June 7, 1932. J. W. SHEPERDSON ET AL 1,861,555

CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 1

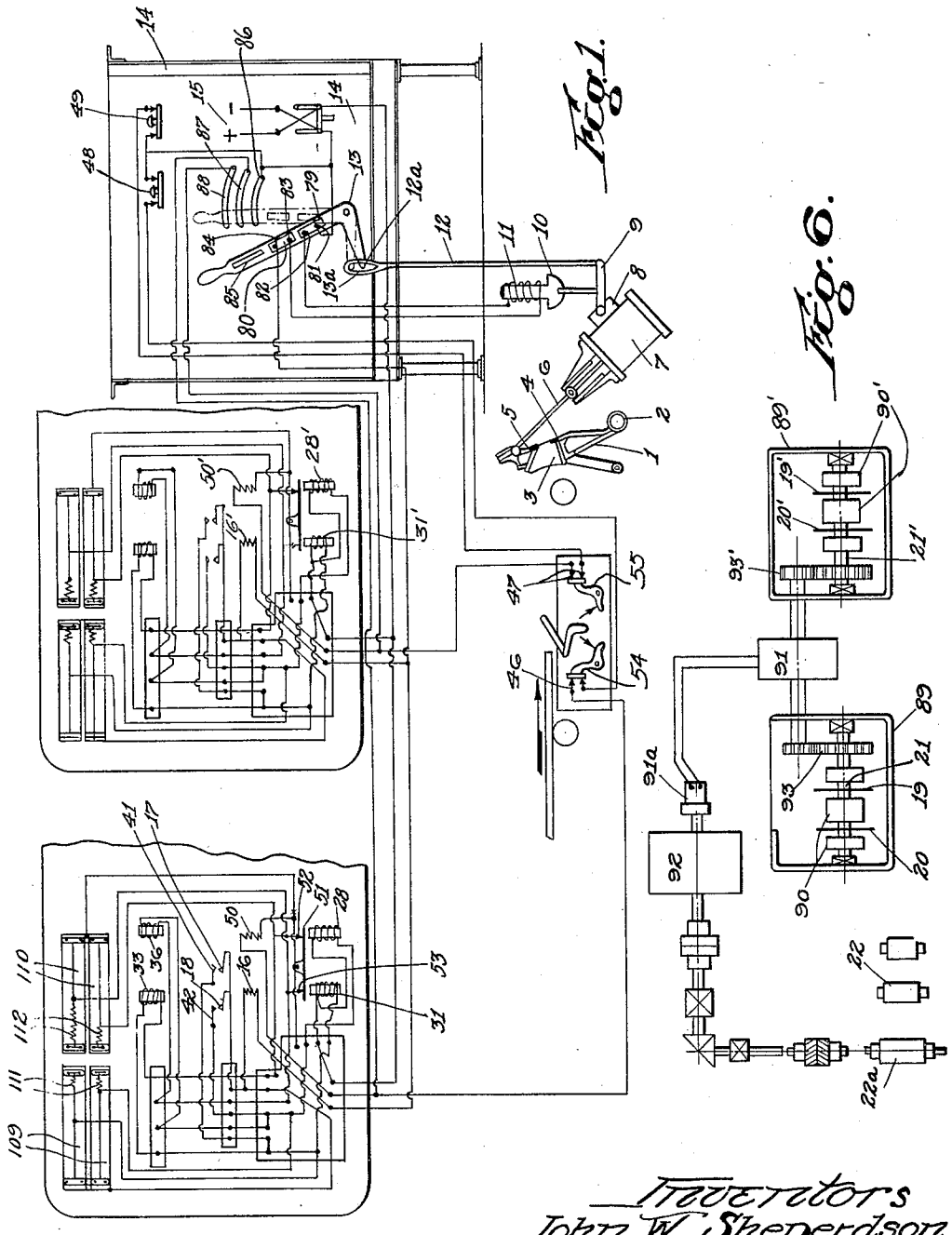


Fig. 1.

