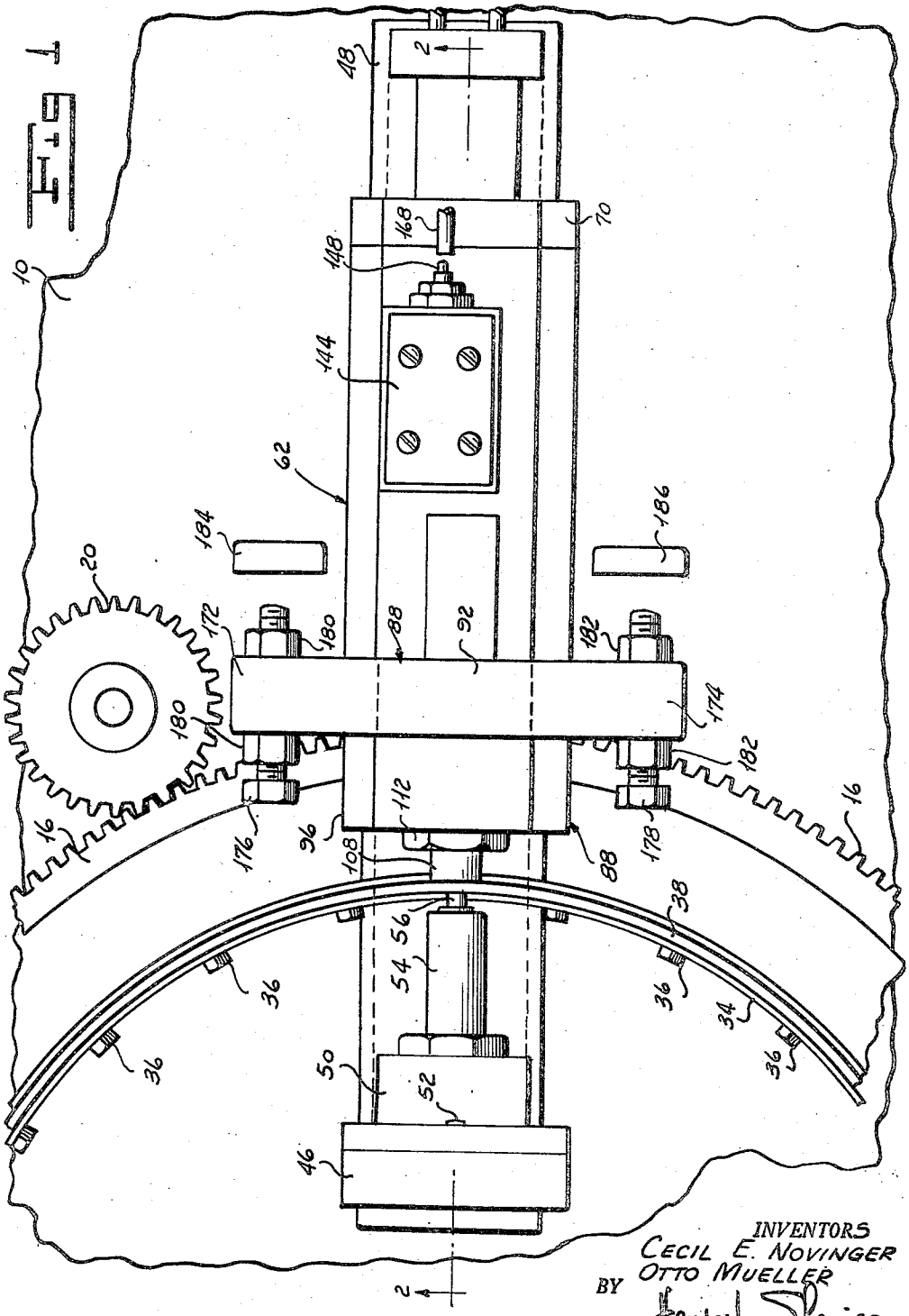
Aug. 14, 1956 C. E. NOVINGER ET AL 2,758,652

