May 23, 1967 C. J. HAMKINS 3,320,740

PRESS

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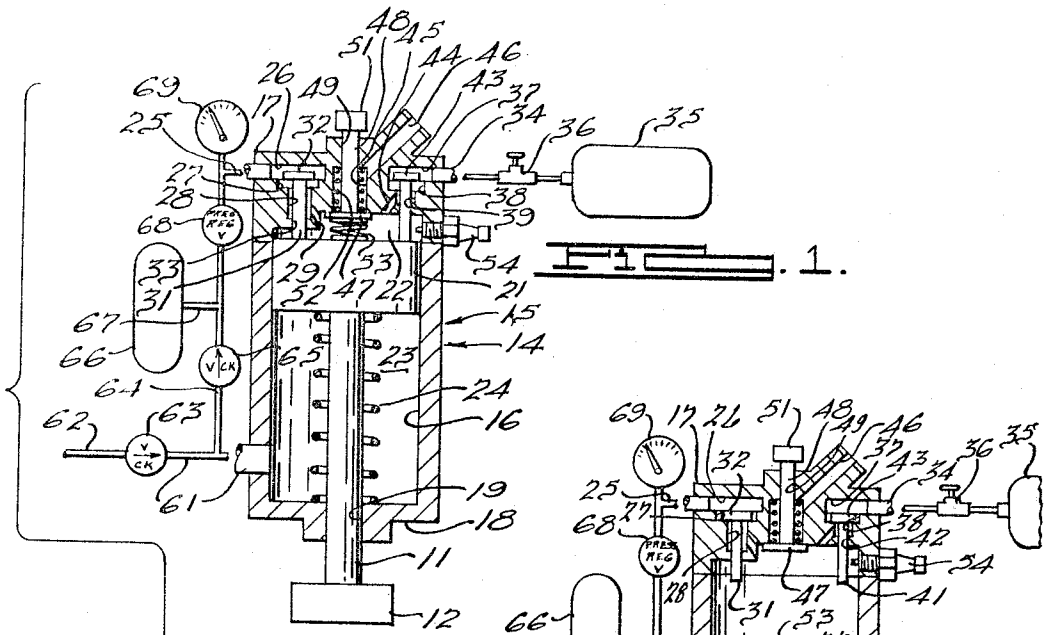


FIG. 1.