Fig. 6.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 2

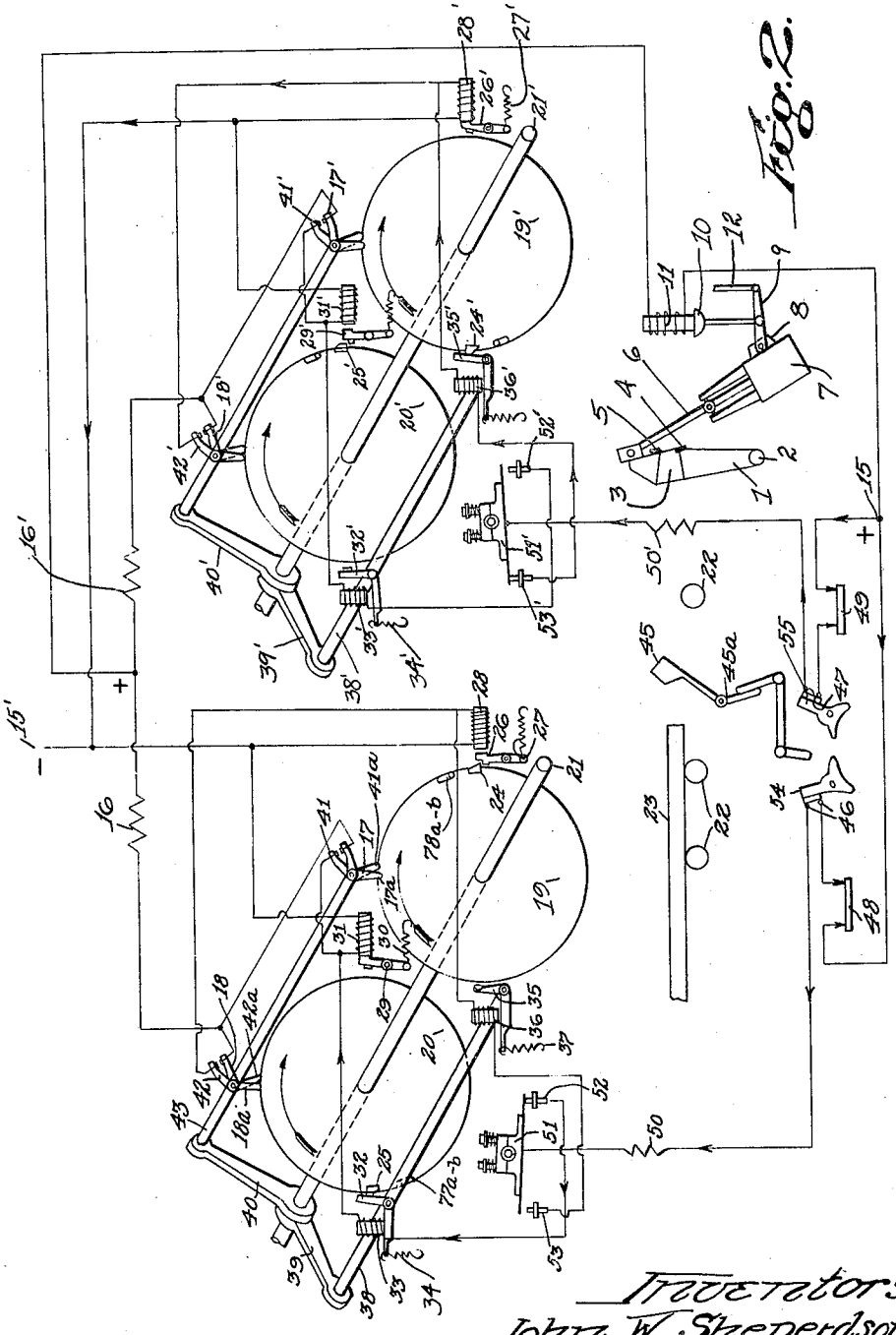


