April 15, 1941. F. E. MUNSCHAUER 2,238,538

CONTROL MECHANISM FOR MACHINES

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FIG. 1.

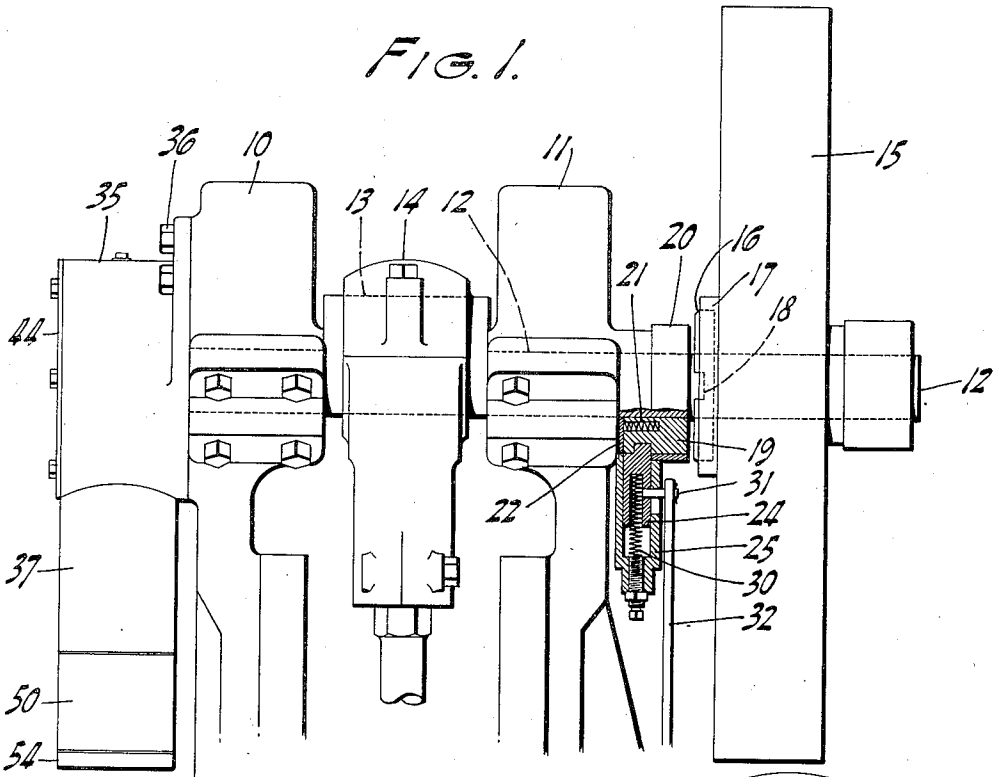


FIG. 6.

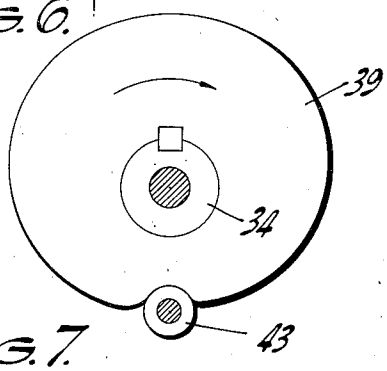


FIG. 7.

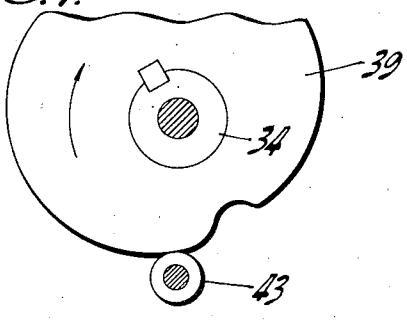
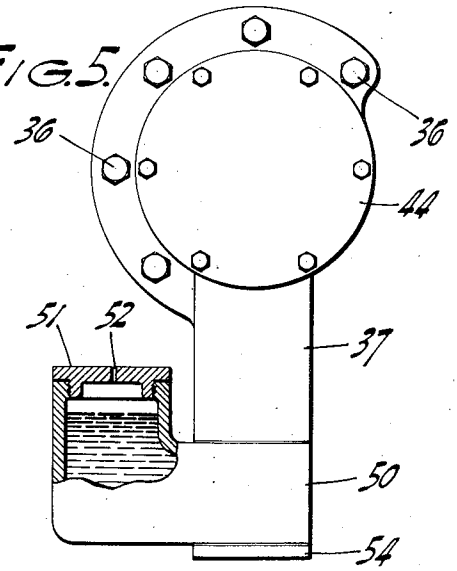


FIG. 5.



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FIG. 2.

