Oct. 19, 1954 J. H. FRIEDMAN 2,691,907

FORGING PRESS WITH SEPARABLE ROLLS

Filed April 6, 1949 4 Sheets-Sheet 1

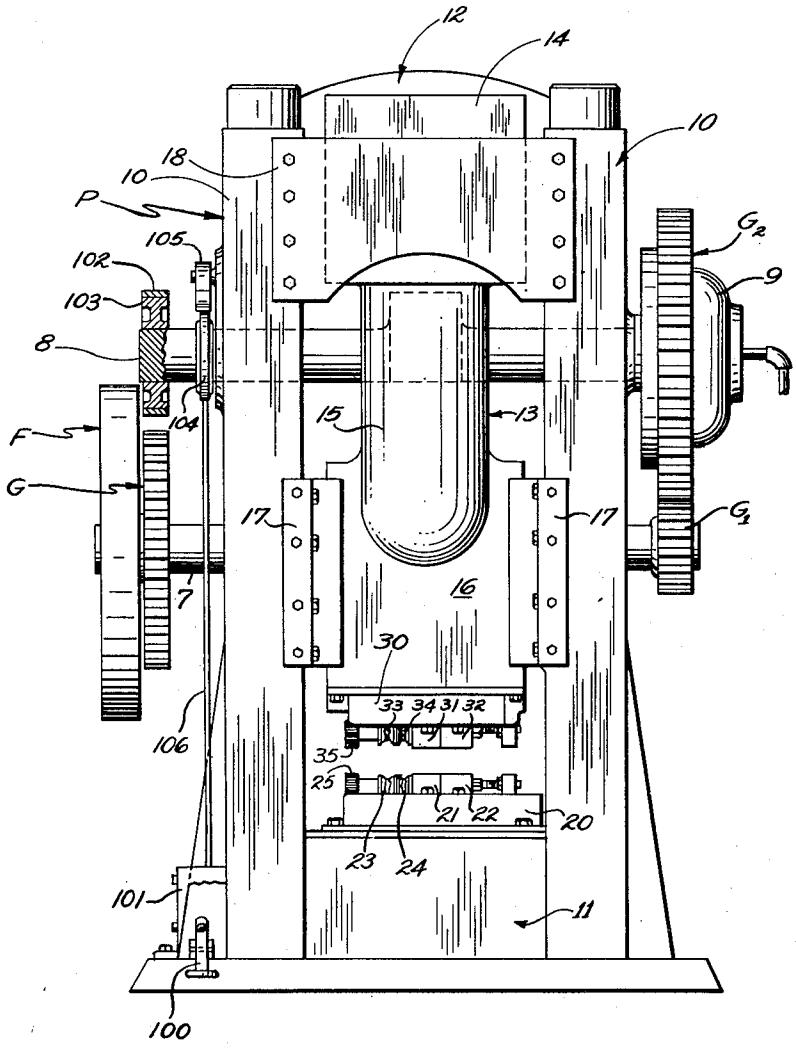



Fig. 1

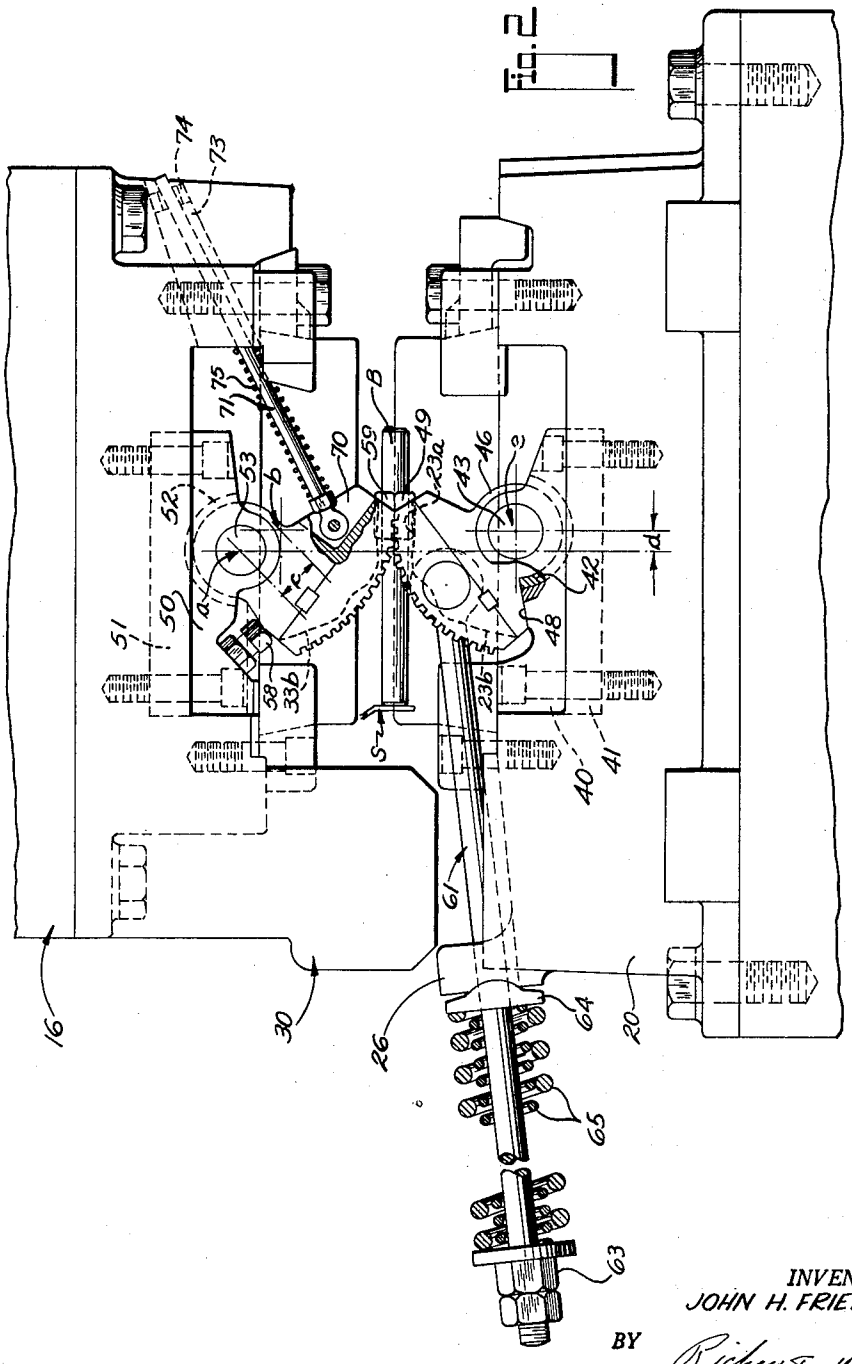
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Filed April 6, 1949 4 Sheets-Sheet 2