Fig. 2.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 3

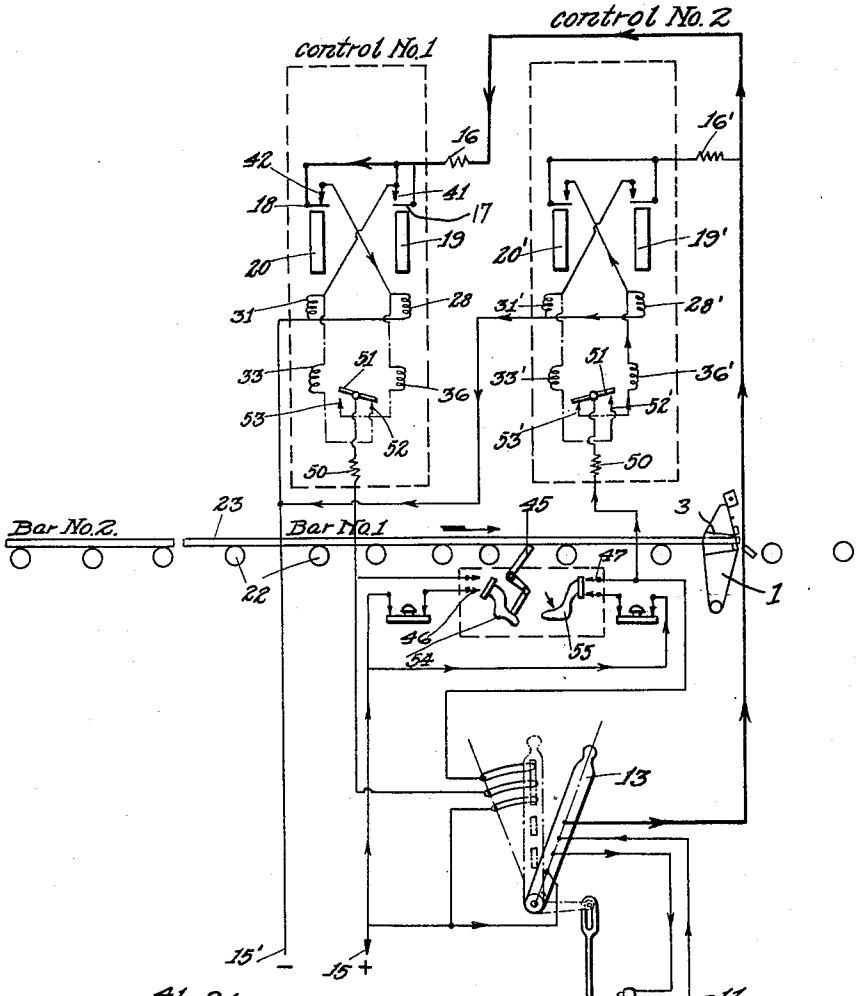


Fig. 3.

