Oct. 15, 1935. T. B. HAWKES 2,017,622

CUTTING MACHINE

Filed Aug. 29, 1933 2 Sheets-Sheet 1

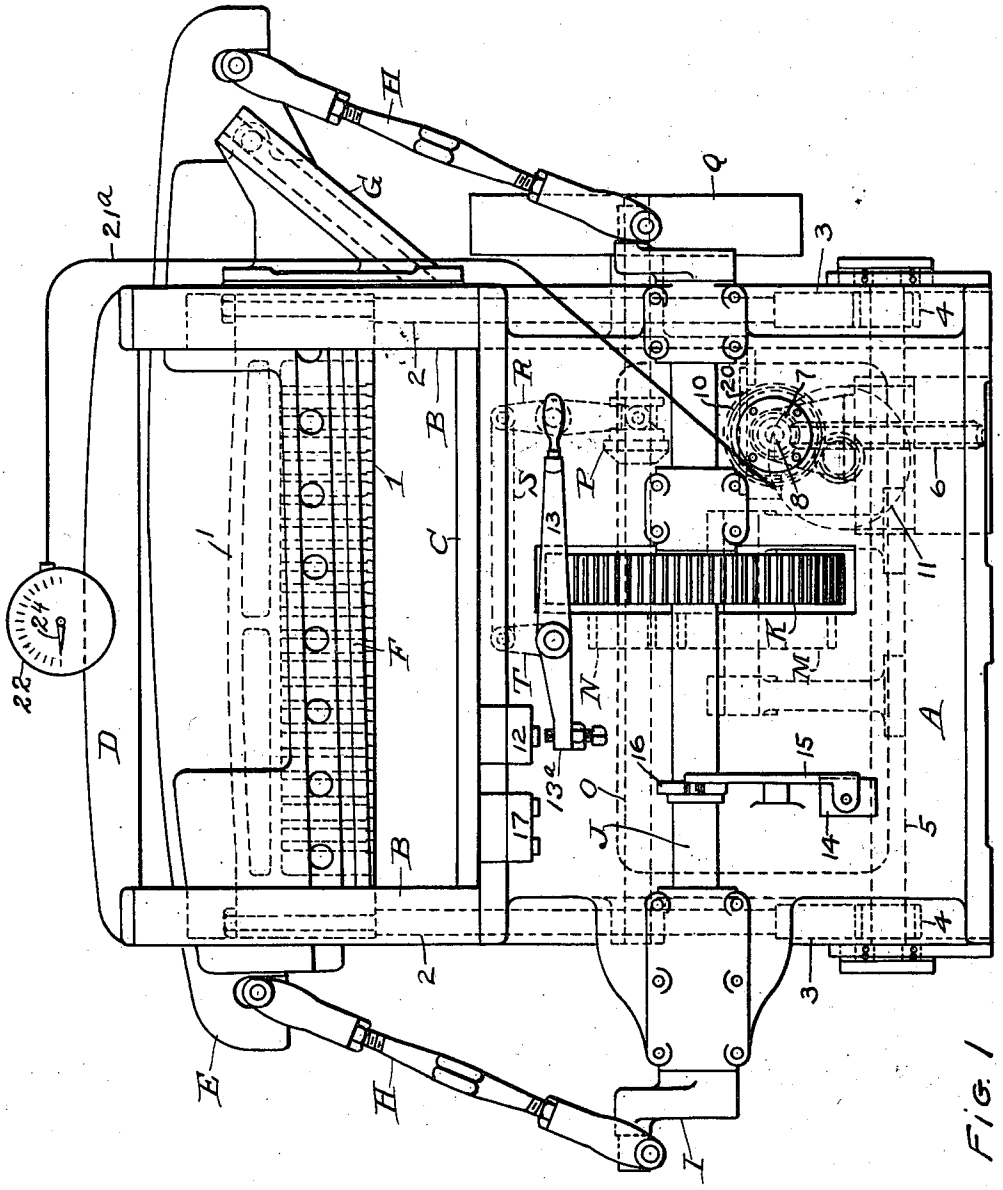


FIG. 1

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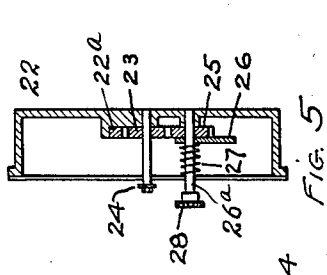