Fig. 2




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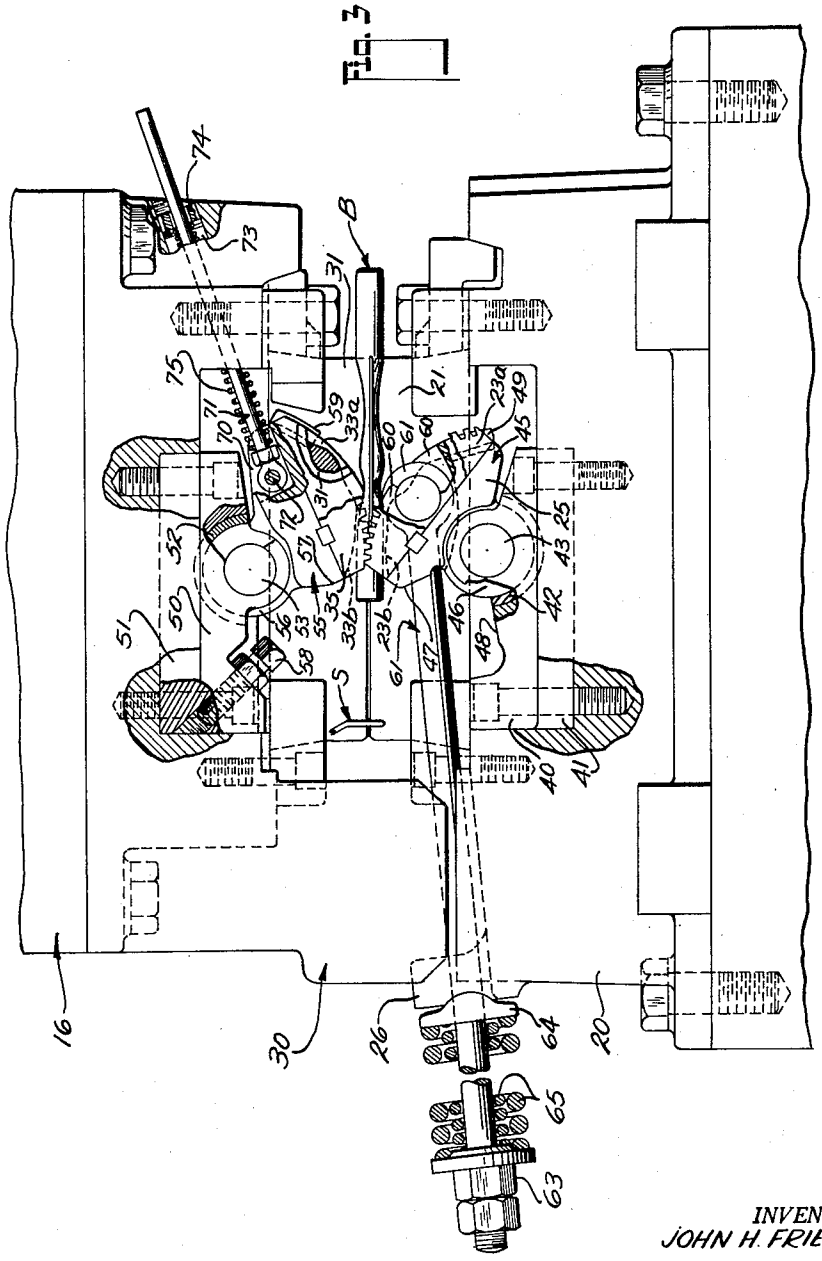
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FORGING PRESS WITH SEPARABLE ROLLS

Filed April 6, 1949 4 Sheets-Sheet 3