HYDRAULIC PUNCH AND STRIPPER

Filed Dec. 7, 1953 5 Sheets-Sheet 1

FIG. 1



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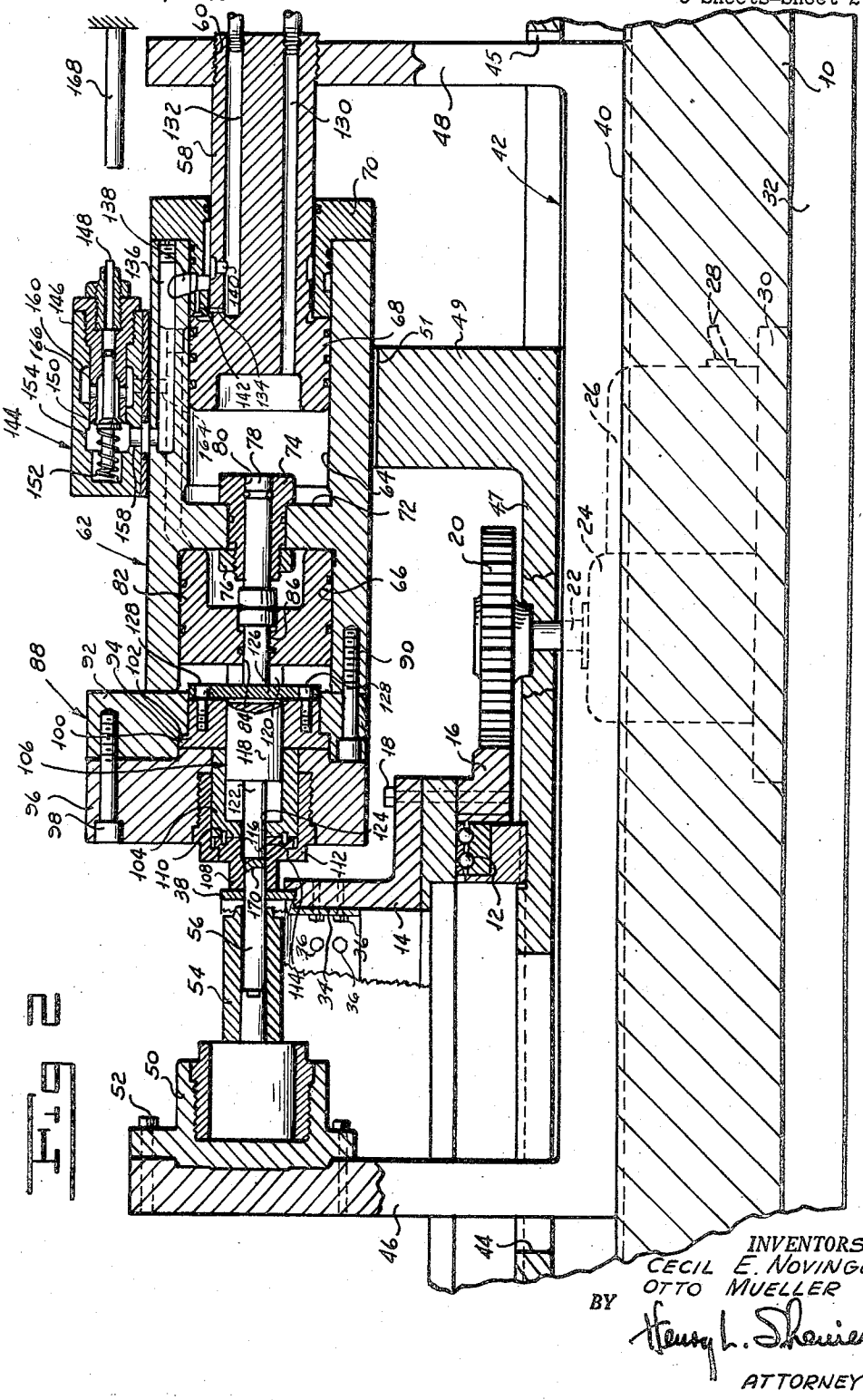

Fig. 2

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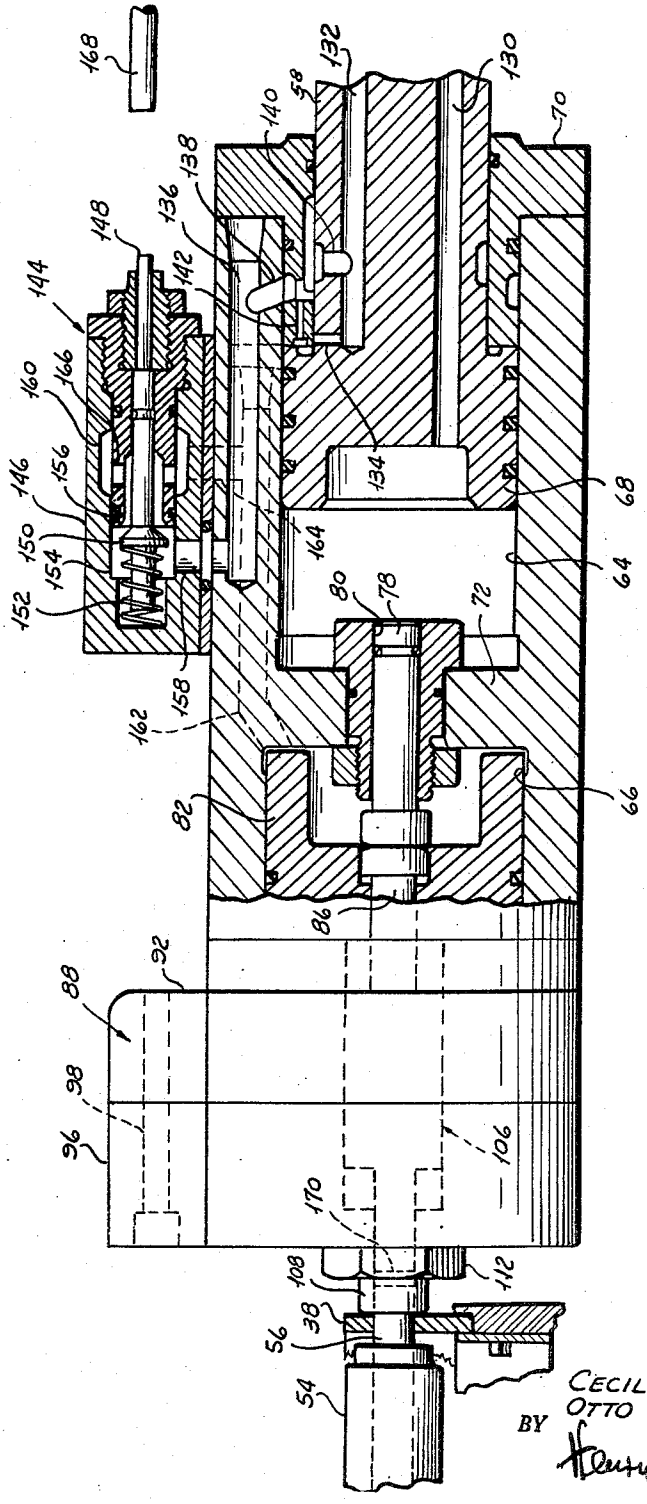