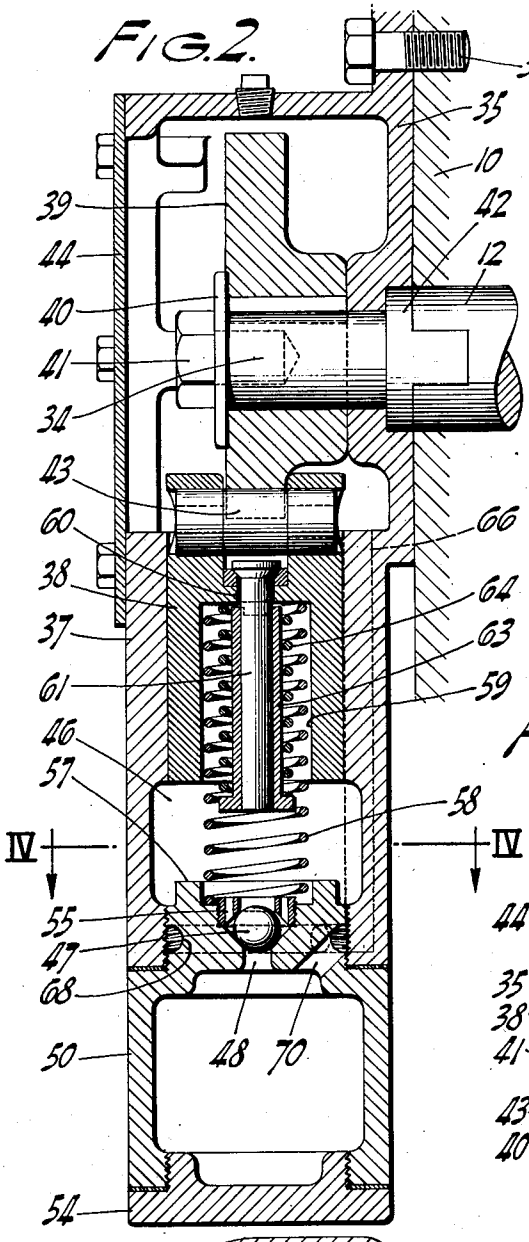


FIG. 8.

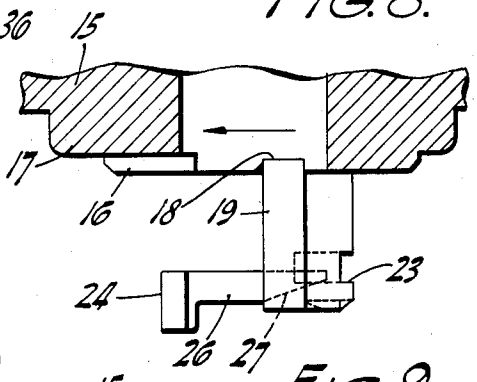


FIG. 9.

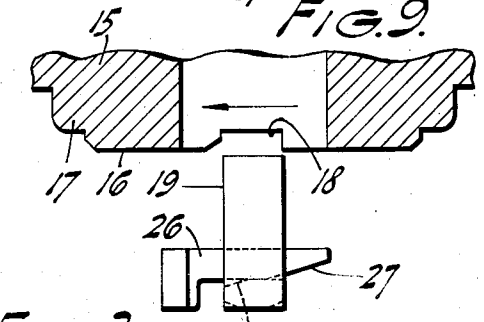
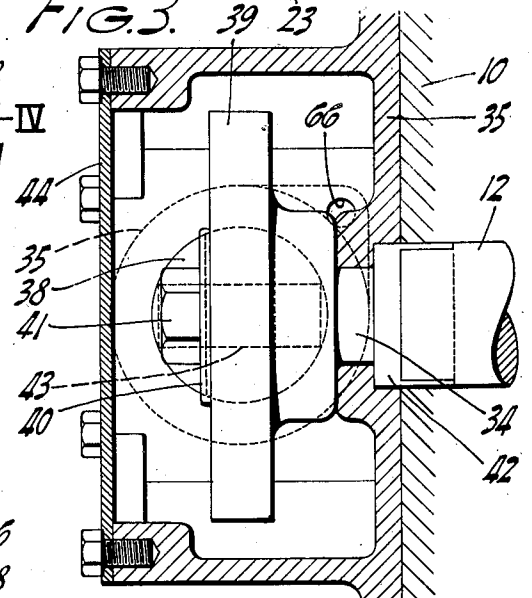


FIG. 3.



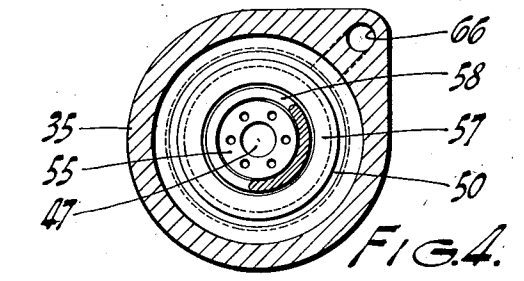


FIG. 4.

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UNITED STATES PATENT OFFICE

2,238,538

CONTROL MECHANISM FOR MACHINES

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Application August 22, 1940, Serial No. 353,664

19 Claims. (Cl. 192—149)

This invention relates to motion controlling and limiting mechanism for use in metal fabricating machinery and has particular adaptability in that class of machines normally employed in metal stamping for forming and cutting metal sheets, bars and analogous materials.

In punch presses, shears and like metal working machines individual punching or cutting strokes engender the setting in motion of relatively large masses and necessitate the accurate stoppage of such masses at a predetermined point at the end of one or more punching or cutting cycles. It is conventional practice to use what is known in the art as a single revolution clutch which, after being manually initiated, continues in engagement for the execution of a complete cycle of punching or cutting as the case may be, then automatically disengages. Continuous execution of successive work cycles in machines of this class may usually be effected by holding the manual stroke initiating means in initiating position, whereupon whenever the initiating means is released the machine will automatically continue operation until the end of the stroke which is then in progress and then, through the operation of the so-called single revolution clutch, automatically declutch.