Fig. 3




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Oct. 19, 1954 J. H. FRIEDMAN 2,691,907

FORGING PRESS WITH SEPARABLE ROLLS

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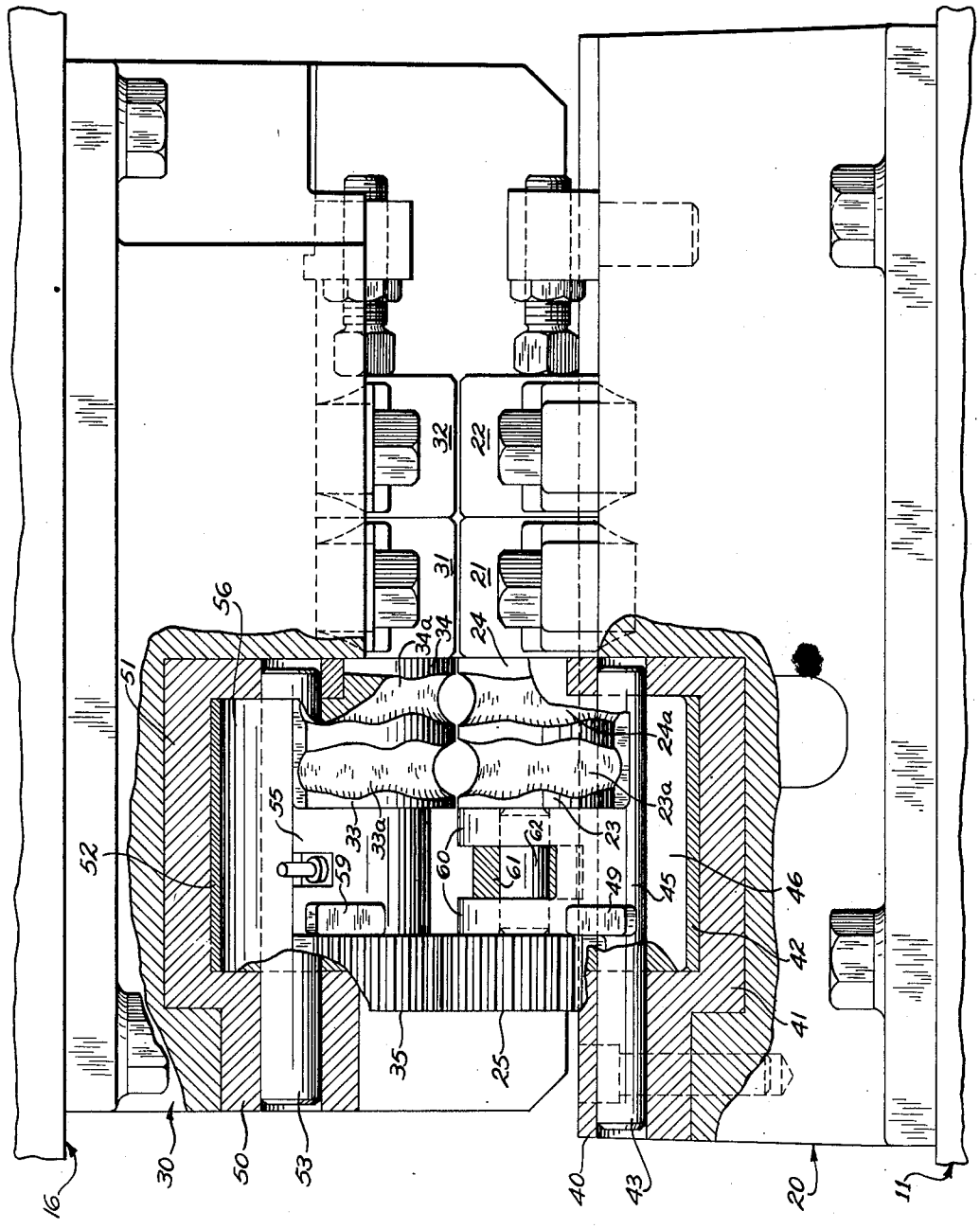