FIG. 5

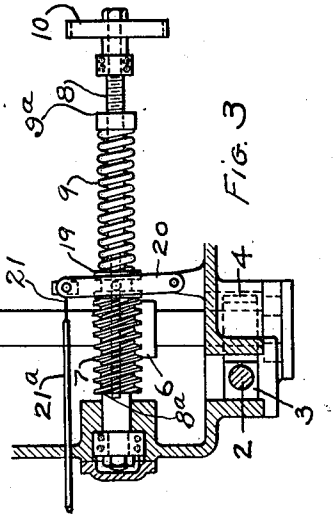


FIG. 3

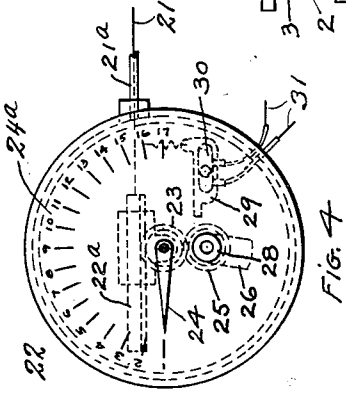


FIG. 4

FIG. 2

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UNITED STATES PATENT OFFICE

2,017,622

CUTTING MACHINE

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Application August 29, 1933, Serial No. 687,277

16 Claims. (Cl. 164—54)

This invention is a novel cutting machine, for example for cutting or severing piles of paper or for trimming or slicing the edges of analogous materials such as paper board, books in process of manufacture and the like. This known type of machine comprises a cutting bed or table on which the work is laid, a clamp coming down upon the material to place it under compression and hold it during the cutting, and a knife or blade following the clamp and effecting the severing or slicing operation. A typical example of a machine of this class is the Sheridan paper cutting machine, an illustration of which is contained in U. S. patent of C. L. Smith No. 1,726,369 of August 27, 1929.

The present invention has for an object to afford an improved and powerful clamping mechanism adapted for heavy duty cutting or trimming work upon material of varying thickness. A particular object is to afford a clamping mechanism for the described or similar purposes wherein the clamping pressure is applied with a cushioning action, and the pressure gradually built up to the desired clamping pressure, thus progressively squeezing out any air existing between the layers or sheets of paper or other material; this arrangement obviating the impact or shock which occurs with the friction-slip type of pressure application as illustrated in said Smith patent. A further object is to afford control of the maximum pressure by causing the cessation of pressure increase at a predetermined point, and holding the clamp with the pressure at this point until the cutting operation has been completed.

Other and further objects and advantages of the present invention will be set forth in the hereinafter following description of an illustrative embodiment thereof or will be apparent to those conversant with the subject. To the attainment of such objects and advantages the present invention consists in the novel cutting machine and the novel features of operation, combination and construction herein shown or described.

In the accompanying drawings Figure 1 may be considered a front elevation view of a cutting machine of the Sheridan type embodying the features of the present invention.

Fig. 2 is a right elevation of the machine shown in Fig. 1.

Fig. 3 is a top plan view of certain details seen in Figs. 1 and 2.

Fig. 4, on an enlarged scale, is a detached face view of the pressure gage and limit device, with the interior part shown in dotted lines.

Fig. 5 is a central vertical section view of the device shown in Fig. 4.

The same reference numerals apply to the corresponding parts in the several figures of the drawings.

Referring first to some of the well known and standard parts of a cutting machine of the type referred to, the base A rests at floor level and has upstanding from it heavy plates or side frames BB, these being suitably slotted or grooved for the up and down sliding of the clamp and knife bar to be described. The frame carries the cutting bed C, and at the top the side frames are connected by a girder or top piece D, thus completing the framing of the machine.

Sliding up and down in the vertical slots of the side frames B is the knife bar or head E which preferably has not only its downward and upward parallel motion, but also a longitudinal or horizontal motion so that in its descent it delivers a shearing or slicing action to sever the edges of the pile of paper which projects forwardly of the clamp. The knife bar carries a cutting blade F which thereby moves downwardly and upwardly in face contact with the side frames and practically in contact with the front face of the clamp. The endwise movement of the descending knife bar and blade may be effected by the fixed inclined guide or cam G engaged by a pin projecting facewise from one end of the knife bar. For effecting the down and up movements the ends of the knife bar are shown connected by links H to cranks I carried on an operating shaft J turning in heavy bearings on the base. Each complete turn of the shaft causes the knife bar to descend and rise, and it may come to rest at its highest position while the paper or other products are shifted or replaced upon the cutting bed. The lower or cutting edge of the knife is shown with the usual slant so that it operates progressively across the material.