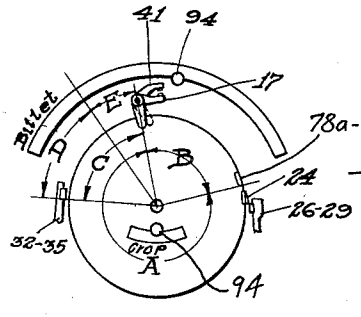


Fig. 5.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 4

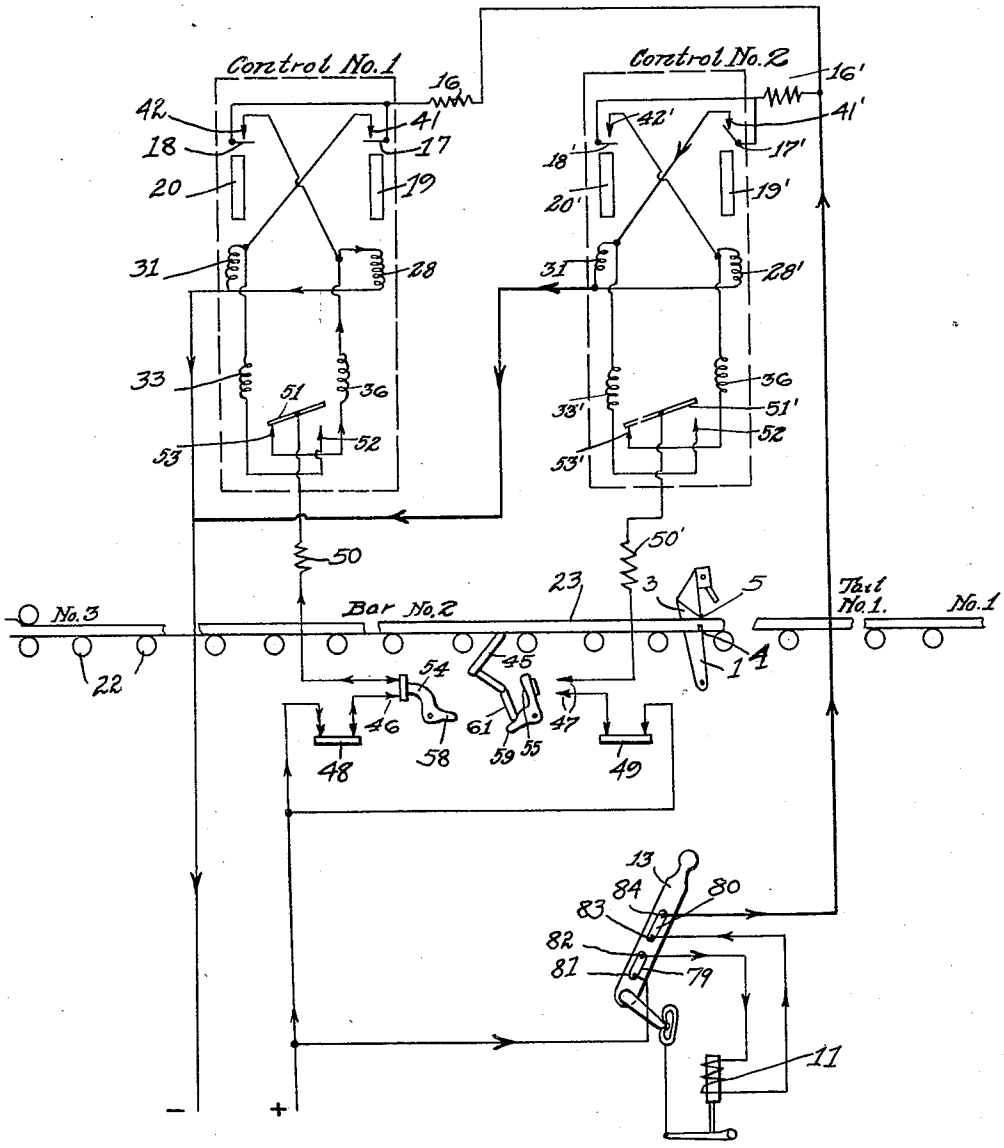


Fig. 4.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 5

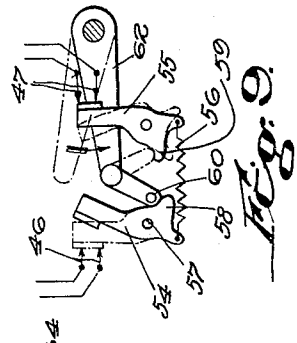


Fig. 9.

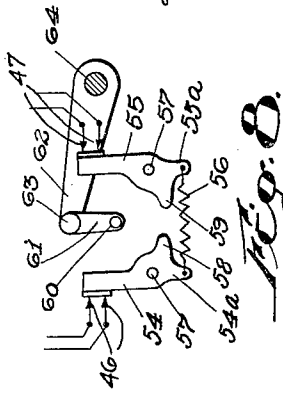


Fig. 8.

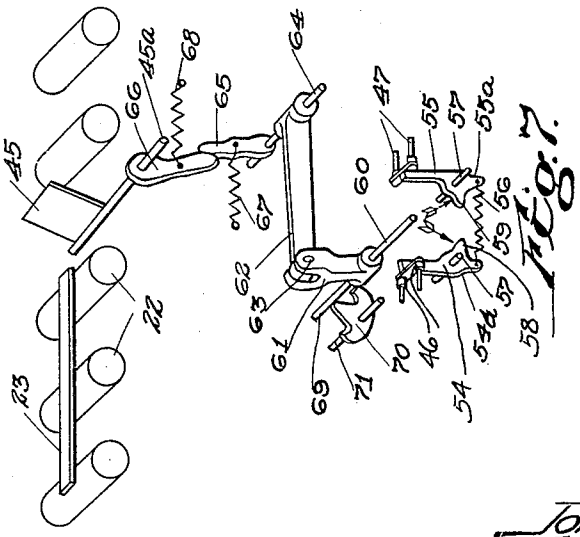


Fig. 7.

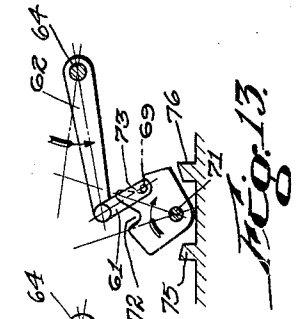


Fig. 13.

