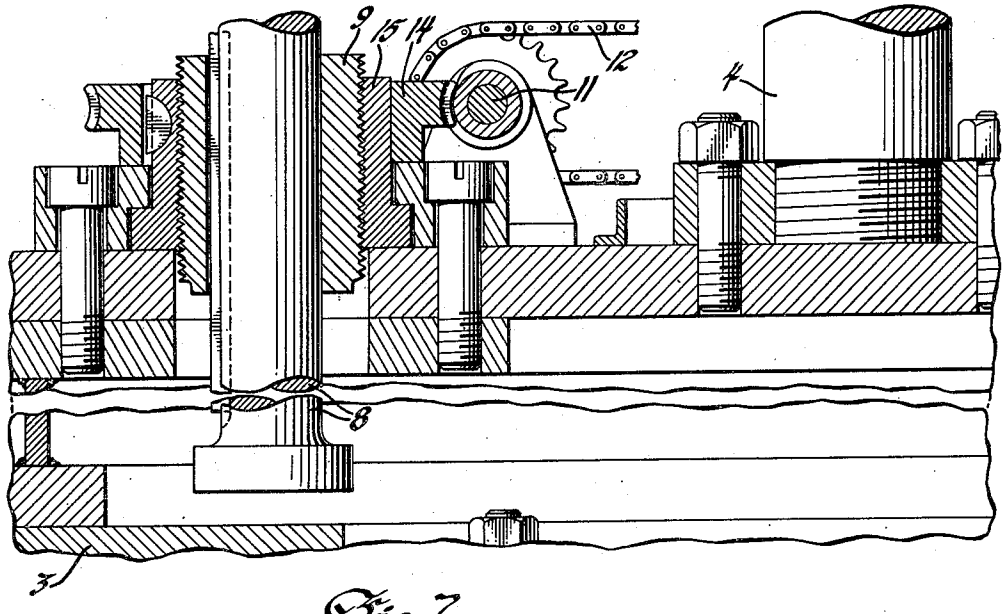


Fig. 7

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TRIMMING MACHINE

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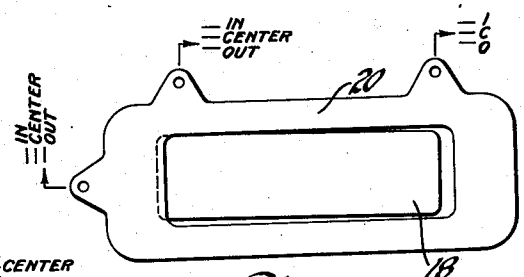