Fig. 4

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2,691,907

## FORGING PRESS WITH SEPARABLE ROLLS

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8 Claims. (Cl. 80—29)

1

This invention relates to machines for working metal and more particularly to forging machines or presses that combine rolling and pressing or forging operations.

This invention represents a modification of the forging apparatus disclosed and claimed generically in Serial No. 42,791 filed August 6, 1948, now abandoned.

As described in detail in the aforesaid application, in the use of a forging press to form an article having a varying cross-sectional area of metal from a blank of substantially uniform cross-section such as a length of bar or rod stock, it is necessary to throw out as flash between the dies the excess metal from the portions of smaller cross sectional area. Such flash not only causes excessive wear of the dies and waste of metal, but limits the type of article that may be formed by pressing, since excessive flash prevents proper forming of the article.

It is a feature of the present invention that forgings having portions of different cross-sectional area are produced directly from stock of substantially uniform cross section, with a minimum waste of metal and a minimum flash, and with a minimum number of working and heating operations on the blank. In addition, such forgings are formed in a single continuous operation with a minimum of labor and expense and without reheating or preliminary forming of the blank. Broadly speaking, these advantages are accomplished by a method and machine in which stock of a greater cross-sectional area than the smallest cross section of portions of the desired blank is reduced to form the said portions of smallest cross section by one or more rolling passes, and the stock is forged to form the portions of greater cross section by one or more blows with a forging machine or press die so as to produce the desired cross-sectional area and physical properties in each portion of the blank.

It is an object of this invention to accomplish the aforesaid advantages by providing one or more pairs of rolls on a forging press wherein the upper rolls are mounted upon and travel with the ram. In this manner the rolls are entirely opened before the rolling operation takes place which provides ample clearance and facilitates insertion of the blank in the rolls.

A further object of the invention resides in synchronizing the rolls even though the upper set moves with the ram, there being no connecting linkage between the rolls. Briefly, this is accomplished by mounting a pivoted roll upon both the upper and lower bolster plates. The

2

pivot axis of one roll is displaced from its geometric center and the rolls are arranged so that when they are brought together their point of contact is laterally displaced from a line joining the pivot axes. Thus, a turning torque is exerted on the roll with the displaced pivot and since the rolls are geared together both turn in synchronism.

A further object resides in relieving the initial stress on the gears as the rolling operation is initiated. In a preferred form I accomplish this by placing starting blocks on the upper and lower rollers which engage one another as the gears mesh but which assist in causing the initial rotation to begin and so relieve the gears of the heavy load which they otherwise would have to bear.