While this system of operation is widely accepted in the field under consideration, it imposes severe strains on the clutch instrumentalities, both from the standpoint of frictional wear and sudden applications of direct loads of large magnitude. It is an object of the present invention to provide means for relieving the clutch mechanism from these loads and strains and to provide means for insuring stoppage of the moving parts of the machine more accurately and more efficaciously than is possible by prior art practices. Speaking generally, my objects are attained by providing a novel combination of elements including resilient means for driving the moving parts of the machine independently of the clutch drive during certain portions of the cycle of operation and finally accurately disposing such parts in a predetermined rest position, together with hydraulic means cooperating therewith to absorb the inertia of the moving parts abruptly but without undue strain on the machine elements.

In one form of my invention I provide, further, means for counterbalancing the gravitational forces tending to bias the reciprocating cutting or punching instrumentalities to one or another of their extremes of movement and such counterbalancing means may conveniently be incorporated in the novel motion controlling means set forth herein.

The improved type of stop means, with or without provision for counterbalancing, is applicable effectively to the several types of inclinable and straight side presses, as well as to squaring shears and other machines falling within this general classification. One application of the principles of my invention is exemplified in the provision of a cam track arranged for movement with the reciprocating slide of a press, shear or the like, with yieldable means engageable with and exerting pressure upon the cam track. The track is provided with a portion which serves as a stop upon engagement of the yieldable means therewith but the stopping action of such engagement is augmented and rendered certain in its action by cooperation therewith of hydraulic means for insuring a positive cushioned stopping of the machine at an accurately predetermined point at the end of its cycle of movement.

In addition to the beneficial results achieved by reason of the accuracy of stoppage, the present invention results in completely relieving the clutch parts per se of all strain, shock and wear incident to removal of the clutch parts from engagement and stopping of the reciprocating slide and its associated instrumentalities.

The cam may be so designed that the yieldable means resists forward movement as the reciprocable member approaches work, engaging position, to compensate for the action of gravity on the reciprocating parts, another portion of the cam being designed in such a way that the yieldable means gives forth the energy stored therein by such resisting action to counteract the force of gravity as it tends to deter upward return movement of the reciprocating parts. Such latter portion of the cam is arranged to impart an increased driving action to the reciprocating parts as the end of the return stroke is reached whereby to effectively return the parts to their position of rest independently of the conventional clutch means, particularly when the automatic clutch disengaging means is performing its disengaging function.

Obviously the single revolution clutch means heretofore referred to is synchronized with the operation of the stop and counterbalancing elements in such manner that they cooperate to effectively stop the machine in predetermind position of rest efficiently and certainly. A study of the following detailed description, in connection with the drawings, will render apparent to those skilled in the art that many mechanical changes and modifications might be effected without in any wise departing from the spirit and scope of my invention as defined in the appended claims.

In the drawings:

Fig. 1 is a fragmentary front elevational view of the upper portion of a metal fabricating machine, in the illustrated instance a punch press, provided with apparatus embodying the improvement of the present invention;

Fig. 2 is a vertical cross sectional view, likewise viewed from the front of the machine, showing the improved control mechanism on a larger scale;

Fig. 3 is a horizontal cross sectional view taken on the center line of the principal drive shaft of the machine and showing further the details of the improved control mechanism;

Fig. 4 is a cross sectional view taken on the line IV—IV of Fig. 2;

Fig. 5 is a side elevational view of the improved control mechanism taken on approximately the same scale as Fig. 1 and with portions thereof in cross section to show the liquid reserve supply;

Fig. 6 is a side elevational view showing the cam and follower elements of the control mechanism with the machine in a position of rest;

Fig. 7 is a similar view with the machine approachng a position of rest;

Fig. 8 is a fragmentary plan view, in cross section and somewhat schematic, showing the flywheel hub, the clutch pin, and the clutch throw-out cam in a position approaching a position of rest; and,

Fig. 9 is a similar view with the clutch shown disengaged.

In the drawings like characters of reference denote like parts and the numerals **10** and **11** designate a pair of press frame members providing bearing for a drive shaft **12** which is conventionally provided with a crank portion **13** which is engaged by the bearing portion of a connecting element **14**, the opposite end of which connects with a slide member or crosshead (not shown). The slide member or crosshead is adapted to hold and support cutting, punching and stamping tools for reciprocation toward and away from a relatively stationary die or other cooperating tool in a manner which is well known in the art and need not be described or illustrated in setting forth the principles of the present invention.

Also in a conventional manner, the drive shaft **12** has disposed thereon a flywheel **15** which may serve also as a drive pulley in the case of a belt driven machine. The flywheel is preferably mounted for normally free rotation on the drive shaft **12** and is provided with a clutch face **16** which may form a portion of its hub **17** and is engageable by suitable clutch mechanism for selectively locking the flywheel **15** to the drive shaft whereby the latter may be driven by the former to perform working cycles. It is desirable in machines of the kind under consideration that there be a predetermined position of rest wherein the slide is in an upper position away from the relatively stationary die or tool previously referred to and, generally speaking, there is provided a single-revolution clutch, that is, one which, after manual engagement, produces one revolution of the drive shaft, then automatically disengages.