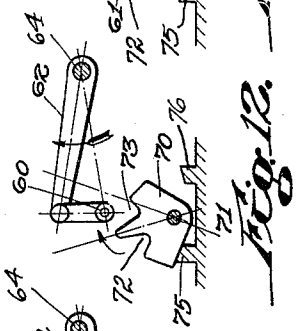


Fig. 12.

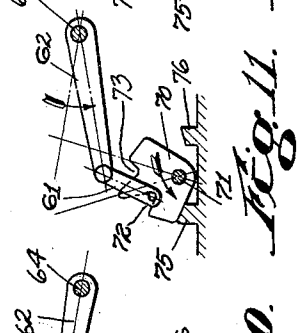


Fig. 11.

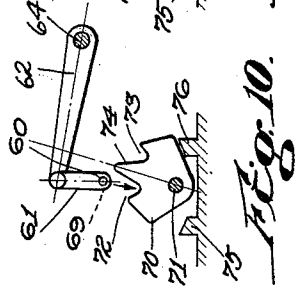


Fig. 10.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 6

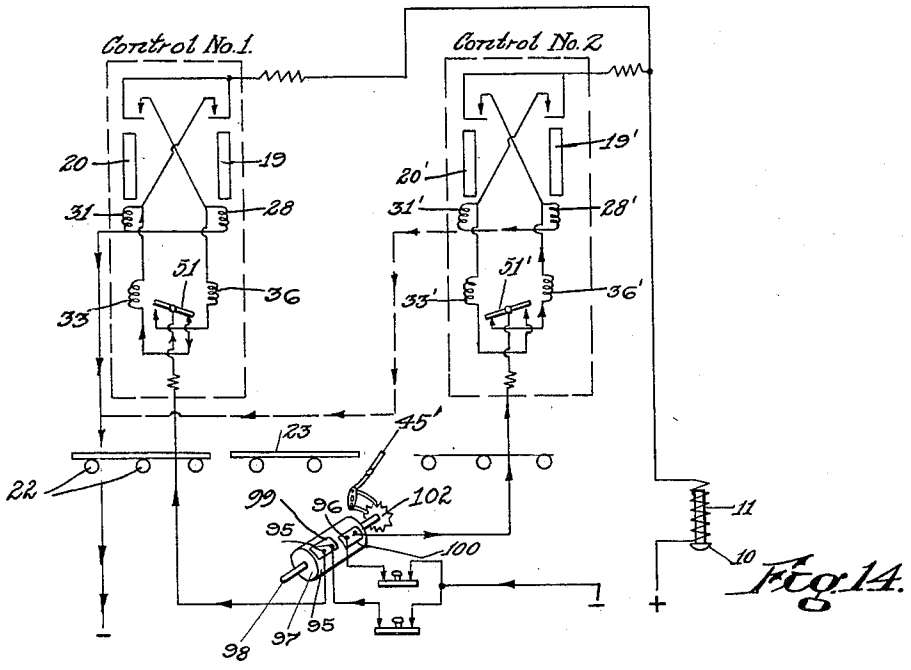


Fig. 14.

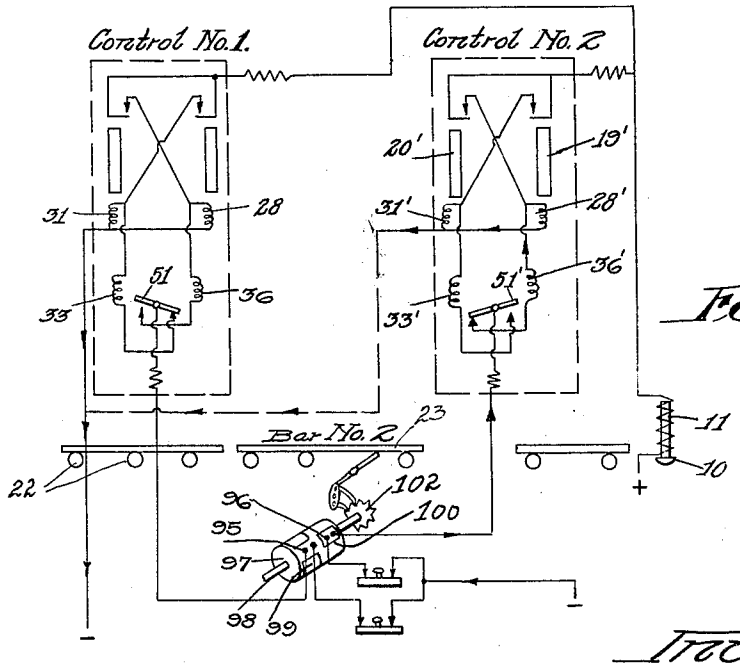


Fig. 15.