Fig. 9

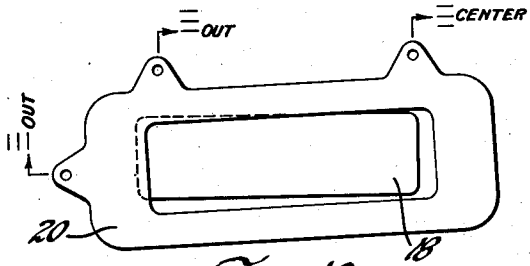


Fig. 10

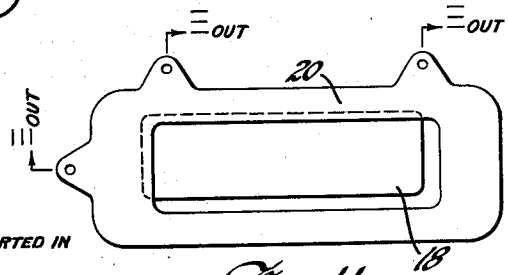


Fig. 11

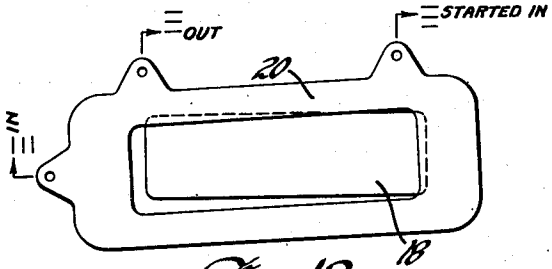


Fig. 12

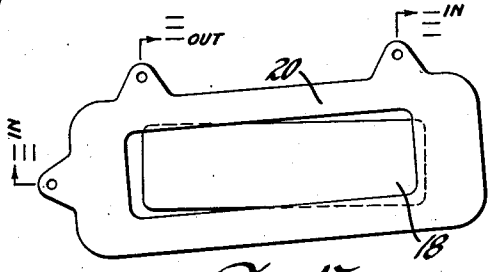


Fig. 13

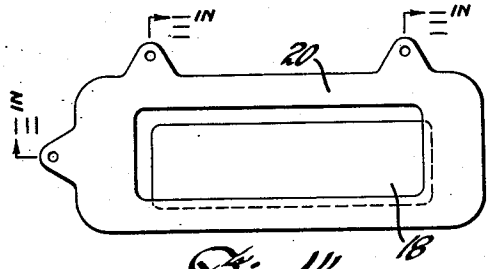


Fig. 14

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TRIMMING MACHINE

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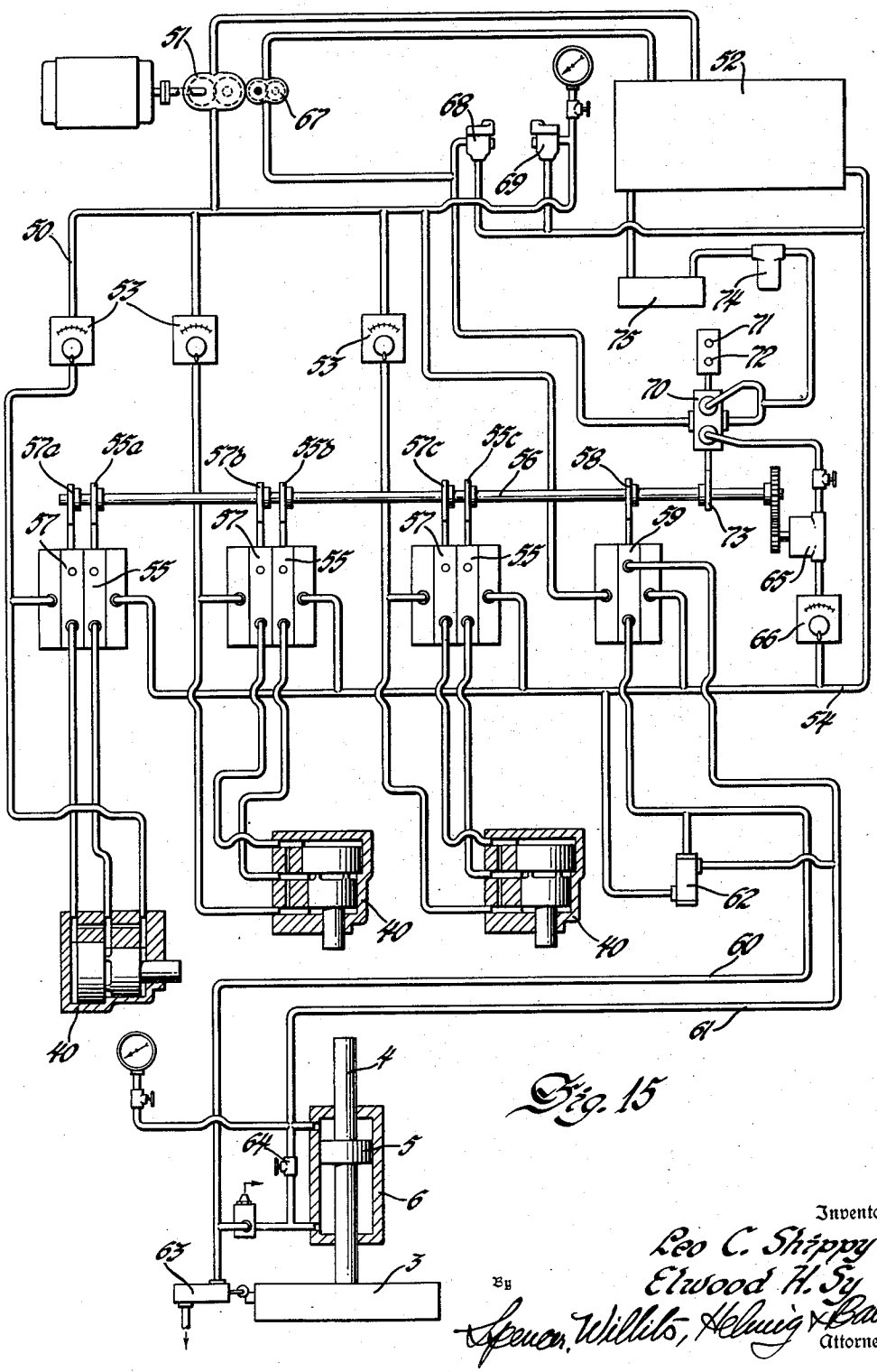