The driving connections for the shaft J and knife bar may be of any desired kind; for example there is shown on the shaft a gear K which is driven by a pinion L on a counter shaft that also carries a gear M, the gear M meshing with a pinion N on a power shaft O. The pinion N may be clutched to or unclutched from the shaft O by a clutch P, and the shaft O may be considered as the initial source of power for the described train of connections, and it may carry a fly wheel Q to afford momentum and steadiness of action.

By these described connections, when the clutch P is closed, the shaft J will rotate to move the knife bar E down and up. The clutch may be

shifted by a rocking shift lever R, the lower end of which is forked to engage the clutch groove, and the upper end of which is connected by a link S with an upwardly extending rock arm T turning about a rock shaft which carries a lever or handle 13 to be described.

The clamp 1 consists of a heavy horizontal bar rearwardly adjacent to the knife bar and sliding with parallel motion vertically in the guideways afforded by the frame side plates B. The clamp 1 may be operated by vertical draw rods 2, their upper ends extending through the ends of the clamp and their lower ends carrying or connected to toothed racks 3, one at each side of the machine. The racks are shown engaged by pinions 4 mounted at the ends of an operating shaft 5. By this arrangement the turning of the shaft 5 in one direction causes the pulling down of the clamp, while the reverse rotation thrusts upwardly the clamp to its initial or highest position as shown in the drawings.

The operation of the shaft 5 and thereby the clamp, namely by connections containing resiliently yielding resistance means to apply the clamping pressure with cushioned impact and gradual increase of pressure will now be described in a preferred embodiment, the principles however being susceptible to embodiment in various equivalent ways. The embodiment herein illustrated is best shown in the top plan view of Fig. 3, but may be followed in the front view Fig. 1 and the right elevation Fig. 2. A worm gear 6 fast on the shaft 5 is shown engaging with a worm 7 on a shaft 8. This worm and wheel arrangement serves not only for the stated purposes, but also as a speed reduction means, giving the shaft 5 the desired slow movement for the operation of the clamp. The worm 7 is arranged to rotate with its shaft 8, but in this embodiment of the present invention this worm is selected as the resiliently yielding element in the train of connections, and for this purpose it is shown in Fig. 3 as keyed to the shaft so as to rotate with it, but to be capable of sliding longitudinally upon it. The normal position of the worm 7 on the shaft 8 is at its leftward position shown in Figs. 2 and 3, in contact with a shoulder 8^a formed on the shaft near its left end. The worm is shown held resiliently to the shoulder 8^a by means of a powerful spring, in this case taking the form of a helical spring 9 surrounding the shaft to the right of the worm and confined there under compression by an adjustable shoulder or nut 9^a at the right end of the spring, this part of the shaft 8 being threaded for the initial adjustment of the tension of the spring. The described combination of elements affords a cushioning and resilient pressure increasing means, since as the shaft 8 and worm 7 drive the worm gear 6 to pull down the clamp the worm may yield rightwardly on the shaft as the clamp comes to position on the material being trimmed, this yield first cushioning the shock of the impact and thereafter permitting progressive yield, the clamp pressure increasing as the spring comes under greater and greater compression. If desired the spring 9, which should be quite heavy and strong, may be under a very light or zero initial compression, so that it may initially commence its yield with light clamping pressure, the spring resistance however increasing rapidly with its compression by the rightward yielding of the worm, so that the actual compression of the clamp upon the goods may reach a very high pressure with the extreme yield of the worm and spring. As will be described the yield of the worm and spring is not allowed to continue indefinitely but is arranged to terminate at a definite or predetermined point, so that the clamping pressure will not exceed a desired maximum but will be held at the predetermined point until the cutting operation is completed.

The driving of the shaft 8 for the operation of the clamp may be effected in various ways. It may for example take its drive from the same source or power shaft O as the knife bar, with suitable means for uncoupling it to terminate the clamp pressure increase at the predetermined point. However in the present embodiment it is preferred to provide a separate power source for the clamp, this being readily coordinated to insure that the clamp reaches and presses the goods before the knife reaches the goods. On this principle the following connections are shown. At the right end of shaft 8 is shown a gear 10 which is in mesh with a pinion 10^a on the shaft of a motor 11. The motor 11 is preferably a standard high duty motor of the type which may be driven either forwardly or reversely by change of electric connections, for example the kind which is controlled by magnetic contactors which in turn are controlled from remote points by simple switches or push buttons; and the motor also preferably is self-braking when deenergized, so that in practical operation the motor is either being driven in one direction or the other or held against rotation. These details are well known and are deemed unnecessary to illustrate specifically.

