Dec. 5, 1950 O. H. MAY 2,532,850

SELF-BREAKING TOGGLE

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FIG. 1.

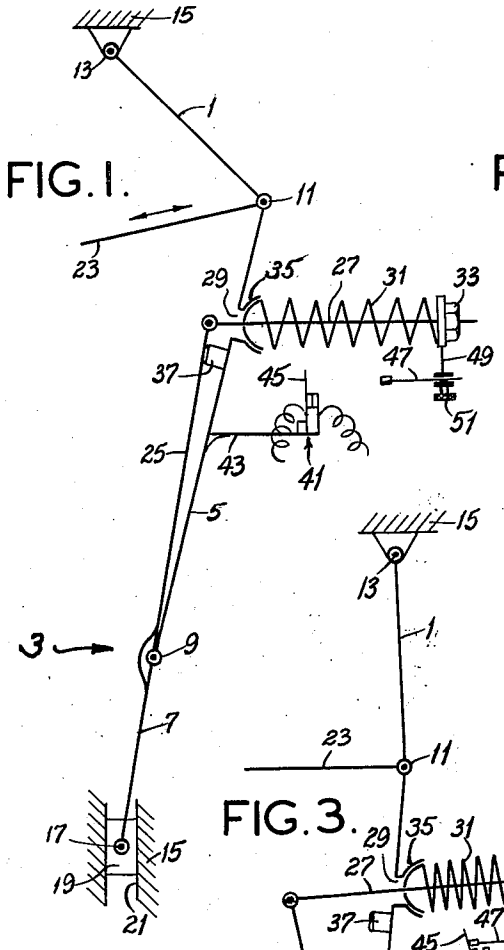


FIG. 2.

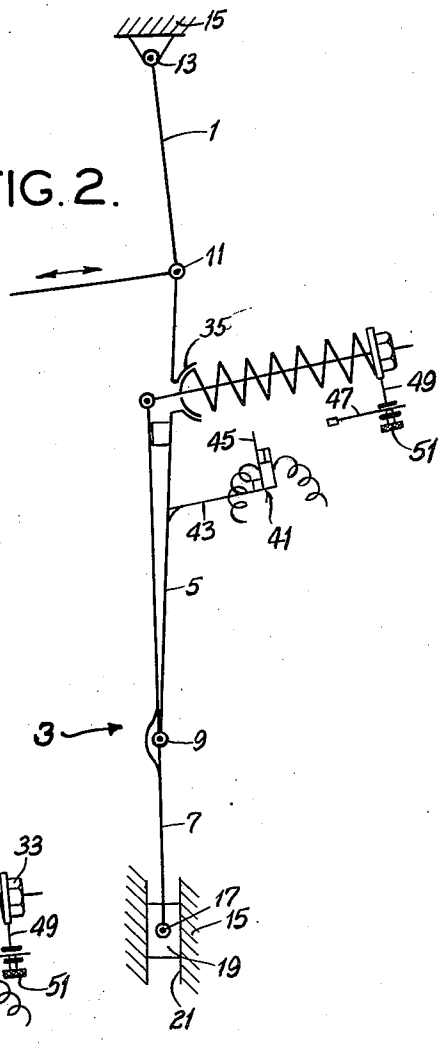
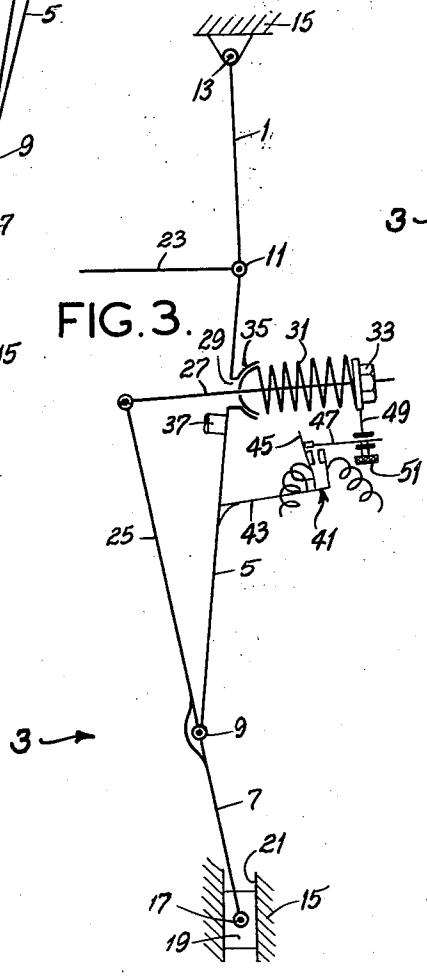