FIG. 5

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HYDRAULIC PUNCH AND STRIPPER

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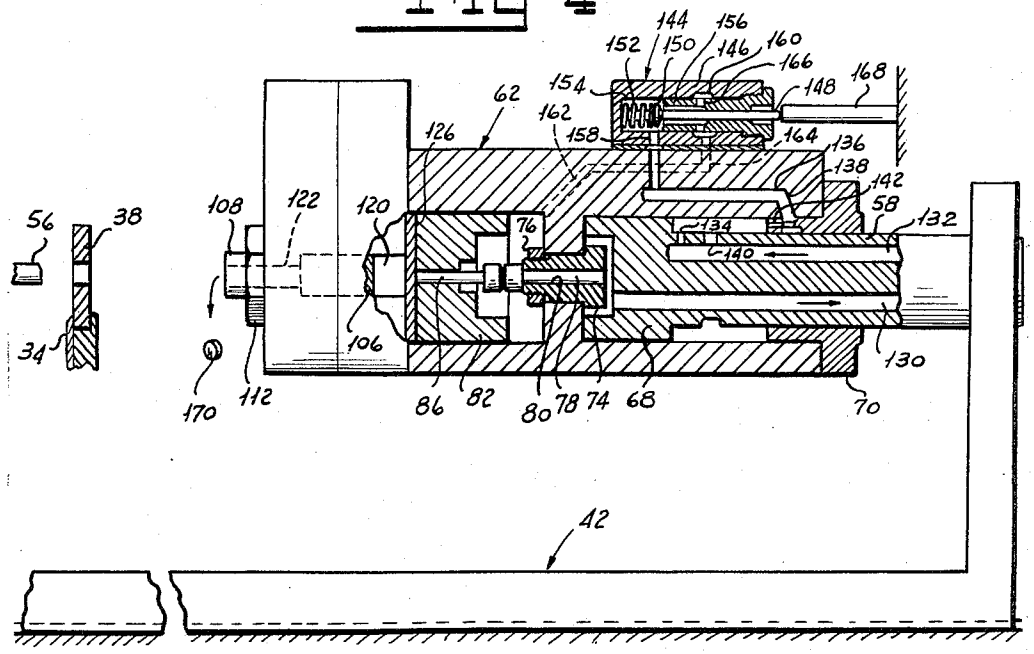
Fig 4



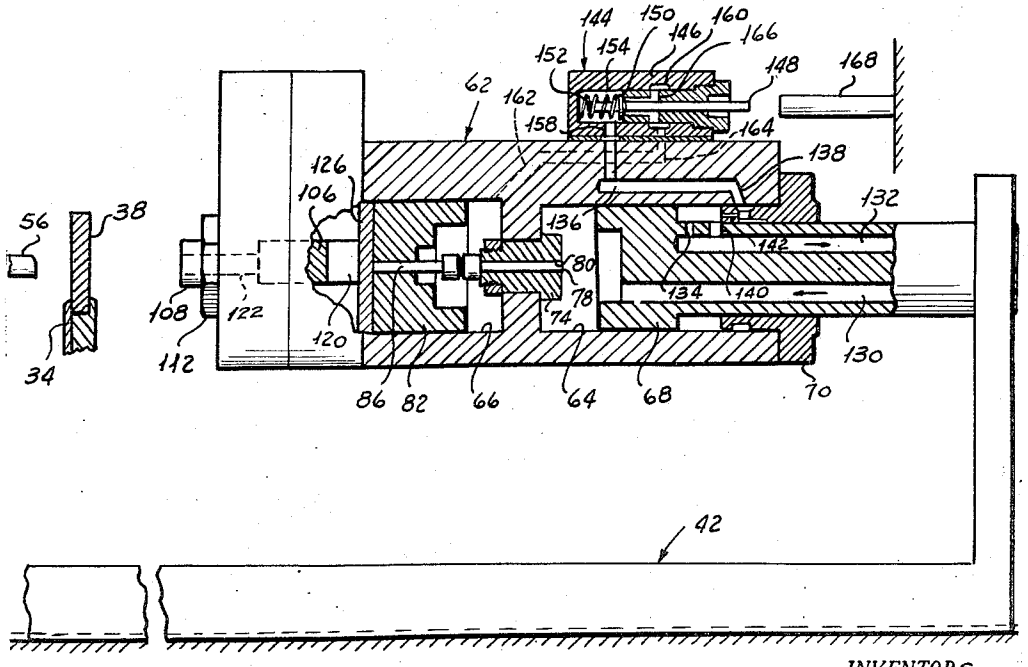


Fig 5

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HYDRAULIC PUNCH AND STRIPPER