A system of switches or push buttons is shown for effecting various controls. Thus a push button switch 12 is arranged with suitable circuits extending to the motor 11 to cause the starting of the motor into forward rotation. The circuits for this and the other control to be described are not herein shown but can be readily arranged by those skilled in electric wiring. The switch 12 is shown as operated by a handle or lever 13, thrown or rocked downwardly manually to effect the starting of the machine, this lever having a fixed fulcrum and a rock arm 13^a beyond the fulcrum with a mechanical contact beneath the switch 12 so that when the handle arm 13 is depressed the rock arm 13^a rises and closes the switch.

A second switch 14 is shown which may be described as a reversing switch, being connected by suitable circuits to start up the motor 11 in the reverse direction. The switch 14 is shown operated by a lever 15 centrally fulcrumed and having at its top end a roll engaging with a cam 16 mounted on the knife operating shaft J. By this arrangement when the knife has completed its cutting stroke the cam 16 starts the motor 11 into reverse rotation thereby starting the upward retraction of the clamp.

Adjacent to the switch 12 is shown another push button switch 17 having two buttons manually operable, one for starting the motor into forward rotation to bring the clamp down and the other for reversing the motor to lift the clamp, when it is desired to effect these operations by manual control without operation of the knife mechanism.

Another switch 18 is operated by the lifting of the clamp, the clamp carrying at its top side a vertical pin 18^a which, at the extreme upward movement of the clamp effects the closing of the switch 18 thereby cutting off the current to the motor 11, causing the motor to stop and its braking action to be applied.

There remains to be described the means for effecting the automatic stoppage of the rotation of the shaft 8 or of the train of connections by which the clamp is pulled down, so that when the clamp is under a predetermined maximum pressure its further actuation will cease and it will be held in this position, with the goods under predetermined pressure, until subsequently released by the completion of the operation of the knife. In the case of mechanical drive of the shaft 8 from the same power source or shaft O as the knife, the connections therefrom would include a clutch or coupling, to be opened when the critical or predetermined pressure is reached. In the present embodiment however this control is readily obtained by the stopping and braking of the motor 11 at the predetermined pressure point. For these purposes the degree of compression of the spring 9, or the extent of recession or backing up of the worm 7 is utilized to effect the cessation of clamp actuation. A grooved collar 19 is shown surrounding the shaft 8 and this is shown engaged by the depending stud of a swinging lever 20, its right end being fulcrumed to a fixed part, its free or left end thus partaking of the receding movement of the worm and its extent of movement representing the compression of the spring and the degree of clamping pressure. The described collar 19 and lever 20 constitute the controlling connections from the resiliently yielding system to the clamp operating connections, whatever form the latter may take.

The control of the clamping pressure as illustrated may be described as follows. The free end of the control lever 20 is shown connected by an operating wire 21 for the operation of a switch 30 to be described by which the motor 11 is stopped and the clamping action brought to a halt. The wire 21 for example may be a push-and-pull wire operating within a tube 21a, this tube and wire connecting means being itself well known. The tube and wire connection are shown extended upwardly to a gage and control device 22, shown separately in Figs. 4 and 5. The end of the tube 21a is fixed to the entrance of the gage 22, while the wire 21 extends through and is connected to a light sliding rack 22a, which thereby moves rightwardly in the gage with increase of clamping pressure and vice versa. The teeth of the rack 22 are shown engaged with a pinion 23, the shaft of which carries an exterior hand or index 24 movable around a dial 24a calibrated to give an indication of the clamping pressure.