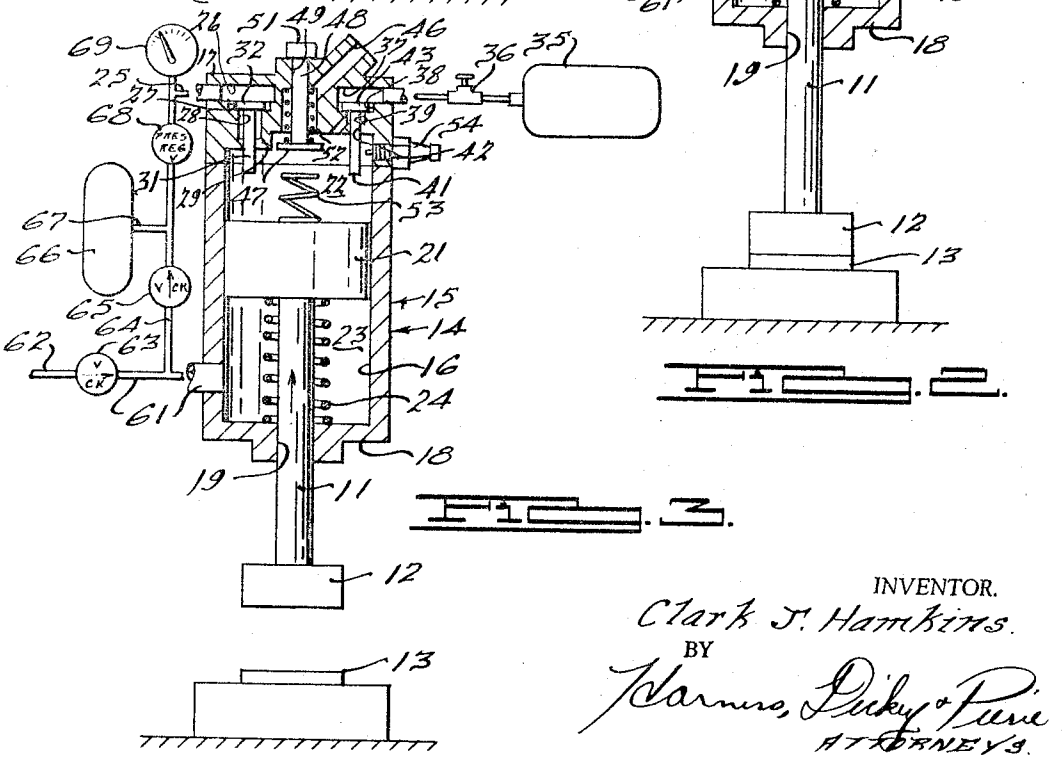


FIG. 2.

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PRESS

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1 Claim. (Cl. 60—26.1)

This invention relates to a press for cutting or forming workpieces and more particularly to an explosively operated device for actuating such a press.

It is an object of this invention to provide an explosively actuated press.

It is a further object of the invention to provide an improved driving mechanism for an explosively actuated press.

It is a still further object of the invention to provide improved valve devices for an explosively actuated press that do not require additional operating mechanisms.

It is a still further object of the invention to provide an improved driving structure that incorporates an integral means for compressing the air within the explosive press.

An explosively actuated press embodying this invention comprises a power ram adapted to carry a tool and has means supporting the ram for reciprocation of the tool into engagement with a workpiece. The ram is actuated by relatively movable piston and cylinder members one of which is interconnected to the ram for reciprocally driving the ram. Means are provided for charging the space between the piston member and the cylinder member with a stoichiometric fuel-air mixture when the members are in a first position prior to an operative stroke of the ram. Means are provided for igniting the stoichiometric mixture to drive the ram, for returning the ram to its first position and for exhausting the fired mixture from the space between the members.

Other objects and advantages of the invention will become more apparent as this description proceeds, particularly when considered in conjunction with the accompanying drawings, wherein:

FIGURES 1 through 3 are partially schematic cross-sectional views of an explosive press embodying this invention and show the press in various positions.

FIGURE 1 illustrates the press in a charged position prior to an operative stroke.

FIGURE 2 illustrates the press at the completion of an operative stroke.

FIGURE 3 illustrates the press in an intermediate position prior to the return to the charged position.

Referring now in detail to the drawings, a press embodying this invention comprises a ram **11** adapted to carry a tool **12** which in turn engages a workpiece (not shown) supported upon a die **13**. It is to be understood the tool **12** and die **13** may be of any known type or the ram **11** may be used to perform any type of forming operation.

An explosive or internal combustion driving device **14** is provided for driving the ram **11** through an operative stroke into engagement with the workpiece. The driving device **14** comprises a cylinder assembly, indicated generally by the reference numeral **15**, defining an axially extending cylinder bore **16** that is concentrically disposed with respect to the ram **11**. The upper end of the cylinder assembly **15** is closed by a cylinder head **17** and the lower end is closed by a base portion **18** in which a cylindrical bore **19** is formed. The cylindrical bore **19** guidingly engages the ram **11** and supports it for reciprocation, the cylinder **15** being supported in a fixed position with respect to the die **13** in any known manner.

A piston member **21** is supported for reciprocation within the cylinder bore **16** and divides it into first and second confined spaces or chambers **22** and **23** respectively. The ram **11** is formed integrally with the piston member **21** and thus functions as a piston rod for the piston **21**. Alternatively, the ram **11** may be connected in any known manner to the piston **21**.

A coil compression spring **24** encircles the ram **11** and engages the lower side of the piston **21** and the upper side of the cylinder base portion **18**. The coil spring **24** normally urges the piston **21**, ram **11** and tool **12** to an upward or first position at the completion of the operating stroke of the ram **11** and in a charged position for the next operating stroke.