Fig. 15

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Patented Oct. 17, 1950 2,526,163

UNITED STATES PATENT OFFICE

2,526,163

TRIMMING MACHINE

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Application June 21, 1947, Serial No. 756,198

5 Claims. (Cl. 164—56)

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This invention relates to an improved machine for trimming or cutting the draw flange from a shell drawn from sheet metal as a finishing operation to provide a straight sided wall having a clean cut.

A preferred embodiment of the improved machine consists essentially in a pair of cutting dies, one to be projected into fixed position inside the shell and the other to surround the shell and to be laterally shiftable for cooperation with the cutting edge of the inner stationary positioned die to shear through the shell wall from the outside to the inside below the draw flange and to be actuated by a series of contractible-expansible power devices controlled in timed sequence to impart to the outer die an oscillating movement starting at a point and continuing around the shell perimeter to the starting point, with an angular shear action throughout its entire circuit.

In general it may be said that the oscillation of the outer shear ring is accomplished by means of spaced apart hydraulic piston cylinder motors with at least one providing reciprocation in a direction substantially at right angles to the general direction of reciprocation produced by the others and all being swivelly mounted for a slight swinging action to compensate for relative projection and retraction of the several pistons in a predetermined cycle. By properly cycling the relative projection and retraction of the pistons the shear ring is shifted fore and aft and sidewise through an oscillatory travel pattern which brings together the cutting edges in angular relation at a given starting point and the continuous cutting all the way around so as to progressively shear through the shell wall.

In the accompanying drawings illustrating the preferred embodiment referred to Figure 1 is a front elevation of the machine assembly partly in section and with the dies in open relation; Figure 2 is an enlarged plan view of the machine bed plate looking in the direction of the arrows on line 2—2 of Figure 1 and showing the outer shear ring in centered relation to the inner die, which latter is shown in section in closed die position; Figure 3 is a transverse vertical section as on line 3—3 of Figure 2; Figure 4 is a detail sectional view showing the cutting steels in shearing relation; Figure 5 is a vertical sectional view on line 5—5 of Figure 3; Figure 6 is a horizontal section on line 6—6 of Figure 1; Figure 7 is a vertical section on line 7—7 of Figure 6; Figure 8 is a detail elevational view, partly in section, of a cam control mechanism and is illustrative of the several cams by which the operation of the machine is cycled; Figures 9 to 14, inclusive, are diagrammatic views showing several relative positions of the inner and outer shearing steels in the range of oscillation of

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the outer die ring and Figure 15 is a diagram of the hydraulic control circuit.

Referring to the drawings, the bed plate 1 is supported above the floor upon suitable standards which also house the hydraulic operating mechanism, the manual controls which are mounted on the front face of the machine within convenient reach of the operator, as seen in Figure 1. Projecting upwardly above the bed plate are a series of posts 2—2 for slidably guiding a vertically reciprocal ram 3, whose piston rod 4 has its piston 5 enclosed within a cylinder 6 supported by a cross bar 7 carried at the tops of the posts 2—2. Fluid pressure directed to the top of the cylinder 6 will lower the ram for closing the dies over the work positioned therein and pressure fluid delivered to the bottom of the cylinder 6 will raise the ram upon completion of the die shearing operation.

