June 21, 1966 E. HAAS ETAL 3,256,762

HYDRAULIC DIE CUTTING MACHINE HAVING INERTIA SWITCH MEANS TO CONTROL HYDRAULIC OPERATION

Filed Feb. 12, 1965 2 Sheets-Sheet 1

FIG. 1

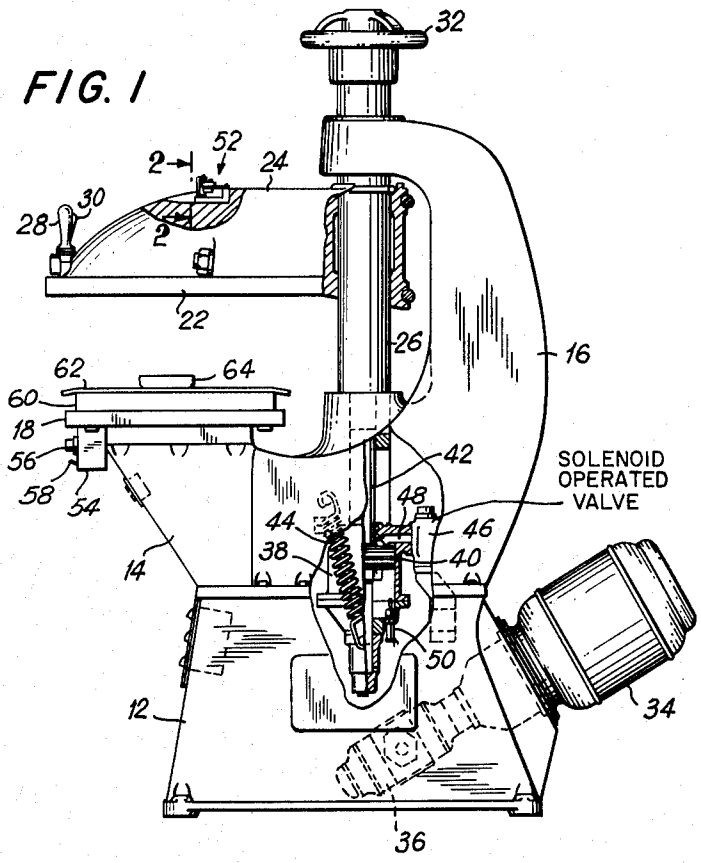


FIG. 2

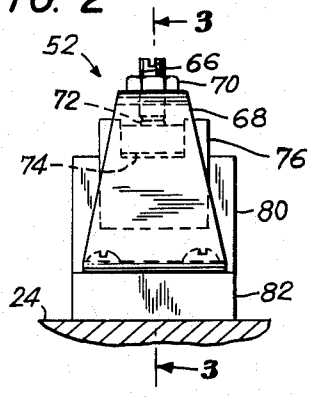
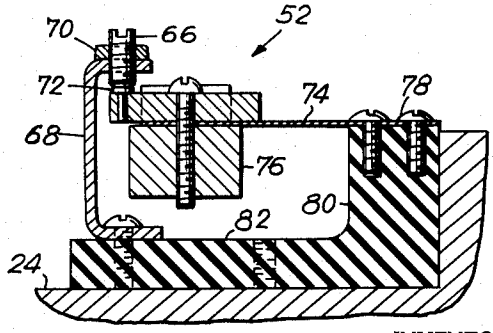