While various forms of single-revolution clutch mechanisms may be utilized in punch presses, shears, or other machines embodying the principles of my invention, for the sake of disclosing a complete and fully operative machine I refer to the single-revolution clutch mechanism set forth in detail in Letters Patent No. 1,752,843 to Paul R. Hahneman, dated April 1, 1930. A portion of such clutch mechanism is shown herein, partially schematically, to show the relationship between clutch operation and the operation of the novel control mechanism which forms the principal subject matter of the present invention.

Referring particularly to Figs. 1, 8 and 9, the clutch face **16** which has previously been stated as provided as a part of the flywheel hub **17** is formed with at least one but usually a plurality of recesses **18** engageable by a clutch pin **19** carried by and for rotation with the drive shaft **12**. The clutch pin **19** is slidable axially of the drive shaft in a slot formed in the inner periphery of a collar **20** which is rigidly secured to the drive shaft. A coil spring **21** is disposed in an opening formed in the clutch pin **19** and bears against an abutment **22** which forms an end wall of the axially extending slot in the collar **20**. In this manner the clutch pin is constantly biased toward a position of engagement with a recess **18** of the clutch face **16**. A transverse notch in the clutch pin **19** provides, in effect, a projecting shoulder **23** at the rear end of the clutch pin and cam means are provided for engaging such shoulder for positively withdrawing the clutch pin from engagement with a recess **18** of the clutch face **16** and for holding the clutch pin in a position of disengagement. Such cam means may comprise a clutch throw-out block **24** mounted for sliding movement toward and away from the clutch pin **19**, as for instance by means of a guide housing **25** secured to the machine frame. The throw-out block is provided with a flange **26** at a point adjacent the notch in the clutch pin **19** and such flange is tapered as at **27** to provide a cam surface for withdrawing the clutch pin from engagement with the clutch face **16**.

When the machine is at rest the clutch pin and the flange **26** of the clutch throw-out block **24** occupy the relative positions shown schematically in Fig. 9, with the clutch pin **19** disengaged from the clutch face **16** and moved substantially therefrom to eliminate the danger of clicking of the clutch pin against the clutch face during periods of disengagement. It will be noted that the flange **26** is disposed within the transverse notch in the clutch pin and has a face bearing against the projecting shoulder **23** of the clutch pin to positively hold the clutch pin in declutched position against the resistance of the clutch pin spring **21**. The throw-out block **24** is normally yieldably maintained in the position shown in Fig. 9, and also in Fig. 1, by means of a compression coil spring **30**, a portion of which may be disposed in an opening in the throw-out block **24**, its opposite end bearing against the bottom of the opening in the guide housing **25**.

A pin **31** is secured in the throw-out block **24** and extends through a slot in the guide housing **25**. The outer end of the pin **31** may be provided with a depending manually engageable operating rod **32**. Manual downward movement of the rod **32** withdraws the flange **26** from its clutch pin retaining position against the resistance of the coil spring **30**, whereupon the clutch pin spring **21** projects the clutch pin against the clutch face **16**. Since the flywheel **15** is constantly rotating the clutch pin **19** will be projected into the next succeeding recess **18** in the clutch face whereupon joint positive rotation of the drive shaft **12** with the flywheel **15** ensues.

In normal operation it is desired to initiate a single complete rotation of the drive shaft **12** so that a single downward and upward cycle of movement of the reciprocating slide is produced. To this end the operating rod **32** is normally released by the operator immediately after he has moved it downwardly to withdraw the throw-out block **24**. Such release projects the throw-out block toward the clutch pin **19** or rather toward the position which the clutch pin approaches as

the end of a single rotation of the drive shaft 12 is approached. The relative position of the parts during this phase of the cycle of operation is shown in Fig. 8 where it will be noted the clutch pin 19 is moving toward the flange 26 of the clutch throw-out block and consequently the projecting shoulder 23 of the clutch pin 19 is coming into contact with the tapered face 27 of the flange 26. Further rotative movement of the clutch pin 19 causes withdrawal of the clutch pin 19 from the recess 18 in the clutch face 16 by cooperation between the tapered face 27 of the flange 26 and the projecting shoulder 23 until complete withdrawal of the clutch pin 19 is effected.

It will be observed that with the construction so far described the removal of the driving force from the drive shaft 12 does not necessarily mean that the drive shaft, the reciprocating slide, and their associated parts will immediately stop moving, since their mass and momentum are considerable and the force of inertia may carry those parts a substantial distance beyond the actual point of clutch disengagement. This is obviously undesirable and the actual distance which the parts will carry past the point of clutch disengagement varies widely under different operating conditions so that it cannot be satisfactorily allowed for in timing the clutch disengaging means. It is to eliminate these obvious disadvantages that the structure which is now to be described was devised by me and while the instrumentalities described up to this point in the description of the drawings are in a general sense conventional, the elements which are added as a result of my new control mechanism enter into patentable combination with the conventional portion of the press structure to the end that a new and patentable combination of the entire machine is produced.