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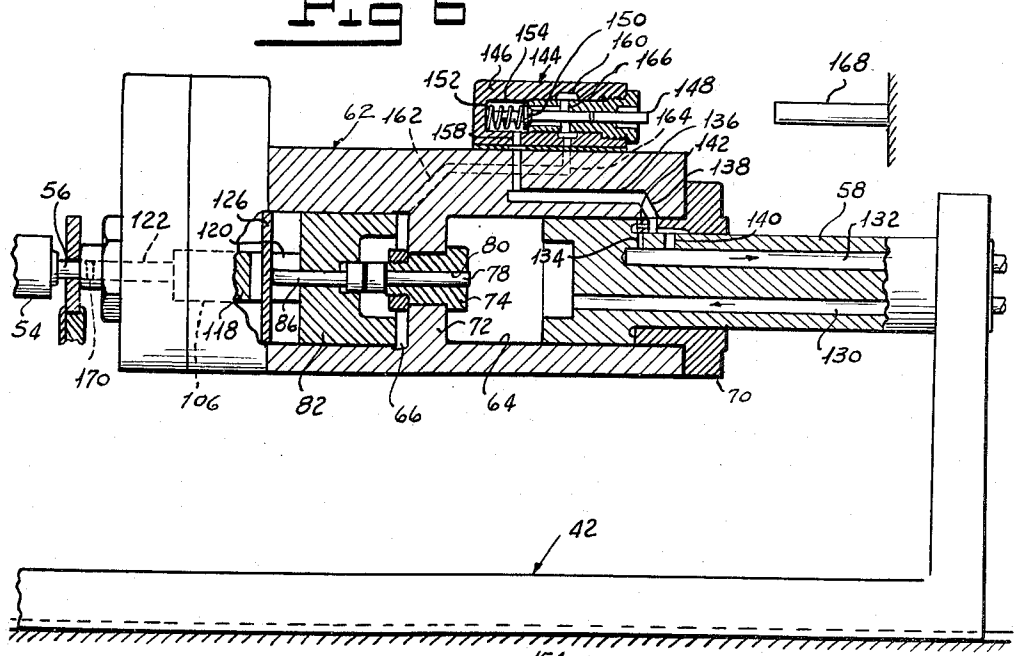
Fig 6



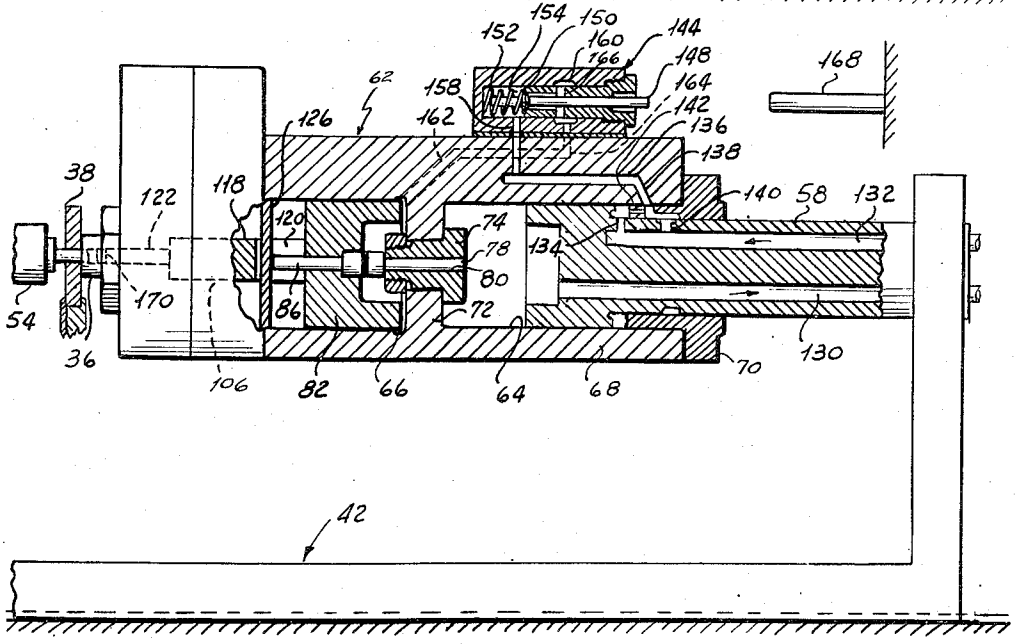


Fig 7

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United States Patent Office 2,758,652 Patented Aug. 14, 1956

2,758,652

HYDRAULIC PUNCH AND STRIPPER

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Application December 7, 1953, Serial No. 396,693

8 Claims. (Cl. 164—95)

Our invention relates to a hydraulic punch and stripper and more particularly to an improved hydraulic punch and stripper which is adapted to eject slugs from a die button when a punch is used to punch from the inside outward of a piece part.

When a punch is used to perforate a piece of work or to form a piece part, it is desirable that the work be held with reference to the punch so that the part will not be distorted or the work broken out when the punch is withdrawn. A hydraulic punch and stripper device for performing this operation has been disclosed in Patent No. 2,534,292, issued December 19, 1950, to Otto Mueller. The device there shown includes a cylinder body formed with a power chamber which houses a power piston and a stripper chamber housing a stripper piston. The power piston cooperates with the cylinder to perform the punching while the stripper piston is adapted to be actuated during the return stroke of the punching cycle to hold a pressure plate against the face of the work while the punch is being stripped by the power piston. Generally, the cylinder body is slidably mounted on a fixed power piston and carries the punch through the work. The die is held fixed relative to the cylinder and its recess is continued back through the die button so that slugs or piece parts formed during the punching operation are forced back through the recess to drop into a suitable container. Any convenient valve means is employed to supply fluid under pressure to the respective power and stripper chambers to perform the punching and stripping operations in the proper sequence.