FIG. 3



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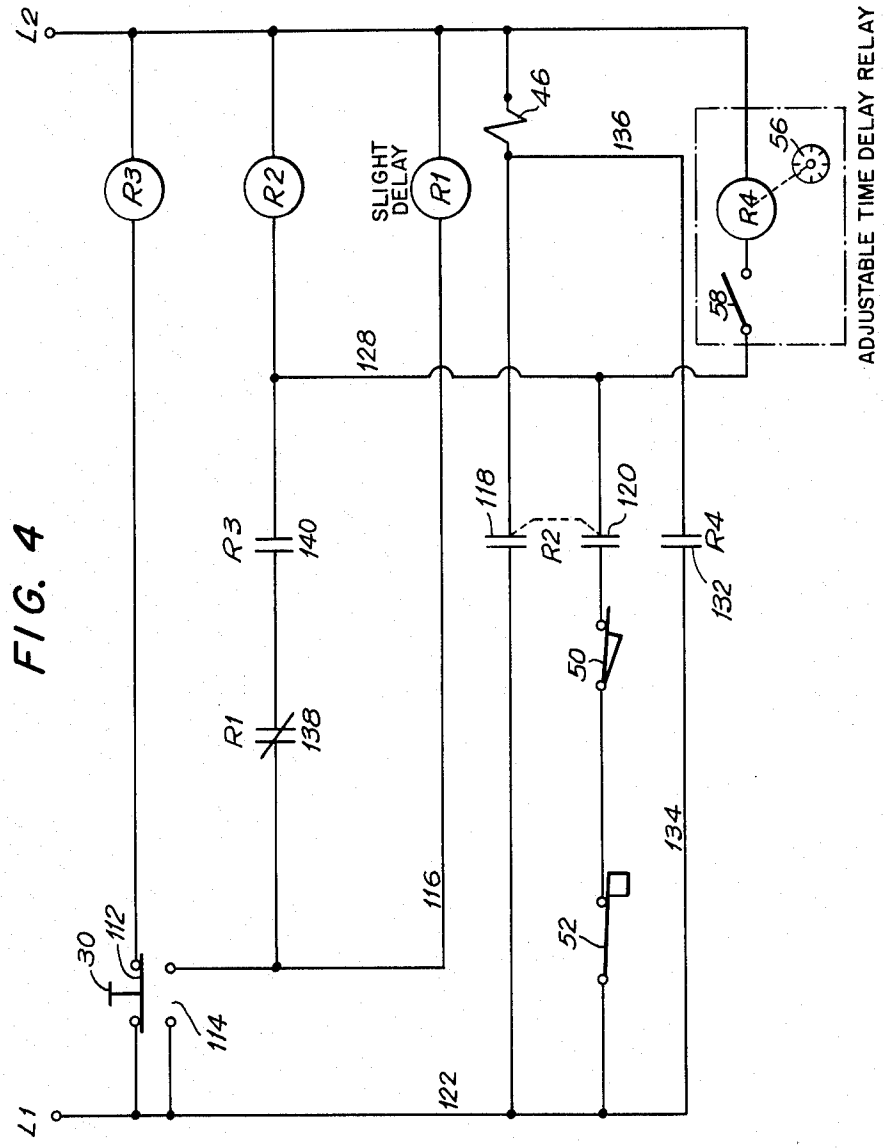


FIG. 4

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HYDRAULIC DIE CUTTING MACHINE HAVING INERTIA SWITCH MEANS TO CONTROL HYDRAULIC OPERATION

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This invention relates to cutting machines, and more particularly to hydraulic cutting machines using loose or moveable dies.

A popular form of cutting machine with which the invention may be used is a machine having a swinging arm or platen. The machine has a table which supports one or more layers of the material to be cut. An operator places one or more loose dies on the material; swings the arm to forward position over the dies and table; and then triggers power means, preferably hydraulic means, for moving the arm downward to force the dies through the material. The arm is swung sideward by means of a handle which usually is provided with a switch to initiate the cutting operation.

The machine may be provided with a limit switch to arrest and reverse the downward movement of the platen when the material has been cut. For convenience the limit switch has been built into the mechanism of the press, for example, at the cylinder and piston mechanism which forces the platen downward. However, the height of the cutting block on which the material rests may vary, and indeed becomes less as the cutting block is worn with long use. Also, the dies may vary in height. This complicates the use of a limit switch and requires frequent adjustment of a handwheel which is inconveniently located at the very top of the machine.

The general objects of the present invention are to improve cutting presses; to overcome the foregoing difficulty; and to provide an improved cut control means which is small, light, accessible, and easily adjusted. In accordance with a further feature and object, the cut control means responds to the beginning of actual cutting of the material, regardless of the height of the die and of the cutting block. For this purpose we provide an inertia switch on the platen arm, and this responds to the abrupt resistance to further movement which occurs at the transition from free movement to cutting movement of the platen. The circuitry includes relays, and the normal relay delay provides adequate time to complete the cut through thin material.

This normal relay delay may be inadequate when dealing with thick material or, when, as is often the case, multiple plies of material are superposed for simultaneous cutting. In accordance with a further feature and object of the invention the control circuitry is provided with an adjustable time delay relay, and this is so arranged in relation to the inertia switch that the inertia switch starts the relay, and subsequent expiration of the adjustable time delay of the relay is what reverses the movement of the platen.

To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, our invention resides in the hydraulic press and electrical control circuitry elements, and their relation one to another as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings in which:

FIG. 1 is a partially sectioned elevation showing the invention applied to a press of the swinging arm type;

FIG. 2 shows the inertia switch, and is an elevation taken approximately on the line 2—2 of FIG. 1;

FIG. 3 is a vertical section taken in the plane of the line 3—3 of FIG. 2; and

FIG. 4 is an electrical diagram explanatory of the circuitry embodying the inertia switch.