Adjustable stops to limit the extent of downward ram movement are provided by means of dependent posts 8—8, carried by the cross bar 7 and terminating in enlarged heads for abutment by adjustable sleeves 9, as best seen in Figure 7. Unison adjustment of the sleeves for both stop rods 8—8 is afforded by a single hand crank 10 mounted on a worm shaft 11 and which has a chain drive 12 with a companion worm shaft 13 and each worm is geared to a wheel 14 keyed to a nut 15 having threaded engagement with the stop sleeve 9 slidably keyed on the post 8. Thus by turning the crank 10 the stop sleeves may be raised and lowered in unison to change the lower limit of ram travel and thereby set up the machine for proper alignment of the die cutting edges.

At the lower limit of ram closing movement the inner die is held in fixed position during the die cutting operation. This inner die, which is removably secured by screw studs 16 to the bottom of the ram is shown as consisting of a holder 17 to which is fixed a plate-like cutting steel 18. Its cutting edge is formed by its lower corner around the four sides in the case of a die for a blank having four rectangular side walls, as is true of the drawn shell 19 as illustrated. The companion cutting edge is afforded by the upper interior corner of a cutting steel ring 20 secured to a holder 21 which is detachably held by screw studs 22 to a die plate 23 slidably mounted on the top surface of the bed plate 1. The shifter plate 23 includes as an assembly therewith a shouldered retainer ring 24 slidably engaging the undersurface of an inwardly extending shoulder on the bed plate 1 bounding the die opening therein. It also includes a U-shaped strap 25 whose arms are welded or otherwise secured to the retainer ring 24 and which mounts a work stripper and clamping element. Spacer bolts 26 secure to the strap 25 a strap 27 for slid-

ably locating a pair of guide bolts 28 on a bar 29, which is depressible against the elastic force of coil springs 30 surrounding the bolts 28 and engaged at opposite ends with the bars 27 and 29. A central button or contact member on the stripper bar 29 cooperates with a central post 31 shiftably carried by the ram to engage and clamp the bottom of the shell 19 against the spring pressed stripper when the ram is closed. The post 31 is mounted on a slider or filler plate 32 which rests against the bottom of the die steel 18 and is flexibly suspended by means of a pair of swinging bolts 33. Each bolt has a semispherical head seated in a socket in the plate 32 and a coil spring surrounding the bolt and retained by the end nut presses against the semispherical washer seated in a socket in the die holder 17 so that the spring maintains the plate in snug sliding contact with the die and tends automatically to center the filler plate 32 while accommodating its sidewise shifting movements by the tilting of the bolts 33 when the outer ring is shifted during the shearing operation, as seen in Figure 4.

The shearing operation occurs when the outer ring and with it the shell or work is shifted laterally in relation to the inner die 18. To shear through the four side walls of the shell the outer die must be shifted from side to side in both directions and forward and backward and for an angular shear cut the ring needs to be cocked relative to the fixed inner die as an incident to its travel. This conveniently is accomplished by the use of three spaced apart power motors arranged as seen in Figure 2, with one at the side and two of the motors at the rear of the machine toward the right and left-hand ends of the shiftable ring. Each motor has its plunger secured to the ring by a pivot pin, as indicated by the numeral 36, and has its opposite end swiveled by a pin 37 mounted on an adjustable lever 38 fulcrumed at one end on the bed plate 1 and having its opposite end located between a pair of adjustable plungers, at least one of which is in the nature of a set screw mounted in a machine bracket 39 whereby the machine can be set up so that the cutting ring is properly centered with reference to the inner die steel 18. The projection and retraction of the plungers relative to each other will control the pattern followed by the die ring in shearing off the draw flange.