It is, however, often necessary to punch from the inside outwardly of a piece part, such as, for example, a shroud ring, in order that the rough edge of the opening punched in the work will appear on the outside surface of the ring. When punching from the inside out there is generally insufficient space inside the ring to accommodate the structure of the cylinder carrying the punch. Consequently, this cylinder must be placed outside the work, and since we desire to punch from the inside out, the die button must be mounted on the cylinder body and the punch disposed inside the ring. When the die button is thus carried by the cylinder, slugs cannot be ejected back through the die recess, since in this case they would interfere with and jam the stripper piston.

We have invented an improved punch and stripper cylinder which is provided with means whereby a slug or piece part formed in the die during a punching operation may be automatically ejected from the die at the end of a punching operation. Our cylinder is adapted, moreover, to be used as a knockout to knock the work out of the die when a shallow forming operation rather than punching operation is to be performed. This latter feature eliminates the necessity of employing a positive bar knockout which operates knockout pins in the dies to actuate a stripping plate in a mechanical press. That is, we have invented an improved punch and stripper cylinder which is capable of performing both the functions of stripping the punch from the work and ejecting slugs or knocking work out of the die.

One object of our invention is to provide an improved punch and stripping device which is capable of performing both the functions of stripping the punch from the work and ejecting slugs or piece parts from the die button.

Another object of our invention is to provide an improved punch and stripper cylinder which is particularly adapted for punching from the inside out of a piece part.

A further object of our invention is to provide an improved punch and stripper cylinder which can be employed as a knockout in the event a shallow forming operation is to be performed.

A still further object of our invention is to provide an improved punch and stripper cylinder which can be selectively arranged to perform its normal operation of stripping or which may be used to perform both the operations of stripping and of ejecting slugs from the die button.

Other and further objects of our invention will appear from the following description.

In general, our invention contemplates the provision of a C-frame having a pair of arms slidably mounted in ways formed on a suitable work table. A first arm of the C-frame is fixed to the power piston of our improved punch and stripper assembly and is adapted to be driven thereby. The other arm of the C-frame supports the punch. The cylinder of our improved punch and stripper assembly includes a power side or chamber in which the power piston is mounted for reciprocation and a stripper side or chamber in which we mount a stripper piston. The stripper side of the cylinder body mounts a housing to which the die button of the assembly is fixed. We mount a knockout plunger for sliding movement within the housing in a position where it is engaged and actuated by the stripper piston. The plunger is formed with a pin for movement into the die button recess to knock out a slug or piece part when the plunger is actuated by the stripper cylinder.

The power piston of our assembly is provided with a pair of bores forming pressure lines, each communicating with the power chamber of the cylinder on a respective side of the power piston. Fluid under pressure is successively admitted to one and then the other of the pair of pressure lines to cause the cylinder, carrying the die button, and the power piston, driving the C-frame which carries the punch, to reciprocate relative to one another first to perform the punching operation and then to return the parts to the starting position. The work is, of course, disposed between the punch and die so that the die button is first moved into engagement with the work and then the punching operation is performed. When the punching operation is completed, a supply valve is reversed to supply pressure to the power piston pressure lines in a direction to strip the punch from the work and return the parts to their initial position.

In order to supply fluid under pressure to the stripper side of the cylinder at the proper time in the punching cycle, we provide the cylinder body with passageways adapted to connect the stripper chamber to the pressure line which serves as an exhaust passage during the punching phase and to which fluid pressure is admitted during the return phase of the operation. Interposed between these passageways is a control valve which is open during the punching phase. This control valve is initially closed during the return phase by suitable means such as a spring but is actuated at the point in the return portion of the cycle at which the knockout operation is to be performed in order to supply fluid under pressure to the stripper side of the cylinder. When this connection is made, the stripper piston actuates the knockout plunger

to move its pin into the die button recess and knock a slug or piece part out of the die button recess. Adjustable means fixed on the work table actuates the control valve. When the knockout operation is completed, the work is stepped around angularly and the supply valve again reversed to perform the next punching operation. The arrangement of our improved punch and stripper assembly is such that, if desired, the punch and stripper assembly may be operated in a conventional manner to perform only the stripping function.

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

Figure 1 is a top plan view of our improved punch and stripper assembly mounted on a suitable work table and showing its relationship to the work.

Figure 2 is a sectional view of our improved punch and stripper assembly taken along the line 2—2 of Figure 1.

Figure 3 is a sectional view on an enlarged scale of a portion of our apparatus.

Figure 4 is a side elevation of a portion of our apparatus with parts in section showing the relative position of the parts immediately after a slug has been ejected from the die button.

Figure 5 is a view similar to Figure 4 showing the relative position of the parts just before a punching operation begins.

Figure 6 is a view similar to Figure 4 showing the relative position of parts near the end of the punching stroke.

Figure 7 is a view similar to Figure 4 showing the relative position of parts at the beginning of the return stroke.