Air under pressure is delivered to the cylinder head **17** by means of an air inlet conduit **25** from a source of air under pressure, as will become more apparent as this description proceeds. The conduit **25** is fitted into a transversely extending passage **26** formed in the cylinder head **17**. The passage **26** is intersected by an enlarged bore **27** formed at the upper end of a smaller bore **28**. The bore **28** is intersected by a diagonal bore **29** that extends into the chamber **22** formed between the head of the piston **21** in the upper portion of the cylinder assembly **15**.

A valve member comprised of an elongated operating portion **31** and an enlarged head portion **32** controls the flow or air from the passage **26** into the cylinder chamber **22** through the passage **29**. The valve operating portion **31** extends coaxially within the bore **28** but is smaller in diameter than it. The cylinder head has a reduced diameter bore **32** that slidably engages the valve operating portion **31** to support it for reciprocation. The head portion **32** is adapted to be received in the bore **27** and is larger in diameter than the bore **28** to shut off the flow through it.

At the opposite side of the cylinder head **17**, a similar valve device is provided for admitting fuel to the chamber **22** to form a stoichiometric fuel-air mixture therein. The fuel admission means comprises a conduit **34** that is connected to a source of pressurized fuel **35**, for example propane under pressure, by means of a pressure control valve **36**. The conduit **34** opens into a passage **37** formed in the cylinder head **17**. The passage **37** is intersected by an enlarged bore **38** formed at the upper end of a smaller bore **39**. An operating portion **41** of a valve element is supported in a cylindrical bore **42** formed in the cylinder head **17** at the base of the bore **39**. The valve operating portion **41** terminates in an enlarged head portion **43** that is adapted to engage the shoulder between the bores **38** and **39** to preclude passage of fuel from the passage **37** into the chamber **22** through a transverse passage **44** that intersects the bore **39**.

Burnt fuel-air mixture is discharged from the chamber **22** through an exhaust port **45** in the form of a cylindrical passage disposed in the cylinder head **17** concentrically with the cylinder bore **16**. The exhaust port **45** is intersected by a diagonally extending passage **46** which communicates to the atmosphere through any suitable type of silencing device (not shown). A pressure responsive exhaust valve controls the flow through the exhaust port **45**. The exhaust valve has an enlarged head portion **47** that is adapted to abuttingly engage the lower surface of the cylinder head **17** and close off the mouth of the passage **45**. A stem portion **48** of the exhaust valve extends through and is slidably supported by a mating bore **49** formed in the cylinder head **17**. The stem portion **48** has an enlarged portion **51** at its upper end to preclude the valve from falling into the cylinder and to limit the degree to which it opens. A coil spring **52** encircles the exhaust valve stem portion **48** and engages the cylinder head **17** and the head portion **47** to normally urge the exhaust valve to an open position. A coil spring **53** is affixed to the head of the piston **21** and is adapted to engage the exhaust valve head **47** under certain circumstances to close it.

A spark plug **54** is threaded into the cylinder head **17** and has its spark gap exposed within the chamber **22**. The

spark plug **54** may be fired by means of any suitable high tension coil and timing mechanism to ignite the mixture formed within the chamber **22**.

Operation

The press is preconditioned for an operative stroke of the ram by the coil spring **24** urging the piston **21** to an uppermost position (FIGURE 1). In such position the head of the piston **21** contacts the air and fuel valve operating portions **31** and **41** to move the valve heads **32** and **43** away from their seats. Air under pressure then enters the cylinder chamber **22** through the passages **26**, **28** and **29** and fuel enters the cylinder chamber **22** through the passages **37**, **38**, **39** and **44**. The pressure of the fuel and air sources are regulated to a stoichiometric fuel-air mixture within the cylinder chamber **22** when both fuel and air valves are opened. At this time, the coil spring **53** overcomes the action of the coil spring **52** to hold the exhaust valve head **47** against its seat.

To initiate a press or punching operation, the spark plug **54** is fired. This ignites the mixture within the chamber **22** and causes a rapid combustion or an explosion that abruptly increases the pressure within chamber **22**. The piston and ram **11** are then urged downwardly whereby the piston head **21** no longer contacts the valve operating portions **31** and **41**. The fuel and air valves then will close. It is to be understood that springs (not shown) may be provided to assist the closing of the valves. As the piston **21** is driven downwardly, the increased pressure within the chamber **22** acting upon the exhaust valve head **47** holds it in its closed position against the action of the spring **52** (FIGURE 2). During the downward movement of the piston **21**, the coil spring **24** is compressed until the tool **12** strikes the workpiece upon the die **13**.