Within the gage 22 are shown connections for effecting the stopping of the motor 11 as follows. The pinion 23 is shown engaged with a pinion 25 which carries a tripping arm, lug or cam 26. The pinion 25 and trip 26 are shown mounted on a shank 26a slidable endwise to disengage and reengage the pinion 25 with the pinion 23, a spring 27 surrounding the shank and serving to hold the pinions in engagement. The exterior of the shank 26a carries a thumb piece or knob 28 by which the shank may be drawn outwardly to disengage the pinion 25 and may be rotated to change the relative position of the trip 26, the engagement being restored by the spring 27. The purpose of the trip 26 is to cooperate with a swivelled plate or rocker 29 carrying a mercury switch 30. In the position shown in Fig. 4 the switch is closed and therefore the circuit through wires 31 is closed, so that the motor 11 may operate. When however the wire 21 is pulled by the lever 20 the rack 22a rotates the pinions 23 and 25 so that the trip 26 is swung upwardly to the right, progressively as the lever 20 swings to the right, until the trip strikes the rocker 29, lifting its left end and thus tilting the mercury switch to break the circuit 31. This causes the stoppage of the motor 11 and the holding of the clamp operating parts in position with the desired clamping pressure applied.

The operation of the described mechanism may be briefly reviewed as follows. The machine is shown in its starting position. Assuming a pile of sheets to be placed upon the cutting bed and moved forwardly beneath the clamp and knife, the handle 13 will be depressed to start the machine. The clutch P starts the descent of the knife as described. The switch 12 is closed and this applies current to start forwardly the motor 11. The motor causes the descent of the clamp sufficiently fast to precede the operation of the knife. As the clamp reaches the material to be cut the resistance to its descent commences and very shortly any slack in the material will be taken up as the air is squeezed out from between the sheets. When the clamping resistance reaches a substantial point the yielding of the spring 9 commences since the worm 7, unable to drive freely the clamp, is compelled to back up rearwardly, this yielding movement being accompanied by the progressive increase of the resistance of the spring 9 so that the clamping pressure is gradually brought up to the desired maximum. Assuming that the yield of the worm is to be one inch then the control lever 20 at its top end will retract about two inches, and this movement will be transmitted through the wire 21 to cause the swinging of the trip 26, the trip at the end of the predetermined movement tilting up the rocker 29 and causing the opening of the switch 30. This cuts off the current from the motor 11 and the motor stops and is held with the goods under the predetermined pressure. When the knife bar has completed its downward stroke the cam 16 on its operating shaft causes the switch 14 to be closed, or this operation may take place after the knife has started up or has cleared the work. The closing of the switch 14 starts the motor 11 into reverse operation. The shaft 8 and worm 7 are thereupon reversely rotated. The worm returns to its normal position and turns the worm wheel 6 to cause the upward retraction of the clamp. This return of the worm restores the mercury switch 30 in readiness for the next operation. When the clamp has reached its topmost position it operates the switch 18 which again opens the circuit to the motor 11 causing the stoppage of the motor and the bringing to rest of the clamp, the knife bar in the meanwhile having reached its topmost position and having come to rest by the opening of its driving clutch, assuming that the handle 13 has been released. This completes the cycle of operations, which may be repeated upon the shifting or replacing of the work upon the cutting bed. If the trip lug 26 be adjusted leftward by disengaging and reengaging pinion 25, the worm and spring will yield further and the clamping pressure become greater before the action is tripped.

In one aspect the invention is characterized by certain elements describable as follows. The shaft 8 or the connections driving it may be described as the actuator for the clamp. A train of mechanical connections extends from this actuator to the clamp to force it down and thereby apply clamping pressure to the material. This

train of connections includes an element, represented by the worm 7 with its spring 9, which is adapted to yield with progressively increasing resilient resistance, during the actuation, thereby to increase progressively the clamping pressure. The worm 7 and the gear 6 that it drives are illustrative; they afford not only the yielding action of the worm in an advantageous manner, but they serve at the same time for reducing the speed ratio. The action of the worm upon the wheel may afford a one-direction drive, it being well known that such a drive may be constructed to be non-reversible, the wheel being unable to turn the worm, so that this device may afford the locking or braking function necessary to hold the clamp in its lowered position under clamping pressure. In view of this construction the employment of a brake upon the motor 11 may be unnecessary. The described arrangement affords also an effective means of stopping the actuation of the clamp at a predetermined pressure, namely by simply uncoupling or terminating the driving action when the yielding element or worm has yielded or been displaced to an extent corresponding with the desired clamping pressure. In the description and claims directional terms such as down and up are used in a relative sense only since manifestly the same principles would operate in other directions or positions.

There has thus been described a cutting machine embodying the principles and attaining the objects of the present invention. Since various matters of combination, arrangement, operation, construction and detail may be variously modified without departing from the principles it is not intended to limit the invention to such matters except so far as set forth in the appended claims.