More particularly, referring now to Figures 1 and 2, a work table **10** has a ring bearing **12** mounted thereon which supports, for rotary movement, a work holder **14** to which is fixed a ring gear **16** by means of bolts **18**. Ring gear **16** is engaged by a drive gear **20** fixed on a shaft **22** which is driven by an appropriate indexing mechanism **24** known to the art. A motor **26**, having electrical connections **28**, provides a drive means for driving indexing mechanism **24**. A base **30** supports indexing mechanism **24** and motor **26** and is mounted on a bracket **32** supported from the table by any appropriate means (not shown). Suitably formed clamps **34** are screwed to work holder **14** by screws **36** to hold the work **38** in position, as can be seen by reference to Figures 1 and 2. The indexing mechanism **24** provides a means by which the work can be stepped around with relation to the punch and stripper assembly to be described. A pair of slots **44** and **45** in the surface of the table **10** open into a guideway **40** formed below the surface of the table **10**. We mount a C-frame, indicated generally by the reference character **42**, for reciprocation along guideway **40** so that the respective arms **46** and **48** of C-frame **42** extend upwardly through slots **44** and **45**. It will be appreciated that in order to permit assembly of C-frame **42** in the guideway **40**, the portion **47** of the table **10** separating the slots **44** and **45** may be made removable by any suitable means (not shown). Portion **47** of table **10** may also be provided with an upward extension **49** provided with a guideway **51** to support the cylinder assembly, which will be described hereinafter, for sliding movement.

Arm **46** of C-frame **42** carries a fitting **50** by means of screws **52**. A punch holder **54**, which is adapted to hold a punch **56**, is threaded into fitting **50**. Punch **56** is removably held in punch holder **54** by any appropriate means, such as a force fit, well known in the art.

Arm **48** of C-frame **42** supports power piston **58** of the punch and stripper assembly by any appropriate means, such as screw threads **60**. The cylinder body, indicated generally by reference numeral **62**, includes a power side or chamber **64** and a stripper side or chamber **66**. The head **68** of piston **58** is slidably mounted within the power side **64** of cylinder **62** which is closed by a cap **70** to retain pistonhead **68** therein. The stripper chamber **66** and power chamber **64** are separated by an annular inwardly extending flange **72** in the opening of which we mount a plug **74** and provide a nut **76** for holding the plug in place. A pin **78** is mounted for reciprocating movement in a bore **80** formed in the plug **74**. A stripper piston **82** is slidably mounted within the stripper chamber **66** of cylinder **62** and has a bore **84** carrying a pin **86**.

The die holder assembly, indicated generally by reference character **88**, is fixed on the end of the stripper side **66** of cylinder **62** by bolts **90** attaching a first collar **92** to cylinder **62**. A cylindrical member **94** is disposed within the bore of collar **92** and retained in position within the bore by a second collar **96** attached to the first collar **92** by bolts **98**. An annular flange **100** on member **94** cooperates with a shoulder **102** formed in the bore of collar **92**. A second cylindrical member **104** is disposed within the bore of collar **96** and cooperates with cylindrical member **94** to form a housing for the knockout plunger, indicated generally by the reference character **106**. A die button **108** is carried by a pair of threaded studs **110** screwed into the end of member **104**. Die button **108** and member **104** are retained in position with respect to collar **96** by a special cap nut **112** threaded within the bore of collar **96**. An inwardly extending annular flange **114** on nut **112** cooperates with shoulder **116** formed on the die button. The knockout plunger **106** includes a body portion **118** having bifurcations **120** formed at one end thereof and a rod or pin **122** extending from the other end. It will be appreciated that body portion **118** is mounted for sliding movement within the housing formed by members **94** and **104** and that rod or pin **122** extends through an opening **124** formed in the end of member **104** and into the recess of die button **108**. A bar **126** is mounted by bolts **128** on member **94** between the bifurcations **120** of knockout plunger **106**. This bar is provided to immobilize pins **86** and **78** for reasons which will be explained in detail hereinafter.

A suitable valve of a type known in the art but not shown supplies fluid pressure for actuating the cylinder and piston assembly to perform the punching, stripping, and knocking out operations. Referring now to Figures 2 and 3, power piston **58** is provided with a first bore forming a first pressure line **130** for supplying fluid under pressure from the supply valve to the power chamber **64** of cylinder **62** during the punching phase of the operation. It will be appreciated that when fluid pressure is applied through passageway **130**, cylinder **62** and pistonhead **63**, carried by the C-frame **42**, move relative to one another to move the die button **108** into engagement with the work and drive punch **56** through the work by moving the C-frame to the right. A second bore forming a second pressure line **132** is provided in piston **58** for supplying fluid pressure to perform the stripping, return, and knocking out operations. It will readily be understood that when one of the lines **130** or **132** is connected to a source of fluid under pressure, the other line **132** or **130** serves as a return line. A passageway **134** connects line **132** to power chamber **64** on a side of head **68** such that when pressure is supplied through line **132**, the C-frame **42** and cylinder **62** tend to move relative to one another in a direction opposite to the direction in which they move when pressure is supplied by line **130** to power chamber **64** on the other side of head **68**.

A line **136** formed in the cylinder body is adapted to be connected with line **132** by a connecting passageway **138** in the cylinder body and a passageway **140** in the piston body when the piston and cylinder are in the relative positions indicated in Figures 2 and 3. It will be apparent from an examination of Figures 2 and 3 that passageway **138** is also connected with the power side **64** of cylinder **62** by a passageway **142**.