A further object resides in insuring that the gears that drive the rollers will always come into proper mesh. This is accomplished by provision of means to independently adjust the position of one of the rolls relative to the other.

Other objects and advantages will be apparent as the following detailed description of a preferred embodiment of my invention proceeds.

In the drawings:

Fig. 1 is an external view of a press embodying the invention;

Fig. 2 is a partial side elevation showing the parts as the rolling operation is about to begin;

Fig. 3 is the same view showing the completion of the first rolling pass; and

Fig. 4 is a partially sectioned front elevation illustrating the construction details of the roller assembly.

The salient features of a press embodying the invention appear in Figs. 1 and 2 and such a press is described in the patent to Clouse, No. 2,017,784, October 15, 1935. Basically, the press P includes a rigid open framework 10, joined at the bottom by base structure 11 and at the top by a crown member 12. A ram or slide 13 is mounted for vertical reciprocation in the press frame and has an upper guiding member 14, an intermediate connecting member 15 and a lower guide member 16. Lower guide bearing assembly 17 and upper guide bearing assembly 18 constrain the ram in its path of travel. The ram 13 is reciprocated by means of a connecting rod pivoted thereto and journalled on a crank or eccentric shaft 8. As shown in the aforesaid patent to Clouse and in the aforesaid copending application, the drive mechanism includes the usual motor and pinion assembly (not shown) that drives gear G which, in turn, drives pinion gear

$G_1$ by means of a frame supported shaft connected thereto. Large gear $G_2$ is journalled on the crank shaft 8 and is driven by gear $G_1$. In the arrangement shown, a fly wheel F is fixed to the countershaft 7 and and a clutch 9 is arranged to connect the gear $G_2$ to the crank shaft 8. In the preferred form a one-revolution clutch and a brake for the crank shaft may be incorporated in the drive so that although the motor runs continuously the eccentric shaft 8 makes but one revolution at a time. Such a clutch is described in the patent to Clouse, No. 2,241,241, May 6, 1941. Control means are provided which cause engagement of the clutch whereupon the eccentric shaft 8 makes one revolution and the clutch automatically disengages, a brake being employed to prevent overtravel. During the single revolution of the eccentric shaft the ram makes one stroke, that is, it descends from its upper position, closes the dies, and returns to its upper position.

Details of the clutch and brake form no part of the invention, typical units and their control being clearly disclosed in the patent to Frost, 2,389,425, and in the aforesaid copending application. The operation of the device and the functioning of the controls is such that when treadle 100 is depressed by the operator connections in switch box 101 are made and fluid motors under control of electrical solenoids cause engagement of clutch 9 to couple gear $G_2$ to the crank shaft. Simultaneously brake band 102 is released from its drum 103. After shaft 8 has made one revolution, cam 104 on the crank shaft operates contacts in switch box 101 by means of follower 105 and push rod 106, which contacts setup circuits that cause disengagement of the clutch and engagement of the brake to prevent over-travel of the ram.

The lower die and roller mechanism is mounted on the lower bolster plate 20 that includes one or more dies 21 and 22, and one or more integral rolls 23, 24 and the synchronizing gear 25 for the rolls. The upper bolster plate 30 mounts one or more dies 31, 32, one or more integral rolls 33, 34 and the upper gear 35 for the rolls.

Figs. 3 and 4 illustrate constructional details of the roll mounting and operating mechanism. It is understood that the design details have been simplified for clarity of illustration only the basic elements necessary to accomplish the principles of the invention being shown and engineering refinements omitted. The rolls are mounted to one side of the dies. The lower rolls 23, 24 are mounted on a trunnion block 40 which has an extension 41 received within a suitable socket or relieved portion in the lower bolster plate 20. A bushing 42 may be provided to assist the trunnion shaft in taking the rod in operation. Roll supporting block 45 has a trunnion member 46 which pivots about the pin 43 and engages the aforesaid bushing 42 at its periphery. A stop face 47 is formed on the roll block for engaging stop face 48 formed on the trunnion block 40. The lower gear 25 is mounted in a recessed portion of the block 45 and the rolls 23 and 24 are either integrally mounted on the block 45 or detachably mounted thereon in accordance with standard practice. The upper trunnion support block 50 has an extension 51 fitting in the upper bolster plate 30. As with the lower construction, there is an outer bushing 52 engaged by surface 56 of the upper roll block. Pivot pin 53 mounts the upper roll block 55 in block 50. A stop face 57 is formed on the roll block for engagement with an adjustable stop screw 58 fixed to the trunnion support block 50. It can be seen that with the lower stop faces 47 and 48 in engagement, adjustment of screw 58 causes rotation of the upper roll block 55 relative to the lower one so that mesh of the roll gears may be assured.