Referring to the drawing, and more particularly to FIG. 1, the press there shown comprises a base **12** supporting a bed **14** and a pedestal or C-frame **16**. The bed **14** carries a table **18** on which a cutting block **60** is mounted. This is usually made of wood, but other satisfactory materials have been employed.

The platen **22** forms part of a swinging arm **24** which is mounted on a post **26** which is rotatably received in the C-frame **16**. The arm **24** may be swung back and forth by means of a handle **28**, and this preferably embodies a switch **30** which may be used to initiate the cutting operation. The height of the arm **24** may be adjusted, as by means of a hand wheel **32** at the top of the machine. It is shown at maximum elevation, but usually is close to the die **64**, to minimize lost motion.

The hydraulic drive means of the press may be conventional. In the present case the base **12** acts also as an oil reservoir. An electric motor **34** drives a submerged pump **36** which supplies fluid under pressure to the upper end of a cylinder **38** carrying a piston **40** which is connected to post **26** by means of piston rod **42**. In the form here shown the cylinder **38** is single acting, and the return or upward movement of the post is produced by means of a pair of return springs **44**, one on each side of the cylinder. The upper ends of these springs are fixedly mounted in the machine, and their lower ends are connected to a horizontal bar connected to a downward extension of the piston rod.

The flow of fluid from pump **36** to the upper end of the cylinder is controlled by a solenoid operated hydraulic valve **46**, which controls flow through passage **48** to the top end of the cylinder **38**. A four way valve is not needed because the cylinder is single-acting. A limit switch **50** is built into the mechanism, and is so arranged in the electrical circuitry that it operates the valve **46** to cause return movement of the piston. Such a limit switch may be used as the sole means for that purpose, but in the present case the limit switch **50** is retained only as a safeguard to prevent the piston from reaching the bottom of the cylinder.

When using the limit switch **50** along the height of the arm **24** would be adjusted by means of wheel **32** as to terminate the downward movement when the die **64** penetrates the material being cut. In the course of work different dies are used, and these may differ in height. The arm then must be set at different heights for the different dies, and it is inconvenient to change the adjustment of the hand wheel **32**, which is located at the very top of the machine, and which is a rather heavy adjustment to make.

In the present machine the height of the arm may be adjusted primarily with a view to locating it slightly above the die so as to minimize the lost motion between the platen and the die. The cut is controlled by the inertia switch, and this switch takes effect at the beginning of the cut even if one die is higher than another, or the number of plies of material is changed, etc.

FIG. 1 as drawn shows the platen in its highest position, and is unrealistic because in actual practice the hand wheel **32** would be used to lower the platen to a height where it just clears the dies intended to be used.

The inertia switch is indicated at **52**, and is located in the press arm **24**. It is preferably supplemented by means of an adjustable time delay relay, here shown located in a protective box **54**, the timing adjustment being made by means of a dial indicated at **56**. There is also a switch **58** which makes the time delay relay operative or inoperative. we call this a selector switch.

In FIG. 1 the table **18** carries a conventional cutting block **60** on which the material **62** which is to be cut is rested. A loose die **64** is placed on the material **62**, and is driven through the material when the arm **24** is swung over the die by means of handle **28** and the trigger **30** is operated to initiate the downward or cutting movement. On completion of the cutting movement the arm **24** rises, regardless of whether the trigger **30** is held or released, and the arm then may be turned aside; the die **64** moved to an adjacent position; the arm swung back over the die; and the trigger **30** again operated to blank out another unit from the material **62**.

The inertia switch may be described with reference to FIGS. 2 and 3 of the drawing. It comprises a fixed adjustable contact **66** threadedly received in a bracket **68**. The adjustment is locked by means of a lock nut **70**. A lower contact **72** is carried on a thin leaf spring **74** which is weighted by means of a heavy metal block **76**. The fixed end of spring **74** is anchored at **78** on the raised part **80** of an insulation base **82**, which also carries the bracket **68**.

It will be understood that the contacts are normally closed. However, when the arm **22** (FIG. 1) engages the die **64** to begin cutting the material, there is an abrupt resistance to continued movement which causes the arm **24** and the switch contact **66** (FIG. 3) to hold back, while the weight **76** and switch contact **72** continue moving, thereby momentarily breaking the circuit through the contacts. It will also be evident that the force needed to open the contacts is adjustable by means of the screw **66**.

In the machine shown, the die **64** is a loose die which is engaged by the arm, but it will be understood that the same principles would apply to a die mounted on the underside of arm **22**, because the inertia switch then would open when the die meets the material, instead of when the platen meets the die. In either case the inertia switch opens at the beginning of the cutting operation and regardless of the height of the cutting block **60**; the thickness of the layer or layers of material **62**; the height of the die **64**; and the height of the arm.