The control mechanism of the present invention may conveniently be associated with an end of the drive shaft 12 and for the accomplishment of this purpose the drive shaft 12 has, in the illustrated embodiment, been slotted at its left end to receive the flattened end of a stub shaft 34. A casing 35 for the control mechanism may be secured against machine frame element 10 as by means of screws 36 and this casing has a depending portion 37 which is provided with a vertical bore for receiving and guiding axial movement of a piston element 38, all as best shown in Fig. 2.

A cam 39 is secured to the stub shaft 34 by means of a collar 40 and a machine screw 41, the cam being fixed for rotation with the drive shaft 12 as by means of a key or the like. It will be noted that the stub shaft 34 is provided with a flange 42 which cooperates with the collar 40 to prevent axial movement of the stub shaft when assembled. A cam follower or roller 43 is journaled at its opposite ends in bearings provided at the upper end of the piston element 38 so that vertical movement of the cam follower 43 by the cam element 39 is translated directly into corresponding vertical movement of the piston element. To facilitate assembly, the outer face of the casing 35 is provided with an opening and a removable cover member 44 therefor.

It will be noted that the entire control mechanism, comprising the casing 35 and the parts assembled therein, may be removed from the machine proper as a unit by mere removal of the screws 36.

Below the bore for the piston element 38 the casing 35 is provided with a hydraulic chamber 46 which is provided at its lower end with a ball check 47 which permits free fluid movement into the chamber 46 through a port 48 but prevents fluid egress through such port. For convenience of manufacture the casing 35, in the illustrated embodiment, is shown open at its bottom end, with screw threads for receiving the correspondingly threaded upper end of a casing 50 which comprises a reserve liquid supply. To insure adequate liquid supply at the check valve 47 at all times, the casing 50 extends rearwardly and upwardly as shown in Fig. 5, whereby the normal liquid level in the reserve casing 50 may always be above the level of the check valve 47. The cover member 51 of the rearward and upward extension of the casing 50 may be provided with an atmospheric vent 52 to permit free liquid flow from the reserve casing through the port 48 when the valve 47 is unseated. The reserve casing 50 may be drained when desired by removing the screw threaded bottom cap 54.

The screw threaded upper portion of the reserve casing 50 is formed to provide a tapered seat for the ball check valve 47 and is further provided with a retaining element 55 which permits limited raising of the ball check valve upon upward movement of the piston element 38 tending to expand the volume of the hydraulic chamber 46. Such upper portion of the casing 50 is also preferably formed to provide an annular ridge 57 which locates and provides a seat for the lower end of a compression coil spring 58 whose upper end is disposed in an axially extending recess 59 formed in the lower end of the piston element 38. The spring 58 is normally under a substantial degree of compression whereby the piston element is always urged toward its upper limit of movement and the cam roller 43 is consequently held in constant engagement with the periphery of the cam element 39. From the foregoing it will be clear that upward movement of piston element 38, resulting from the cam roller 43 engaging across a receding portion of the contour of the cam element 39, results in free liquid ingress to the then expanding hydraulic chamber 46 through the port 48 and around the then unseated ball check valve 47.

In the form illustrated in the preferred embodiment the axial opening 59 in the piston element 38 terminates in a reduced portion 60 which receives the stem of a valve element 61. The valve 61 is normally seated against a valve seat disposed at the point where the restricted opening 60 emerges at the top of the piston element 38. For holding the valve element 61 in seated postion the depending stem thereof has secured to it a sleeve whose lower end is flanged outwardly to provide a seat for the lower end of a compression coil spring 64. The upper end of the spring 64 abuts against the upper wall of the axial opening 59 of the piston element.

Downward movement of the piston element 38 engendered by action of a rising portion of the cam contour against the cam roller 43 is resisted by the entrapped liquid in the hydraulic chamber 46. Such resistance may be overcome, however, by a cam force sufficient to unseat the valve element 61 against the resistance of the valve spring 64, whereupon the hydraulic fluid passes upwardly through the restricted port 60. In the preferred embodiment lubricating oil is selected as the hydraulic medium and it will be seen that successive discharges of the lubricating oil through the passage 60 results in frequent

and complete lubrication of the cam roller **43**, the cam element **39** and the piston element **38**.

Spent liquid which is discharged into the upper portion of the casing **35** drains back through a downwardly extending passage **66** formed in the casing **35**. For convenience of manufacture the upper portion of the reserve casing **50** is provided with the semi-circular groove **68** which is disposed adjacent the lower terminal portion of the downwardly extending passage **66** and is provided with a passage **70** extending into the reserve casing **50**. With this construction the downwardly extending passage **66** and the passage **70** need not be in circumferential alignment to provide free return flow of the hydraulic medium from the upper portion of the casing **35** back into the reserve casing **50**.

The profile of the cam element **39** in a preferred form is shown in Fig. 6. In that figure the cam is illustrated in the position which it occupies during periods of rest between operating cycles of the machine. It will be noted that the cam roller or follower **43** is engaged in a substantial depression in the periphery of the cam element and in such position serves as a resilient detent. When the clutch is engaged by manual operation of the operating bar **32** clockwise rotation of the cam element **39**, as viewed in Fig. 6, forces the follower element **43** downwardly out of the depression in the cam profile and results in a forcible expression of the liquid medium from the hydraulic chamber **46** through the port **60** and past the then unseated valve **61**. It will be noted that this downward movement of the cam follower **43** and the piston element **38** by which it is carried is accomplished against the joint resistance of the valve spring **64** and the compression coil spring **58** which normally urges the piston element **38** and the cam follower **43** to an upper position, as well as the resistance to fluid flow through the restricted aperture **60**.