It is noted in Fig. 2 that the pivot axis *a* of the upper roll is displaced from the geometric center *b* of its roll surface by a distance *c*. It is also noted that a line passing through the center of rotation *e* of the lower roll, the point of contact of the rolls, and the geometric center *b* of the upper roll, is displaced from the pivot axis *a* of the upper roll by a distance *d*. With this arrangement, when the rolls are brought together, due to the lever arm *d* a turning torque is exerted on the upper roll causing it to rotate. Due to the pressure that the rolls exert on the blank and due to the meshing of the two gears, both rolls turn together and roll and elongate the blank.

As seen in Fig. 2, a pair of starting blocks 49 and 59 are mounted on the lower and upper rod blocks, respectively. As the ram descends and the gears 25 and 35 engage, the faces of these blocks may engage and relieve the gears of a large percentage of the load which they would otherwise have to withstand in initiating the rolling action.

In order to cause the rolls to return to their initial position illustrated in Fig. 2, a pair of spring return devices is employed. A lower roll block 45 is formed with a pair of cheeks 60 and a return rod 61 mounted in the block by means of pins 62. The other end of rod 61 is provided with a spring assembly which urges it to the left to Figs. 2 and 3 to return the lower roll against its stop. This assembly includes a rocker washer 64 pivotally mounted against an abutment plate 26 in the lower bolster 20. Adjustable means 63 is provided for one or more springs 65 which urge the roller to its initial position as described. A similar return mechanism, but of lighter construction, is employed for the upper roller. This includes a return rod 71 mounted on a pin 72, there being a recess 70 in the upper roll block 55 to receive the end of the rod. The rod extends through an abutment 73 in the upper bolster plate 30 which is closed by a threaded stop member 74. A compression spring 75 urges the upper roller against the stops when the dies are operated by upward motion of the ram.

In operation, before the ram descends to the roll operating position a heated blank B is passed to the machine operator who lays it in the lower groove 23*a* of the first roll and backs it up against a stop S. The control treadle is tripped and as the ram descends, and with adjusting bolt 58 properly set, the gears 25 and 35 mesh and starting block 59 usually engages block 49, depending upon the blank diameter. Due to the lever arm *d* caused by the offsetting of the axes of the upper roller, further descent of the ram causes the rollers to turn about their axes and impart the desired configuration of the heated blank. Since the appreciable work is performed upon the blank by the rollers and since the area of the blank in contact with the rollers at a given time is relatively slight, very little, if any, heat is lost during the rolling process. At the completion of the downward stroke of the ram the blank extends toward the operator as shown in Fig. 3.

Suitable pockets or relief portions 23*b* and 33*b* are provided in the roll impression surfaces so that the operator may remove the blank with his tongs from the rolls as soon as the rolling action is completed. Then, according to the nature

of the operation being performed, the operator may either transfer the blank to the second set of roll impressions for a second pass through the rolls or he may transfer the blank to the first die for the initial forging operation. Upon retraction of the ram the roll return springs return their respective rolls to their starting position and when the ram automatically stops in its upper position due to the clutch and brake action described, the rolls have likewise automatically returned to a position wherein they are ready to receive another blank when one is placed between them by the operator.

It is customary in designing forging machines of the nature of that disclosed to depend upon the dies themselves to reduce sections of the blank. Although such dies are satisfactorily employed for this work, the section reduction is accomplished largely by the extrusion of flash between the dies. This not only wastes material, but causes a very rapid wear on the die corners past which the flash is extruded. On the other hand, with applicant's forging machine an initial reduction of section is performed at the rolls without a loss of heat and without the formation of an appreciable amount of flash. This relieves dies of a good deal of the work which they would otherwise have to perform to produce a given blank and effects a saving in blank metal, as well as greatly increasing the life of the dies.