After the expansion has taken place, the pressure in the chamber **22** decreases sufficiently to permit the spring **52** to urge the exhaust valve head portion **47** away from its seat (FIGURE 3). The coil spring **24** also urges the piston **21** upwardly at this time, causing the burnt mixture to be exhausted from the chamber **22** through the passages **45** and **46**. When the piston **21** again reaches its uppermost position (FIGURE 1), the chamber **22** can be charged for the next initiation of the press stroke.

As has been noted, the cylinder chamber **22** is charged with air under pressure. The compression of the volume within the chamber **23** during the descending motion of the piston **21** is utilized to compress the air for delivery to the chamber **22**. For this purpose a conduit **61** extends into the chamber **23** through the wall of the cylinder assembly **15** at a point below the bottom dead center position of the piston **21**. The conduit **61** is connected to an atmospheric inlet passage **62** by means of a check valve **63**. The conduit **61** also is interconnected to a conduit **64** in which a check valve **65** is provided. The conduit **65** is interconnected to a pressure accumulator device **66** by means of a conduit **67** and to a pressure regulator valve **68** that discharges into the conduit **25**. A pressure indicating gauge **69** may be positioned upstream from the pressure regulator valve **68** so that the pressure which enters the cylinder chamber **22** may be read.

When the piston **21** is in the position shown in FIGURE 1, the check valve **63** can be opened and the check valve **65** is closed. Air may then flow under pressure from the accumulator **66** into the cylinder chamber **22**. Atmospheric air may also flow into the cylinder space **23** through the conduit **62** and check valve **63** at this time. Although most of the air intake will take place when the piston **21** is ascending. When the mixture within the chamber **22** is fired and the piston **21** begins its downward stroke, the check valve **63** will close. When the pressure in the chamber **23** exceeds that at which the check valve **65** opens, air will be delivered under pressure to the accumulator **66**. If desired an auxiliary air source (not shown) can also be added to charge the accumulator **66**.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claim.

What is claimed is:

An explosively actuated press or the like comprising a power ram adapted to carry a tool, a work supporting base for supporting a workpiece adapted to be engaged by the tool, a cylinder, a piston supported for reciprocation within said cylinder and dividing said cylinder into two chambers on opposite sides of said piston, means affixing said cylinder with respect to said work supporting base, means affixing said piston to said ram for driving said ram, means for charging one of said chambers with a stoichiometric fuel-air mixture, said means comprising inlet passage means formed in said cylinder and opening into said one chamber and inlet valve means supported for reciprocation by said cylinder having an enlarged head portion adapted to control the flow through said inlet passage means, said inlet valve means having an integral portion extending from said head portion into said one chamber and adapted to be engaged by said piston when said piston is in a first position for opening said inlet valve means, exhaust passage means extending through said cylinder from said one chamber to the atmosphere for discharging a burnt charge from said one chamber, exhaust valve means supported for reciprocation by said cylinder for controlling the flow through said exhaust passage means, said exhaust valve means having an enlarged head portion exposed to the pressure within said one chamber and adapted to control the passage of exhaust gases through said exhaust gas passage means, biasing means cooperating with said enlarged head portion of said exhaust valve means for urging said exhaust valve means to an open position, spring means carried by said piston and adapted to engage said exhaust valve head portion and urge said exhaust valve to its closed position when said piston is in its first position, biasing means disposed in the other chamber of said cylinder and engaging said piston for urging said pitson to said first position, means for firing the stoichiometric fuel-air mixture in said one chamber for urging said piston from said first position to a second position wherein the tool carried by said ram is adapted to engage a workpiece supported upon said work supporting base, an air accumulator, conduit means interconnecting said air accumulator to said inlet passage means for delivering air under pressure to said inlet passage means, and valved passage means interconnecting said other chamber with the atmosphere and with said accumulator for drawing air from the atmosphere into said other chamber upon movement of said piston from its first position to its second position and for delivering air under pressure to said accumulator upon movement of said piston from its first position to its second position.

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