The valve assembly for controlling the knocking out action of plunger **106** is indicated generally by the reference character **144** and includes a housing **146** in which we slidably mount a plunger **148** formed with a valve head **150**. Plunger **148** is normally urged to the right as viewed in Figure 3 by a spring **152** bearing between one end of the valve chamber **154** and the valve head **150**. Spring **152**, therefore, normally urges head **150** in a direction to engage a seat **156** formed in chamber **154**. Line **136** communicates with valve chamber **154** by a passageway **158** in the wall of housing **146**. A second valve chamber **160** formed on the side of head **150** removed from chamber **154** communicates through a passageway **164** with a line **162** formed in the body of cylinder **62** and leading to stripper chamber **66**. As can be seen by reference to Figures 2 and 3, when the valve head **150** is in the position shown, chamber **160** communicates with chamber **154** through openings **166**. An adjustable stop **168** is fixed with reference to the work table and is adapted to actuate plunger **148** to move it from a closed position to the position shown when the cylinder **62** carrying valve **144** occupies a predetermined position in the return stroke of the operational cycle.

Line **162** opens into the stripper side **66** of cylinder **62** so that when fluid under pressure is admitted to line **162** by valve **144**, piston **82** is driven to the left as viewed in Figures 2 and 3. Bifurcations **120** of plunger **106** bear against piston **82** so that when the piston is moved to the left, the plunger **106** moves to the left within the housing formed by members **94** and **104** and pin **122** engages the slug or piece part in the die button formed during the punching operation to drive it out of the die button. Such a slug is indicated in the drawings by reference character **170**. In the event we desire to use the assembly in the ordinary manner to perform the stripping function, we may deactivate the valve by any suitable means such as a screw engaging plunger **148** to prevent its movement.

Referring now to Figure 1, we provide collar **92** of die holder assembly **88** with a pair of lateral wings **172** and **174**, each of which carries a respective stop screw **176** and **178** held in position by nuts **180** and **182**. It will be appreciated that stop screws **176** and **178** are adjustable and cooperate, respectively, with stops **184** and **186** fixed to the work table **10** by any appropriate means such as welding or the like to limit the movement of cylinder **62** to the right as viewed in Figure 1 so that the die button is nearer to the work than is the punch at the beginning of a punching cycle.

The operation of our improved punch and stripper cylinder assembly can best be understood by reference to Figures 4 to 7, which illustrate the positions of the punch and die at successive stages of the punching operation. The positions of the elements making up the assembly after knockout and before a punching operation is commenced are shown in Figure 4. The power pistonhead **68** is at its furthest position within the power chamber **64** of cylinder **62**, and the stripper piston **82** is in its outermost position in the stripper chamber **66** of cylinder **62**. To initiate the punching operation, line **130** is connected to the source of fluid pressure, and line **132** is connected to the return side of the supply valve. Fluid entering through line **130** tends to force piston **68** and cylinder **62** away from each other; that is, it tends to force cylinder **62** to the left as shown in Figure 5 and pistonhead **68** to the right. The result of this application of pressure to line **130** will be a movement of the cylinder **62** to the left as viewed in Figure 5 to bring die button **108** into engagement with the work **38**. After the cylinder **62** has moved to the left, its further movement will be prevented by the engagement of die **108** with the work **38**, and piston **68** drives the C-frame **42** and punch **56** to the right. During this movement of the cylinder **62** and piston **68** relative to one another, the return side of piston **68** is connected to return line **132** by passageways **134** and **140**. As the punch **56** moves through the work, it

forms a slug or piece part **170** and pushes it into engagement with rod **122** of plunger **106**. Upon further movement of the punch, plunger **106** is moved to the right, and by virtue of the engagement of its bifurcations **120** with stripper piston **82**, it pushes the stripper piston **82** back into the stripper chamber **66** of cylinder **62**. This stage of the operation is illustrated in Figure 6. As will be apparent from an examination of Figure 6, fluid from chamber **66** will be forced through passage **162** into chamber **160**, through openings **166** to lift valve **150** from its seat against action of spring **152**. This permits fluid to flow through passage **158** into passage **136** and then through port **140**.

As mentioned hereinbefore, we have provided bar **126** to immobilize pins **78** and **86** during the punching operation. In the conventional stripper piston and cylinder assembly such as is described in Patent No. 2,534,292, previously referred to, stripper piston **82** is formed as a solid member without a pin **86**. It will be appreciated that in such an assembly when pressure is applied to line **130**, it would move pin **78** to the left, as viewed in the drawings, to force the stripper piston **82** to the left. That is, it would initiate a movement of piston **82** to eject a slug by means of plunger **106** before the punch has been stripped from the work. To obviate this result, we provide piston **82** with pin **86** and arrange bar **126** to prevent any movement of pin **78** when pressure is applied through line **130**. It is to be understood that our cylinder and piston assembly could be arranged to operate in a conventional manner merely by employing a conventional arrangement so that the movement of pin **78** is not blocked by means such as bar **126** and by maintaining valve **150** open.

When the punching operation has been completed, the supply valve is reversed so that line **132** is connected to the supply side of the valve. Line **130** is connected to the return side of the supply valve and the die button moves away from the work. This connection of lines **130** and **132** results in a movement of the cylinder assembly carrying die button **108** to the right and a movement of punch holder **54** to the left as viewed in Figure 7.

When the return cycle is initiated, there is no more exhaust pressure from stripper chamber **66** so that spring **152** closes valve **150**. Since this valve is closed, fluid under pressure from line **132** cannot actuate the stripper piston **82**.