FIG. 3.



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SELF-BREAKING TOGGLE

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This invention relates to toggle presses and more particularly to self-breaking toggle systems for such presses.

Briefly, the invention comprises a toggle system for operating the ram of a press adapted to relieve the force applied to the toggle by yieldingly breaking the toggle when the force exceeds a predetermined value. In general, this is accomplished by constructing one of the arms of the toggle as a pair of pin-connected links, and providing means, such as a spring, for biasing the links to a normal position wherein they are slightly off their dead center position. Thus, at forces up to a limiting force as determined by the force applied by the biasing means to straighten the links, the links remain in normal position. When the force exceeds this limiting value, the links buckle at their pin connection and relieve the force, the excess of force being taken up in the biasing means.

It is therefore one of the objects of the invention to provide a toggle system for operating the ram of a press which is self-breaking when a predetermined force is reached to limit the amount of force to which the toggle is subjected. The invention is also particularly suitable for use in presses for operations where the ram of the press must dwell at the end of its power stroke and apply force to work which shrinks under pressure (for example, plastic material cooling under pressure). With the present invention, the ram, under the action of the biasing means, continues to apply force to the work as it shrinks. Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing, in which one of various possible embodiments of the invention is illustrated,

Fig. 1 is a diagrammatic kinematic layout of a toggle system of this invention, at the beginning of a power stroke;

Fig. 2 is a view like Fig. 1 illustrating the toggle system at or near the end of a power stroke, the toggle being substantially straight; and

Fig. 3 is a view like Fig. 2, illustrating the toggle broken.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

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As shown in the drawing, the toggle system of this invention comprises a pair of toggle arms 1 and 3. The arm 1 comprises a single link. The arm 3 is compound and comprises two semi-rigidly connected links 5 and 7 pivotally connected at a pin joint 9. The link 5 is pivotally connected to the arm 1 at a pin joint 11 forming the knee of the toggle. The arm 1 is pivoted at its upper end as indicated at 13 to the frame 15 of the press. The link 7 is pivotally connected at is lower end as indicated at 17 to the ram 19 of the press. The ram is guided for vertical reciprocation in vertical alignment with the pivot 13 by means of a guide 21 carried by the frame of the press. At 23 is shown a link pivotally connected to the knee of the toggle for operating the latter. The link 23 is actuated by any suitable driving means (not shown).

The link 7 has an integral lever arm 25 extending upward beyond the pivot 9. A rod 27 is pivotally connected at one end to the upper end of this arm and extends across the link 5. As shown, the rod 27 extends through an aperture 29 in the link 5. A spring 31 is shown surrounding the rod 27 and compressed between the link 5 and an abutment comprising a nut 33 adjustably threaded on the free end of the rod 27. Preferably, the spring reacts from a cup-shaped seat 35 on link 5 surrounding the aperture 29 so that the spring is free to move as the rod 27 rocks with respect to the link 5. The spring, acting through the rod 27, biases the arm 25 of link 7 to rock clockwise as viewed in the drawing about the pivot 9 and thereby normally holds the arm 25 against a stop 37 on the link 5 in an initial position wherein the links 5 and 7 are just off their dead center position (Figs. 1 and 2). Link 7 and the arm 25, however, may rock counterclockwise about pivot 9 against the force of the spring.