The construction wherein the upper rolls are mounted on the ram so that they separate when the ram is retracted is not only a simple one, but has the advantage of facilitating insertion of the blank between the rolls. Of course, it is not absolutely necessary to provide the synchronizing gears because pressure of the rolls against the blank tend to cause them to turn and roll the blank as the ram descends. However, a more uniform blank is obtained by synchronizing the rolls positively with the gears. Although the starting blocks **49** and **59** play an important role in relieving the gears of a share of the load during the initiating of the rolling operation, they too could be dispensed with without affecting the basic principle of the invention. Nevertheless they represent an important element in the construction of the machine.

It will be noted that the oscillating motion imparted to the rolls by the ram and the spring results in twice rolling the blank in the same die and that the second rolling operation is in a direction opposite to the first. In addition to the improvement in the blank accomplished by this second rolling operation in a reverse direction the blank is supported in the press at the conclusion of each cycle so that the transfer of the blank to the next adjacent roll or from a roll to a die is a lateral motion only. Accordingly, the operator is not required to move the blank in the direction of its length intermediate the series of rolls and dies that effect the working of the blank. All such axial blank movement between the roll stations and between the last roll and the first die is accomplished by the press and therefore at a rate that minimizes the transfer time. The saving in transfer time is of course reflected in the conservation of the heat in the blank.

Since the pivotal axis of the upper roll is eccentric of its geometric axis and the pivotal axis of the lower roll is concentric with its geometric axis, the geometric axis of the upper roll moves away from the geometric axis of the lower roll when the ram moves down to effect a rolling operation on the blank. Thus it will be understood that while the pivot axis of the upper roll is approaching the pivotal axis of the lower roll the geometric axis of the upper roll is receding with respect to the geometric axis of the lower roll.

Having completed a detailed description of a preferred embodiment of my invention, I contemplate that variations may be made therein by those skilled in the art without departing from the spirit of the invention and accordingly I contemplate that the appended claims rather than the aforesaid embodiment be determinative of the scope of my invention.

What is claimed is:

1. Metal working apparatus comprising a pair of opposed relatively movable supports, a roll die pivotally mounted on each support, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pivot axes in a direction transverse to the relative motion of the supports, whereby after said rolls engage the blank they are self actuated by further approach of their supports.

2. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, means associated with one of said rolls for engaging means associated with the other of said rolls as the supports approach one another, the center of pressure of said engagement being displaced from a line joining the roll pivot axes in a direction transverse to the relative motion of the die supports, whereby said rolls are self actuated by further approach of their supports.

3. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, the geometric center of one of said rolls being displaced from its pivot axis, means associated with each roll that engage as the rolls approach, the center of pressure of said engagement being displaced from a line joining the roll pivot axes in a direction transverse to the relative motion of the die supports, whereby said rolls are self actuated by approach of their supports.

4. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pivot axes in a direction transverse to the relative motion of the die supports, whereby when said rolls engage a blank they are self actuated by further approach of their supports and a gear element associated with each roll which mesh and prevent slippage between the rolls.

5. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pivot axes in a direction transverse to the relative motion of the die supports, whereby when said rolls engage a blank they are self actuated by further approach of their supports and a gear element associated with each roll which mesh and prevent slippage between the rolls and block means associated with each roll that engage as said gear elements

mesh to initiate roll rotation and relieve the strain on the gear elements.

6. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pixot axes in a direction transverse to the relative motion of the die supports, whereby when said rolls engage a blank they are self actuated by further approach of their supports, stop means and spring return means to return said rolls to their control position when separated.

7. Forging apparatus including a pair of opposed relatively movable die supports, a roll die pivotally mounted on each die support, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pivot axes in a direction transverse to the relative motion of the die supports, whereby when said rolls engage a blank they are self actuated by further approach of their supports and a gear element associated with each roll which mesh and prevent slippage between the rolls, stop means and spring return means to



return said rolls to their control position when separated.

8. Metal working apparatus comprising a pair of opposed relatively movable supports, a roll die pivotally mounted on each support spring means biasing said rolls toward one position, the geometric center of one of said rolls being displaced from its pivot axis, the center of pressure of said rolls when engaging a blank being displaced from a line joining their pivot axes in a direction transverse to the relative motion of the supports, whereby the blank is moved axially in one direction as said movable supports approach each other and said blank is moved axially in an opposite direction as said movable supports move away from each other.

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