What is claimed is:

1. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp including a reducing gear to force the clamp down and thereby apply powerful clamping pressure to the material, said train including at its high speed end an element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure.

2. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp to force it down and thereby applying clamping pressure to the material, said train including a rotary element or gear adapted to shift bodily with progressively increasing resilient resistance thereby to increase progressively the clamping pressure.

3. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including a reducing gear one of the members of which is adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure.

4. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including a spring element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure, and a trip means between the actuator and clamp to stop the operation of said train of connections and thereby the actuation of the clamp when a predetermined pressure is attained, and means whereby said trip means is operated by a predetermined extent of yield of said spring element.

5. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including an element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure, and means to stop the actuation of the clamp when a predetermined pressure is attained, comprising a trip for stopping actuation, and a control part or lever shifted by the yield of said train element, and connected to operate the trip after a predetermined shift of the control part.

6. Clamping mechanism comprising a clamp movable down and up, an actuator, a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including a spring element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure up to a predetermined pressure, and control means associated with said spring element and operated by a predetermined extent of yield of said element when the pressure attains such predetermined pressure to render inoperative the train of connections.

7. Clamping mechanism comprising a clamp movable down and up, an actuator, a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including an element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure up to a predetermined pressure, and control means operated by the yield of said element at such predetermined pressure to cause the stoppage of actuation, said control means comprising a control part or lever shifted by the yield of the yielding element, a trip for causing stoppage, and a connection from the control part to the trip for operating the trip at such predetermined pressure.

8. Clamping mechanism comprising a clamp movable down and up, an actuator, a non-slipping train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including a spring element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping presure up to a predetermined pressure, and control means operated by the extent of yield of said spring element at such predetermined pressure, a disconnecting device disconnected by such control means at the predetermined clamping pressure

thereby to cause the stoppage of actuation, and means for adjusting the initial condition of the spring element to vary the clamping pressure at which such actuation is stopped.

9. Mechanism as in claim 7 and wherein is means for adjusting said control means to vary the clamping pressure at which such actuation is stopped.

10. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a clamp movable down and up adjacent the cutter, an actuator or shaft, and a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, such train including a worm or screw driving a gear, and said worm adapted to yield with relative longitudinal displacement under progressively increasing resilient resistance thereby to increase progressively the clamping pressure.

11. Clamping mechanism comprising a clamp movable down and up, an actuator, a train of connections from the actuator to the clamp to force it down and thereby apply clamping pressure to the material, said train including a worm driving a gear, the worm adapted to yield axially with progressively increasing resilient resistance thereby to increase progressively the clamping pressure up to a predetermined pressure, and control means operated by the yield of said worm at such predetermined pressure to cause the stoppage of actuation.

12. Mechanism as in claim 11 and wherein is a spring associated with the worm to resist progressively its axial yielding.

13. Mechanism as in claim 11 and wherein is a spring associated with the worm to resist progressively its axial yielding, and the control means comprising a control part or lever shifted by the yield of the spring and trip means operated by a predetermined shift of the control part.

14. Mechanism as in claim 11 and wherein is a shaft on which the worm can yield axially, the shaft having a shoulder or contact against which the worm normally rests, and a strong spring holding the worm yieldingly to the shoulder, whereby when the clamping resistance stops the gear from rotating the worm may back up along its shaft to compress the spring.

15. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a first source of power for actuating the cutter, a clamp movable down and up adjacent the cutter, a second source of power for actuating the clamp, a train of connections from the second source of power to the clamp to force it down and thereby apply clamping pressure to the material, said train including a spring element adapted to yield resiliently with progressively increasing resistance thereby to increase progressively the clamping pressure, a trip device associated with said train adapted to terminate the forcing down of the clamp under increasing pressure, and means controlled by the yield of said spring element to cause the operation of said trip device at a predetermined clamping pressure.

16. In a cutting machine having a bed to support the material to be cut and a cutter movable down and up in each cycle, a first source of power for actuating the cutter, a clamp movable down and up adjacent the cutter, a second source of power for actuating the clamp, with a train of connections from the second source of power to the clamp to force it down and thereby apply clamping pressure to the material, said train including an element adapted to yield with progressively increasing resilient resistance thereby to increase progressively the clamping pressure, and with electrical means to control the second source of power, a starting switch to set said train into operation, a limiting switch to stop operation at a predetermined pressure, a reversing switch to set said train into reverse operation after the cutting is completed, and a throw-off switch for stopping operation when the clamp is lifted.

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