A preferred form of electrical circuitry and its operation may be described with reference to FIG. 4 of the drawing. The trigger of the handle switch is indicated at **30**. The switch has upper contacts **112** which are opened and lower contacts **114** which are closed when the trigger **30** is operated. The inertia switch is indicated at **52**, and the maximum down limit switch is indicated at **50**. The time delay dial or adjusting dial for the time delay relay is shown at **56**, and the selector switch for making the relay operative or inoperative is shown at **58**. The time delay relay itself is marked R4, and its contacts are shown at **132**. The solenoid of the solenoid controlled hydraulic valve is indicated at **46**.

Three relays are used in the circuit, these being shown at R1, R2, and R3, the relay R1 having normally closed contacts **138**; the relay R2 having two pairs of normally open contacts marked **118** and **120**; and the relay R3 having normally closed contacts also marked **140**. Relay R1 is sluggish or has a slight delay compared to relay R3.

The diagram shows the circuit elements connected across a conventional power line, represented by terminals L1 and L2. An overall switch, not shown, may be provided ahead of the terminals.

The operation is first described with the assumption that the material being cut is relatively thin and requires no added time delay, in which case the adjustable time delay relay R4 is left out of the circuit by opening the selector switch **58**. Relay R3 is normally energized and its contacts **140** are therefore normally closed. When the operator depresses the handle switch **30** the contacts **112** open and the contacts **114** close. Opening of the upper contacts **112** de-energizes the relay R3, thereby closing its normally open contacts **140**. Closing of the lower contacts **114** energizes the relay R1 through a conductor **116**, and its contacts **138** open, but only after a slight delay, so that relay R2 is actuated, and is held by its own holding contacts, as described later. The closing of the R2 relay contacts **118** energizes the solenoid **46** of the hydraulic valve, the circuit for this being from line L1 through conductor **122**, closed contacts **118**, solenoid **46**, and back to line L2. This causes the press to operate until the platen strikes the die, whereupon the inertia switch **52** opens.

Relay R1 has a slight fixed delay which need not be adjustable, and which is intended merely to make sure that there will be a momentary flow of current through the contacts **138** and **140** to initiate operation of relay R2. All that is needed is that R1 be slower than R3. The contacts **138** of relay R1 then open, but R2 remains energized through its holding circuit next described.

Relay R2 has the two sets of normally open contacts **118** and **120**, and if relay R2 is momentarily energized it then is held energized through a holding circuit which runs from line L1 through conductor **122**, inertia switch **52**, limit switch **50**, relay contacts **120** (then closed) and conductor **128** to relay coil R2 and thence back to line L2.

For thin material the normal relay delay in the described circuit provides sufficient cutting time. The operation takes place as described even if the operator holds the handle switch **30** instead of releasing the same. However, to make a new cut he must release and then again operate the trigger. This is so because when he releases the trigger the relay R1 is de-energized and the relay R3 is energized. The contacts **140** of relay R3 open, and the contacts **138** of relay R1 close, but slowly, thereby momentarily de-energizing relay R2, so that its holding circuit is opened, and the machine then is ready for another operation as previously described.

It may be explained that during operation of the press it is desired that the relay R2 be energized solely through the inertia switch **52**, and it then must not be energized through the circuit of contacts **138** and **140**. These contacts are therefore arranged to operate in alternation. If the operator holds the trigger **30** down, the contacts **138** of relay R1 open, and the contacts **140** of relay R3 open. If the operator releases the trigger **30** quickly after operating the same, the operation for downward movement is the same because the operation of the relays is even faster than the manual release of the trigger, and therefore relay R2 is at least momentarily energized, and then held to complete the cut.

The delay provided by the slight delay relay R1 avoids what is sometimes called "racing of contacts" when, as here, the contacts **138** and **140** are operated in alternation. The delay of relay R1 provides the desired momentary energization of relay R2 when the contacts **138** and **140** are both closed because of their momentary overlap in operation caused by the slower operation of relay R1. This initiates the energization of solenoid **46**, and relay R2 then is held energized by its holding contacts **120**, and thus the main contacts **118** are held closed to energize the solenoid **46** until the inertia switch **52** opens.

It may be observed that contacts **112** and **114** of the trigger switch are operated in sequence. That alone provides a delay in proper direction, and therefore the circuitry shown will operate even without making the relay R1 a slow relay. However, it is preferred to make relay R1 a little slower than relay R3 to insure maintenance of an adequate or safe overlap in the operation of the relay contacts **138** and **140**.