Structurally the several plungers are identical and each includes the swiveled cylinder 40 and the plunger 41. The interior of each cylinder has shouldered portions receiving a large piston 42 and a small piston 43, the latter of which is fixed to the plunger 41. As seen in Figure 3, the pistons are centered in the step cylinder bore with the larger piston 42 seated against the intermediate shoulder and in turn seating the inner end of the smaller piston 43. Suitable spacer formations afford clearance between abutting face areas of the two pistons and the intervening space communicates with a lateral port 44 in the piston wall. Similar ports 45 and 46 communicate, respectively, with the inner side of the larger piston and the outer side of the smaller piston. Restricted ports 47 and 48 communicate the central port 44 with the respective end ports 45 and 46. Thus if the central port 44 is vented or opened to a drain while pressure fluid is delivered to both of the ports 45 and 46 the pistons will be held in the centered relation shown. To project the plunger outwardly the relief or drain from the port 44 may be closed whereupon pressure will build up on the inner face of the small pistons 43 and since its effective surface area is greater than that presented to the pressure on the outer face of the piston an outward movement of the plunger will occur. For retracting the plunger to centered position the port 44 is again open to drain and for a further retraction of the plunger to its innermost limit pressure fluid can be cut off from the port 45, which is then vented through the connecting passage 47 so that pressure on the outer side of the smaller piston moves the larger piston 42 to its inner limit. Restoration to centered position will occur when pressure fluid is again introduced into the port 45.

To initiate the cut starting at the forward left-hand corner at the side wall of the shell or that which as seen in Figure 2 is toward the left-hand bottom of the view, the plunger in the single side cylinder is projected outwardly and at the same time the plunger in the left-hand back cylinder is also projected outwardly slightly so that the ring is tilted in relation to the fixed inner die and its edge adjacent the forward left-hand side of the die is brought into cutting relation with a corresponding point at the cutting edge of the fixed die. The movement carries with it the blank or shell and the backing or filler plate 32 into the relation illustrated in Figure 4. Continued outward projection of the plunger in the side cylinder will continue the shearing action through the right-hand side wall of the shell toward the rear of the machine until the dies assume the relative position illustrated in Figure 9. Further outward projection of the plunger in the left-hand rear cylinder will start the cutting knife shearing through the back wall with a continuous travel toward the right until a mid-point in the length of the wall is reached when the plunger is fully projected. The relation of the parts will be that generally illustrated in Figure 10. Coincidentally with the final outward projection of the left-hand rear plunger will be the outward projection of the right-hand rear plunger to continue the cutting through the back wall to completion when the relation of the parts will be that illustrated in Figure 11, wherein all the plungers are at their outer limit. To sheer forwardly through the right-hand shell wall the pistons in the right-hand rear cylinder and the single side cylinder are both retracted inwardly in a proper ratio of speed and at the completion of the cut the parts will be in the relative position shown in Figure 12. Thereafter the front wall will be sheared toward the left with a continuation of the inward retraction of the right-hand rear plunger until a mid-point is reached, as seen in Figure 13, whereupon the left-hand rear plunger will be started inwardly to complete the shearing operation when the parts will assume the relation illustrated in Figure 14. All plungers may then simultaneously be returned to centered position for returning the dies to the centered relation shown in Figure 2.

Automatic operation of the machine through a given cycle can be controlled by suitable hydraulic circuit, such as diagrammatically represented in Figure 15. As here seen the outer ends of each of the three cylinders have their ports 46 joined by branches of a delivery manifold 50 to which pressure fluid is supplied by a motor driven pump 51 from a sump or supply reservoir 52. Manually set metering valves 53 in each branch insure proper ditribution of the fluid be-