After line **130** has been connected to the return side of the supply valve, cylinder **62** moves to the right until rod **168** engages plunger **148** to open the valve **150**. This permits pressure to be applied to the stripper piston through line **136**, the valve chambers **154** and **160**, and line **162**. Rod **168** is adjusted to a position such that it engages plunger **148** to open the valve. The application of pressure to piston **82** forces the piston to the left as viewed in Figure 4 and, by virtue of the engagement of the piston with bifurcations **120**, forces knockout plunger **106** to the left. Pin **122** thereby engages the slug **170** and pushes it out of the die button as shown. The relative position of the elements of the piston and cylinder assembly are then as shown in Figure 4, and the supply valve may be reversed to initiate another punching operation. Stops **184** and **186** limit the movement of cylinder **62** away from the work during the return stroke and cause movement of C-frame **42** and punch **56** to the left.

While we have shown our punching die as being adapted merely to punch a hole in a work piece, it will be appreciated that any form punch and die could be employed. For example, if the die were employed in a shallow forming job, the knockout plunger **106** could be used to knock the work out of the die. It will be appreciated also that were such a shallow forming job to be done, the stripper piston and cylinder would act as a cushion to give the effect of a double action press operation, when the work pushed plunger **106** to drive piston **82** into the stripper chamber **66** and exhaust the chamber against the action of

spring 152 of valve 150. That is, when the punch moves against the die, pin 122 or its equivalent would be cushioned by the stripper piston 82 so as to give relative to the die. It would then be actuated after punching was completed to knock the work out of the die.

Thus it will be seen that we have accomplished the objects of our invention. We have provided an improved hydraulic punch and stripper which is adapted to perform two functions. It operates to strip the punch from the work and also acts as a knockout to eject slugs or piece parts from the die. In addition, as explained, it may be used when shallow forming is to be done to give the effect of a double action press, and when so used, it also acts to knock the work out of the die. Our improved punch and stripper is particularly adapted for use when punching from the inside out of a piece part.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is therefore to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. A hydraulic punch and stripper assembly including in combination a cylinder body formed with a power chamber and a stripper chamber, a power piston mounted for reciprocation within said power chamber, a stripper piston mounted for reciprocation in said stripper chamber, a die carried by said cylinder body, a punch, means mounting said punch on said power piston for cooperation with said die, means for supplying fluid pressure to the power chamber to move said power piston and cylinder body relative to one another to perform a punching operation, a knockout plunger slidably mounted on the cylinder body, said plunger being formed with a portion adapted to extend into said die, said plunger being in engagement with said stripper piston and means for admitting fluid under pressure to said stripper chamber at a predetermined point on the operational cycle of the assembly after said punching operation whereby said stripper piston moves said plunger portion into the die.

2. A hydraulic punch and stripper assembly as in claim 1 wherein said power piston is formed with a pair of fluid conduits leading to the respective sides of said power piston and said means for supplying fluid pressure to said stripper piston includes a pair of passageways and a valve interposed between said passageways, one of said passageways being connected to one of said fluid conduits and the other of said passageways being connected to said stripper chamber.

3. A hydraulic punch and stripper assembly as in claim 1 wherein said cylinder body is formed with a partition dividing the body into said power and stripper chambers, a pin slidably mounted in said partition and extending between the power and stripper chambers and means for immobilizing said pin.

4. A hydraulic punch and stripper assembly as in claim 1 including adjustable stop means for limiting the movement of the cylinder body away from the work.

5. A hydraulic punch and stripper assembly including in combination a work table, a C-frame slidably mounted in said table and having a pair of arms, a cylinder body formed with a power chamber and a stripper chamber, a power piston fixed to one of said arms and disposed for reciprocation within said power chamber, a die fixed to the end of said cylinder body adjacent the stripper chamber, a punch, means mounting said punch on the other of said arms for cooperation with said die, means for alternately applying fluid under pressure to the power chamber adjacent the respective sides of said power piston to cause relative movement between said cylinder body and said C-frame whereby a punching operation is performed, a knockout plunger slidably carried by the cylinder body and formed with a portion adapted to extend into said die, a stripper piston mounted for movement within said stripper chamber and adapted to engage said plunger and means for admitting fluid under pressure to said stripper chamber at a predetermined point in the operational cycle of the assembly after said punching operation.

6. A hydraulic punch and stripper assembly including in combination a cylinder body having a power chamber and a stripper chamber, a power piston mounted within said power chamber, a first conduit for supplying fluid under pressure to said power chamber adjacent one side of said power piston, a second conduit for supplying fluid under pressure to said power chamber adjacent the other side of said power piston, said conduits being alternately supplied with fluid under pressure to relatively reciprocate said power piston and said cylinder body, a die carried by said cylinder body, a punch, means mounting said punch on said power piston for cooperation with said die, the arrangement being such that said die cooperates with said punch to perform a punching operation when said power piston and said cylinder body relatively reciprocate, a stripper piston disposed within said stripper chamber, means for supplying fluid under pressure to said stripper chamber to actuate said stripper piston at a predetermined point during the operational cycle after said punching operation of the machine and knockout means actuated by said stripper piston to enter said die.

7. A hydraulic punch and stripper assembly as in claim 6 wherein said means for supplying fluid under pressure to said stripper chamber comprises fluid supply conduits formed in said cylinder body, a valve interposed in said supply conduits, and means for actuating said valve at a predetermined point during the return stroke of said assembly.

8. A hydraulic punch and stripper assembly as in claim 6 including a die button assembly forming a knockout plunger housing and wherein said means actuated by the stripper piston comprises a knockout plunger mounted in said housing.

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