The arrangement is such that with the toggle angled at the beginning at a power stroke (Fig. 1), link 7 is held in its initial position by the spring 31. As power is applied to the link 23 to straighten the toggle, the ram 19 is driven downward until it engages and applies force to the work (and to the toggle system). Assuming that the force does not exceed a predetermined limit, as determined by the initial compression of the spring 31, the arm 25 will remain in position against the stop 37, and links 5 and 7 constituting the toggle arm 3 will remain in their initial position (Fig. 2). If,

however, the force should exceed this limit, the force acting back through the toggle causes the link 7 and its extension arm 25 to rock counterclockwise about the pivot 9 against the force of the spring 31 to break the toggle at the pivot 9 (Fig. 3). This relieves the excessive force on the toggle, taking it up in the spring. When the toggle is returned to the Fig. 1 position, the spring expands and moves the link 7 back to its initial position.

The above-described toggle system is particularly useful in presses for operation on work which shrinks under continuous pressure (for example, plastic material cooling under pressure) where the ram must dwell on the work to apply pressure thereto as it shrinks. For such operation, the press is adjusted so that links 5 and 7 break at the joint 9 to compress the spring 31 before the ram completes its deformation of the work. Then, as the work shrinks, the spring returns the lever arm 25 and link 7 toward their initial position, thereby moving the ram toward the work so that it continues to exert pressure on the work in accordance with the compression of the spring.

The toggle system may be provided with a safety device for controlling the press to prevent the force on the toggle from reaching a dangerous value. As shown, such a safety device may comprise a press-controlling switch 41 mounted on the link 7 by means of a bracket 43. The switch is normally closed. It has an operating arm 45 positioned for engagement by a switch-operating rod 47 adjustably mounted on the nut 33 to open the switch when the spring 31 has been compressed a predetermined amount. The rod 47 is shown as slidably adjustable in a bracket 49 carried by the nut and locked in adjusted position by a set screw 51 so that the point at which the switch is opened may be changed at will. The switch may be connected in a circuit to stop the press, reverse it, or perform other operations. It will be understood that the electrical control may be replaced by a mechanical, hydraulic, pneumatic or other type of control.

It will be noted that the stop 37 determines an initial position of the links 5 and 7 wherein they are at a slight angle to one another, just off their dead center position (i. e., the position in which they would be exactly aligned end-to-end). The arrangement is preferably such that links 5 and 7, in their initial position, are not less than 4° off dead center.

It will be understood that the initial compression of the spring 31 may be adjusted by turning the nut 33 to regulate the force at which the toggle will break at the point 9. It will be further understood that means other than a spring, for example, a weight-operated linkage, may be used in place of the spring. It is contemplated that the spring may have special spring-rate characteristics, or comprise a multiplicity of springs, or that a step-by-step weighting mechanism or the like may be used to obtain various desired force-displacement characteristics as may be required by various types of work.

A further important feature of the invention is the arrangement whereby the force of the spring is exerted at the end of the extension 25 of the link 7. This multiplies the effect of the spring in opposing the breaking of the toggle at the joint 9, since the force of the spring is applied at the end of a moment arm of considerable length. It will be observed that the link 7 is relatively short with respect to the extension 25. This requires that the link 5 be substantially long with respect to the link 7. This gives the spring 31 a large mechanical advantage in holding the links 5 and 7 in the approximately (though not exactly) straightened positions shown in Figs. 1 and 2. This allows the use of a weaker spring than would otherwise be required for a given applied force upon the ram 19.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawing, shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, one of said links having an extension past the pivotal connection of said links, and a spring means acting from the other link upon the extension to swing the said one link about the pivotal connection of the links to a predetermined angular position with respect to the other link as determined by engagement of the extension and the said other link.