The operation so far has been described without the adjustable time delay relay R4. When selector switch **58** is closed the relay coil R4 is in shunt with the coil of relay R2, and when energized its contacts **132** provide a shunt circuit through conductors **134** and **136** around the main contacts **118** of relay R2. The result is that when the inertia switch de-energizes the relay R2, the valve solenoid **46** nevertheless remains energized through the shunt circuit **134, 132, 136** until the delay time to which the

delay relay R4 has been set runs out, whereupon the contacts 132 open and valve solenoid 46 is de-energized, permitting the press platen to rise.

It is believed that the construction and method of operation of our improved hydraulic die-cutting machine, as well as the advantages thereof, will be apparent from the foregoing detailed description. It will also be apparent that while we have shown and described the invention in a preferred form, changes may be made without departing from the scope of the invention, as sought to be defined in the following claims.

We claim:

1. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, an electric circuit controlling said valve, an inertia switch mounted on and physically movable with said platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, said switch being so connected in said valve controlling circuit that operation of the switch reverses the movement of the platen after a slight delay adequate for the die to cut through the material.

2. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, an electric circuit controlling said valve, an inertia switch mounted on and physically movable with said platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, an adjustable time delay relay in said valve controlling circuit and so arranged in relation to the inertia switch that the inertia switch starts the time delay relay and subsequent expiration of the adjusted time delay of the relay reverses the movement of the platen.

3. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, an electric circuit controlling said valve, a manually operable handle switch in said circuit to initiate downward movement of the platen, an inertia switch mounted on and physically movable with said platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, said switch being so connected in said valve controlling circuit that operation of the switch arrests and reverses the movement of the platen after a slight delay adequate for the die to cut through the material, and means whereby this reversal takes place regardless of whether the handle switch is still held down or is released.

4. A press comprising a work support and a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, an electric circuit controlling said valve, a manually operable handle switch in said circuit to initiate downward movement of the platen, an inertia switch mounted on and physically movable with said platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, an adjustable time delay relay in said valve controlling circuit and so arranged in relation to the inertia switch that the inertia switch starts the time delay relay and subsequent expiration of the adjusted time delay of the relay arrests and reverses the movement of the platen, and means whereby this reversal takes place regardless of whether the handle switch is still held down or is released.

5. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, a trigger switch with closed contacts and open contacts which are sequentially reversed by operation of the trigger, a relay coil in series with said closed contacts, a relay coil in series with said open contacts, said relays respectively having normally open and normally closed contacts, said contacts being in series with each other and a third relay coil which operates main and holding contacts, said main contacts controlling said solenoid valve, and an inertia switch in series with said holding contacts, said inertia switch being mounted on and physically movable with the platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material.

6. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, a trigger switch with closed contacts and open contacts which are sequentially reversed by operation of the trigger, a relay coil in series with said closed contacts, a relay coil in series with said open contacts, said relays respectively having normally open and normally closed contacts, said contacts being in series with each other and a third relay coil which operates main and holding contacts, said main contacts controlling said solenoid valve, an inertia switch in series with said holding contacts, said inertia switch being mounted on and physically movable with the platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, an adjustable time delay relay coil in shunt with said third relay coil, the contacts of said time delay relay being in shunt with said main contacts of said third relay, whereby the cutting time may be extended and varied by adjustment of the time delay relay.

7. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, a trigger switch with closed contacts and open contacts which are reversed by operation of the trigger, a relay coil in series with said closed contacts, a slower relay coil in series with said open contacts, said relays respectively having normally open and normally closed contacts, said contacts being in series with each other and a third relay coil which operates main and holding contacts, said main contacts controlling said solenoid valve, and an inertia switch in series with said holding contacts, said inertia switch being mounted on and physically movable with the platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material.

8. A press comprising a work support, a platen mounted for movement toward or away from the work support, a cutting die therebetween, hydraulic means to move the platen toward the work support to force the die through sheet material positioned on the work support, a solenoid operated valve for said hydraulic means, a trigger switch with closed contacts and open contacts which are reversed by operation of the trigger, a relay coil in series with said closed contacts, a slower relay coil in series with said open contacts, said relays respectively having normally open and normally closed contacts, said contacts

being in series with each other and a third relay coil which operates main and holding contacts, said main contacts controlling said solenoid valve, an inertia switch in series with said holding contacts, said inertia switch being mounted on and physically movable with the platen and so arranged that it is operated by inertia when the platen causes the die to begin to cut the material, an adjustable time delay relay coil in shunt with said third relay coil, the contacts of said time delay relay being in shunt with said main contacts of said third relay, whereby the cutting time may be extended and varied by adjustment of the time delay relay.

No references cited.

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