As the end of a cycle of operation of the machine is approached, that is a single revolution of the drive shaft **12**, the clutch elements and the cam element **39** reach approximately the positions shown in Figs. 8 and 7, respectively. At the time when the cam portion **27** of the clutch release mechanism actually begins to withdraw the clutch pin **19** from clutching engagement, the cam follower **43** reaches the beginning of the incline leading into the depression detent formed in the cam profile. With the compression coil spring **58** exerting a very substantial upward urge against the piston element **38** and the cam follower **43**, these parts actually exert a driving force against the cam through cooperation with the inclined plane comprising the entrance to the depressed portion of the cam profile, to the end that driving of the machine is taken over by such elements and the normal driving pressure between the clutch pin and its associated recess **18** in the clutch face **16** is relieved and these parts may be disengaged without the frictional wear incident to their release under driving pressure. Further, the driving effect of the action of the piston and cam follower elements against the cam during this phase of the cycle of movement of the machine results in the forcible moving of the drive shaft **12** and associated parts to a position where the clutch pin is not merely just removed from engagement with the clutch face **16** but wherein there is a substantial space between the end of the clutch pin **19** and the clutch face **16**. This overtravel, so to speak, prevents any possible contact between the end of the clutch pin and the clutch face **16** during idle periods when the clutch face **16** is rotating while the clutch pin **19** is relatively stationary.

As the cam follower **43** is moving into the depression in the cam profile and the piston element **38** is moving upwardly the hydraulic medium is being drawn into the hydraulic chamber **46** through the open check valve **47**. At the instant when the cam follower **43** reaches the lowest part of the depression in the cam profile and tends to climb out of such depressed portion, by virtue of the tendency of the force of inertia to continue rotation of the drive shaft **12** and the cam **39**, the movement of the piston element **38** in the portion **37** of the casing **35** tends to reverse, that is, it tends to move downwardly. This results in immediate closure of the check valve **47** and an instantaneous hydraulic lock which would be overcome only by continued movement of the cam element **39** and the drive shaft **12**, which continued movement would increase the pressure to such extent that the valve **61** would be forced away from its seat and thereby permit escape of the hydraulic medium through the restricted port **60**. Such movement through the resctricted orifice is actually effected at the beginning of the working cycle but the momentary resistance which the restriction imposes to further movement of the parts at the end of an operating cycle when the positive drive to the drive shaft **12** is disengaged and only the force of inertia is present results in immediate and accurate stoppage of all of the associated parts with the cam follower in the bottom of the depression in the cam contour.

As specifically described herein, egress of the hydraulic medium through the restricted port **60** can be accomplished only by unseating the normally closed valve **61** but satisfactory operation of the device may be attained by eliminating the spring-biased valve **61** and depending merely on the resistance to liquid flow of a fixed orifice of predetermined restricted effective area. It is to be understood that the positive driving force imparted to the machine when the clutch thereof is in engagement is such that expression of the hydraulic medium from the hydraulic chamber **46** is readily effected when necessary, even though such expression of liquid is sufficiently restricted to prevent idle movement of the machine parts under their own inertia and against such resistance.

While it is not an essential part of the invention, considering the latter in its broader phases, certain advantages of operation are achieved by providing means for counteracting the effect of gravity as it tends to bias the slide and associated parts to a lowered position. To this end the cam element **39** may be so curved and formed as to substantially and continuously load the compression coil spring **58** throughout the major portion of the downward half of the reciprocation of the slide and then to unload the spring throughout the major portion of the upward half of the reciprocation. Such loading and unloading is, of course, over and above the initial spring load provided for the purposes previously set forth.

It is to be understood that, while a single complete and specific example of a machine embodying the principles of my invention is set forth in the foregoing description and illustrated in the drawings, I do not consider my invention as lim-

ited thereto or otherwise than as defined in the appended claims.

It is to be understood that the term "slide" is used in a general sense as designating any form of reciprocating crosshead, ram or similar corresponding element in machines of the class under consideration. The foregoing statement has particular reference to the ensuing claims.

What is claimed is:

1. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, control mechanism comprising a cam element, a follower element therefor, and yieldable means for maintaining engagement therebetween, one of said elements being movable in response to movement of said slide, a depression in said cam and engageable by said follower to yieldably retain the slide in a predetermined position of rest at the end of a return stroke, said cam and follower elements cooperating to load said yieldable means at the beginning of a cycle of movement by movement of said follower out of said depression and to partially unload said yieldable means at the conclusion of a cycle of movement by movement of said follower into said depression, and hydraulic means arranged to resist movement of said follower from said depression.

2. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, control mechanism comprising a cam element, a follower element therefor, and yieldable means for maintaining engagement therebetween, one of said elements being movable in response to movement of said slide, a depression in said cam and engageable by said follower to yieldably retain the slide in a predetermined position of rest at the end of a return stroke, said cam and follower elements cooperating to load said yieldable means at the beginning of a cycle of movement by movement of said follower out of said depression and to partially unload said yieldable means at the conclusion of a cycle of movement by movement of said follower into said depression, a hydraulic chamber and a member movable therein to vary the effective volume of said chamber, said member being movable responsive to loading and unloading movements of said yieldable means, means providing restricted egress of liquid from said chamber upon movement of said member to reduce said chamber in response to loading movement of said yieldable means, whereby movement of said follower from said depression is momentarily prevented by virtue of said restricted egress of liquid.

3. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, control mechanism comprising a hydraulic chamber and a member movable therein to enlarge the size of said chamber during return strokes, means providing free ingress of liquid to said chamber during such enlargement, said member being movable successively to tend to reduce the size of said chamber upon the completion of a return stroke, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of a return stroke is momentarily resisted and causes said slide to stop at its predetermined position of rest at the conclusion of a working cycle.

4. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, control mechanism comprising a cam element, a follower element therefor, and yieldable means for maintaining engagement therebetween one of said elements being movable with said slide, a depression in said cam and engageable by said follower, hydraulic means comprising a member, a hydraulic chamber and a member displaceable therein and responsive to relative movement between said cam and said follower, said member being movable to enlarge the size of said chamber during return strokes, means providing free ingress of liquid to said chamber during such enlargement, said member being movable successively to tend to reduce the size of said chamber upon the conclusion of a return stroke, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of a return stroke is momentarily resisted and causes said slide to stop at its predetermined position of rest between working cycles, the engagement of the cam follower element with said cam depression coinciding with said momentary hydraulic resistance whereby the reciprocating member is yieldingly held in its predetermined position of rest until another cycle of movement is initiated.

5. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, a drive shaft for said reciprocable slide and single-revolution clutch means associated with said drive shaft, a cam disposed upon said drive shaft and having a depressed portion in its contour, a follower element for said cam, a hydraulic chamber, a piston element in said chamber and connected for movement with said follower element, valve means providing free liquid ingress to said chamber and restricted liquid egress, movement of said cam follower into said depressed portion being arranged to expand said chamber and movement of said cam follower from said depressed portion being arranged to contract said chamber, said cam being timed to present its depressed contour portion to the follower element at the conclusion of a cycle of revolution whereby the chamber is freely expanded by movement of the follower into said depressed portion but movement of said follower from said depressed portion is impeded by virtue of said restricted egress sufficiently to dissipate the forward inertia of the drive shaft, the reciprocable slide, and associated parts.

6. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, a cam element having a depressed portion in its contour and a follower element therefor, one of said elements being movable responsive to reciprocation of said slide, a hydraulic chamber, a piston element in said chamber and connected for movement with movement of said follower element by said cam element, valve means providing free liquid ingress to said chamber and restricted liquid egress therefrom, movement of said cam follower into said depressed portion being arranged to expand said chamber and movement of said cam follower from said depressed portion being arranged to contract said chamber, said cam being arranged to present its depressed contour portion to the follower element at the conclusion of a cycle of reciprocation of said slide whereby the chamber is freely expanded by movement of said follower into said depressed portion but movement of said follower

from said depressed portion is impeded by virtue of said restricted egress sufficiently to dissipate the forward inertia of the reciprocable slide and associated parts.

7. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes, control mechanism comprising a cam element, a follower element therefor, and yieldable means for maintaining engagement therebetween, one of said elements being movable with said slide, a depression in said cam and engageable by said follower to yieldably retain the slide in a predetermined position of rest, hydraulic means comprising a chamber and a member displaceable therein and responsive to movements of said cam follower by said cam, said hydraulic means being arranged to temporarily resist movement of said follower from a position of engagement with said depression, and relief means associated with said hydraulic means for permitting subsequent movement of said follower from engagement with said depression.

8. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, control mechanism comprising a hydraulic chamber and a member movable therein to enlarge the size of said chamber during return strokes, means providing free ingress of liquid to said chamber during such enlargement, said member being movable successively to tend to reduce the size of said chamber upon the completion of return strokes, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of a return stroke is momentarily resisted and causes said slide to stop at its predetermined position of rest between working cycles.

9. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a hydraulic chamber and a member movable therein to enlarge the size of said chamber during return strokes, means providing free ingress of liquid to said chamber during such enlargement, said member being movable successively to tend to reduce the size of said chamber upon the completion of return strokes, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of return strokes is momentarily resisted and causes said slide to stop at its predetermined position of rest after disengagement of said clutch means.

10. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a hydraulic cylinder and a piston movable therein, valve means providing free movement of said piston in one direction in said cylinder and retarded movement in the opposite direction, said piston being connected for movement with said reciprocating slide whereby it is moved in said opposite direction at the very beginning of a work fabricating stroke and in the one direction at another portion of its cycle of reciprocation, whereby its retarded movement in said opposite direction serves to prevent the beginning of another cycle of movement after the clutch has been disengaged and under inertia of the moving parts.

11. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a hydraulic cylinder and a piston movable therein, valve means providing free movement of said piston in one direction in said cylinder and retarded movement in the opposite direction, a cam element arranged for movement with said reciprocable slide, and a cam follower element carried by said piston, the contour of said cam being such that reciprocation of said slide causes movement of said cam follower and said piston in the direction of retarded movement at the beginning of a cycle of reciprocation and in the direction of free movement at another period of the cycle of reciprocation, whereby such retardation serves to prevent the beginning of a succeeding cycle of movement under inertia of the moving parts after the clutch has been disengaged.

12. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a hydraulic cylinder and a piston movable therein, means providing retarded movement of said piston in one direction in said cylinder, a cam element arranged for movement with said reciprocable slide, and a cam follower carried by said piston, the contour of the cam being such that reciprocation of said slide causes movement of said cam follower and said piston in the direction of retarded movement at the beginning of a cycle of reciprocation, whereby to prevent the beginning of a succeeding cycle of movement under the inertia of the moving parts after the clutch has been disengaged.

13. In a metal fabricating machine having a substantially vertically reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a cam element, a follower element therefor, and resilient means for maintaining engagement therebetween, one of said elements being movable with said slide, a depression in said cam and engageable by said follower to resiliently retain the slide in a predetermined position of rest between successive return and operating strokes, said cam being formed to substantially increase the load on said resilient means during the major portion of the downward stroke of said slide and successively relieve such increased load during the major portion of the upward stroke of said slide, whereby to counterbalance the force of gravity biasing the slide toward a downward position, and hydraulic means arranged to resist movement of said follower from said depression.

14. In a metal fabricating machine having a substantially vertically reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of

a cycle of reciprocation, control mechanism comprising a cam element, a follower element therefor, and resilient means for maintaining engagement therebetween, one of said elements being movable with said slide, a depression in said cam and engageable by said follower to resiliently retain the slide in a predetermined position of rest between successive return and operating strokes, said cam being formed to substantially increase the load on said resilient means during the major portion of the downward stroke of said slide and successively relieve such increased load during the major portion of the upward stroke of said slide, whereby to counterbalance the force of gravity tending to bias the slide toward a downward position, and hydraulic means comprising a chamber and a member displaceable therein and responsive to movements of said cam follower by said cam, said hydraulic means being arranged to temporarily resist movement of said follower from a position of engagement with said depression, and relief means associated with said hydraulic means for permitting subsequent movement of said follower from engagement with said depression.

15. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a cam element, a follower element therefor, and resilient means for maintaining engagement therebetween, one of said elements being movable with said slide, a depression in said cam and engageable by said follower to resiliently retain the slide in a predetermined position of rest between successive return and operating strokes, movement of said cam into said depression under the impetus of the resilient means imparting to the slide independent forward driving movement, such entrance being timed to coincide with automatic clutch disengagement whereby such disengagement may be freely effected, and hydraulic means arranged to resist movement of said follower from said depression.

16. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a cam element and a follower element therefor, one of said elements being movable with said slide, and hydraulic means comprising a chamber and a member movable therein to enlarge the size of said chamber during return strokes under control of said cam and follower elements, said member being movable successively to tend to reduce the size of said chamber upon the completion of return strokes, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of return strokes is momentarily resisted and causes said slide to stop at its predetermined position of rest after disengagement of said clutch means, said liquid egress means being so directed as to discharge liquid from said chamber against the cam element and follower whereby these parts are lubricated by using a lubricating liquid as the hydraulic medium.

17. In a metal fabricating machine having a reciprocable slide for effecting work fabricating strokes and alternate return strokes, drive means for said slide and a clutch adapted automatically to disconnect said slide and said drive means at the conclusion of a cycle of reciprocation, control mechanism comprising a cam element and a follower element therefor, one of said elements being movable with said slide, and hydraulic means comprising a chamber and a member movable therein to enlarge the size of said chamber during return strokes under control of said cam and follower elements, said member being movable successively to tend to reduce the size of said chamber upon the completion of return strokes, said chamber having means providing limited liquid egress whereby movement of said member to reduce said chamber at the conclusion of return strokes is momentarily resisted and causes said slide to stop at its predetermined position of rest after disengagement of said clutch means, said liquid egress means being so directed as to discharge liquid from said chamber into the upper portion of said control mechanism whereby the working parts thereof are lubricated by using a lubricating liquid as the hydraulic medium.

18. Control mechanism for machines of the type having a reciprocable slide for effecting working strokes, drive means therefor, and a clutch adapted automatically to disconnect the slide and the drive means at the conclusion of a cycle of reciprocation, said control mechanism comprising a hydraulic cylinder and a piston movable therein, means providing retarded movement of said piston in one direction in said cylinder, a cam element arranged for movement with said reciprocable slide, and a cam follower carrier by said piston, the contour of the cam being such that reciprocation of said slide causes movement of said cam follower and said piston in the direction of retarded movement at the beginning of a cycle of reciprocation, whereby to prevent the beginning of a succeeding cycle of movement under the inertia of the moving parts after the clutch has been disengaged.

19. Control mechanism for machines of the type having a reciprocable slide for effecting working strokes, drive means therefor, and a clutch adapted automatically to disconnect the slide and the drive means at the conclusion of a cycle of reciprocation, said control mechanism comprising a cam element, a follower element therefor, and yieldable means for maintaining engagement therebetween, one of said elements being movable with said slide, a depression in said cam and engageable by said follower to yieldably retain the slide in a predetermined position of rest, hydraulic means comprising a chamber and a member displaceable therein and responsive to movements of said cam follower by said cam, said hydraulic means being arranged to temporarily resist movement of said follower from a position of engagement with said depression, and relief means associated with said hydraulic means for permitting subsequent movement of said follower from engagement with said depression.

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