2. A toggle press as set forth in claim 1, said extension being relatively long with respect to said one link.

3. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, one of said links having an extension past the pivotal connection of said links, and compression spring means acting from the other link upon the extension to swing the said one link about the pivotal connection of the links to a position slightly off its dead center position as determined by engagement of the extension and the said other link.

4. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, one of said links having an extension past the pivotal connection of said links, a rod pivotally connected at one end to the end of the extension and extending through an aperture in the other link across the said other link, and compression spring means reacting from the said other link against an abutment at the other end of said rod and acting to bias said one link to an angular position slightly off dead center with respect to said other link as determined by engagement of the extension with said other link.

5. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, means acting on said links to bias them to a position wherein they are yieldingly maintained at a predetermined angle, said links being relatively angularly movable away from said position against the force exerted by said biasing means, and means for controlling the operation of the press in response to movement of the links through a predetermined angle away from said position.

6. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, one of said links having an extension past the pivotal connection

of said links, spring means acting from the other link upon the extension to swing the said one link about the pivotal connection of the links to a predetermined angular position with respect to the other link as determined by engagement of the extension and the said other link, and a switch carried by one of said links and operable in response to movement of said links through a predetermined angle away from said predetermined angular position.

7. In a toggle press, a toggle system comprising a pair of toggle arms pivotally connected at a knee, one of said arms comprising a pair of pivotally connected links, one of said links having an extension past the pivotal connection of said links, a rod pivotally connected at one end to the end of the extension and extending through an aperture in the other link across the said other link, and compression spring means reacting from the said other link against an abutment at the other end of said rod and acting to bias said one link to an angular position slightly off dead center with respect to said other link as determined by engagement of the extension with said other link, a switch carried by said other link, and a switch-operating rod carried by said abutment to actuate the switch in response to swinging of said one link through a predetermined angle away from its stated angular position.

8. In a toggle press, a frame, a ram movable in the frame, a toggle system comprising a pair of toggle arms having a pivot connection at a knee, one of which arms is compound and consists of two links semi-rigidly connected, one of said arms being pivoted to the frame and the other being pivoted to the ram, the compound one of said arms comprising a pair of pivotally connected links, stop means carried on one of the links and limiting their rigid relationship to one in which the pivotal connection between the links is slightly off its dead center position between the knee pivot and the pivot connection at the other end of the compound arm, and biasing means supported upon one of the links of the compound arm adapted to move and hold the other link thereof in said limiting rigid position until the toggle arms approach a dead center position under load on the ram and thereafter in response to increased load on the ram to allow pivoting between the links.

9. In a toggle press, a frame, a ram movable in the frame, a toggle system comprising a pair of toggle arms having a pivot connection at a knee, and one of which consists of plural links,

one of said arms being rigid and pivoted to the frame and the other being pivoted to the ram and consisting of two semi-rigidly pivoted links, stop means carried on one of the links and limiting their rigid relationship to one in which the pivotal connection between the links is slightly off its dead center position between the knee pivot and the pivot connection at the ram, and biasing means supported upon one of the links of the compound arm adapted to move and hold the other link thereof in said limiting position until the toggle arms approach a dead center position under load on the ram and thereafter in response to increased load on the ram allowing pivoting between the links.

10. In a toggle press, a frame, a ram movable in the frame, a toggle system comprising a pair of toggle arms having a pivot connection at a knee, one of which arms is compound and consists of two links semi-rigidly connected, one of said arms being pivoted to the frame and the other being pivoted to the ram, the compound one of said arms comprising a pair of pivotally connected links, stop means carried on one of the links and limiting their rigid relationship to one in which the pivotal connection between the links is slightly off its dead center position between the knee pivot and the pivot connection at the other end of the compound arm, biasing means supported upon one of the links of the compound arm adapted to move and hold the other link thereof in said limiting rigid position until the toggle arms approach a dead center position under load on the ram and thereafter in response to increased load on the ram to allow pivoting movement between the links, and switch means carried by the compound arm adapted to operate in response to pivoting movement of said links.

OTTO HERMANN MAY.

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