tween the several cylinders. Each central drain port 44 is connected to a drain manifold 54 leading back to the sump 52 under control of individual slide valves 55—55. Properly contoured cams 55a, 55b and 55c on a common shaft 56 time the operation of the respective slide valves 55. Delivery of pressure to the end ports 45 of the several cylinders from the pressure manifold is under control of separate valves 57, one for each cylinder, and the operation of these are timed by the respective cams 57a, 57b and 57c on the shaft 56. Another timing cam 58 on the shaft 56 controls the slide valve 59 which communicates with the delivery manifold 50 to one or the other of the delivery lines 60 and 61 leading to the opposite ends of the ram operating cylinder 6. When the valve 59 is operated to direct pressure fluid selectively through one of the lines 60 or 61 the other line simultaneously is connected to the drain manifold 54. Both of the pressure delivery lines 60 and 61 are also connected to a pressure relief valve 62 for bypassing excess liquid back to the drain manifold 54. As a further safety precaution against excess pressure build-up a limit valve 63 is provided in the line 60 to be opened by engagement of the ram as it reaches its upper limit of movement. For machine set-up purposes a normally closed control valve 64 is provided to connect the opposite sides of the plunger 6. For rotating the cam control shaft 56 through one revolution a fluid pressure motor 65 having a manually controlled pressure control valve 66 is provided to receive pressure fluid from a pump 67, also connected with the supply tank 52. A pressure relief valve 68 joins the pressure delivery line from the pump 67 to the drain manifold 54 and a similar pressure relief valve 69 is provided for the pressure fluid manifold 50 associated with the pump 51. A valve 70 controls communication from the pump 67 to the operating motor 65 and this valve is under manual control of a starting button 71 and a stop button 72 as well as under automatic control of a cam 73 on the shaft 56. The manual stop button normally is provided for safety purposes and ordinarily the cycling of the machine is begun when the starting button is depressed to feed pressure fluid to the operating motor 65.

Assuming that the dies are open and a blank has been inserted in the machine the operator, by depressing the starter button, will cause the machine automatically to go through its cycle beginning with the depression of the ram 3 to close the dies and thereupon through the several cams control the projection and retraction of the several die shifting cylinders in predetermined sequence after which the dies are opened and the control cam 73 cuts off further pressure fluid flow to the motor 65. When flow to the motor 65 is diverted it is directed to a filter 74 and a heat exchanger 75 before returning to the sump in order to avoid excessive liquid temperature and the circulation of sledge and dirt.

We claim:

1. In a shearing machine, a reciprocatory ram having a cutting die movable to open position for insertion and removal of a workpiece into the machine and movable to closed stationary position inside the peripheral wall of a work piece inserted in the machine, a shiftable carrier for the workpiece shiftable in all directions in a single plane normal to the direction of ram movement, a shear die ring fixed to the shiftable carrier in surrounding relation to the outside of said peripheral wall of the workpiece for cooperation with the fixedly located die, a pair of travel guides for said ram having stops to define the limit of ram closing travel, adjustable bearing sleeves on the ram for terminal abutment with said limit stops and hand crank operating mechanism arranged to adjust said sleeves in unison for the closed position setting of said cutting die in proper operative relation with the shear die ring.

2. In a shearing machine, a cutting ring for cooperation with a cutting die surrounded thereby, a support shiftably mounting said ring, means to impart an oscillatory path to said ring for progressive annular shearing travel around the cutting die, including a series of fluid pressure motors joined to the ring at spaced points, a source of motor operating fluid pressure, valving controlling pressure fluid circulation to said motors and timing mechanism for cycling the control valving for pressure fluid delivery according to a predetermined sequence.

3. For shearing through an annular wall of a workpiece, cooperating male and female dies to receive the wall therebetween, a plurality of power operated plungers pivotally joined at spaced apart points to one of the dies for moving the same in various directions in a single plane, means pivotally mounting each plunger for swinging travel in said plane, each relative to the other and cycling mechanism for applying operating power to the respective plungers in predetermined successive relation and thereby oscillate said movable die in angular shearing relation with the other die in continuous circuit through the annular wall of the workpiece.

4. In combination, a pair of cooperating shear dies, a series of power devices hinged in spaced apart relation to one of the dies, swiveled mounts for said devices to enable their relative oscillation under differential operation thereof, and operating cycle control means governing power response of said devices in given successive action for relative swinging of the dies.

5. In a device for effecting an angular cut in a continuous circular path through an annular wall, an annular shear die to surround the annular wall to be sheared, a fixed support, a set of three power operated expansible-contractible devices, each comprising a plunger member and a casing member, means hingedly connecting one member of each device to the fixed support and the other member of each device to the shear dies in an arrangement wherein the expansion and contraction of two of the devices is directed angularly to that of the third device, and means to supply power to said devices in timed sequence and thereby oscillate the die through six consecutive shearing strokes, each successive stroke shearing through the wall starting from the end of the preceding stroke shear and completing the shearing operation in one continuous sweeping circuit.

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