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Filed Feb. 28, 1929 7 Sheets-Sheet 7

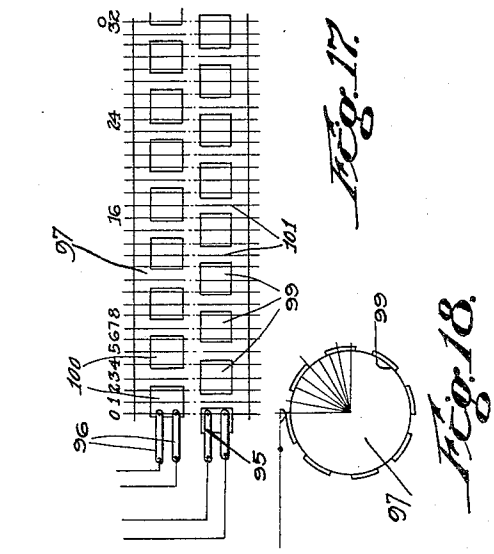


Fig. 17.

Fig. 18.

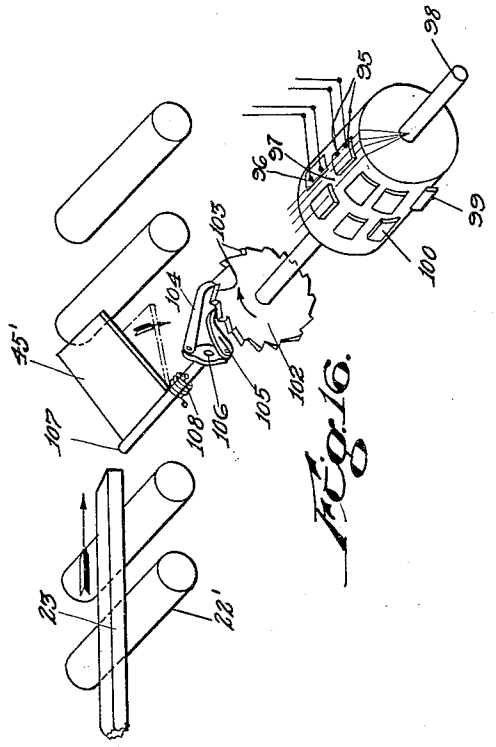


Fig. 16.

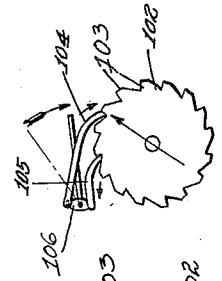


Fig. 22.

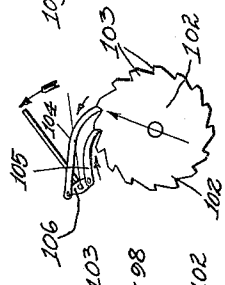


Fig. 21.

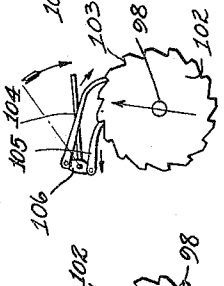


Fig. 20.

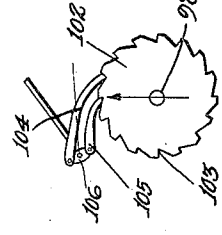


Fig. 19.

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Patented June 7, 1932 1,861,555

UNITED STATES PATENT OFFICE

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CONTROLLING THE SHEARING OF METAL BARS WHILE IN MOTION

Application filed February 28, 1929. Serial No. 343,428.

The present invention relates to the shearing or cutting of metal bars and other elongated materials, while the same are in rapid motion,—as is the practice, for example, in steel mills where the rapidly moving hot rolled product is required to be cut up into commercial lengths as fast as it is delivered from the finishing rolls of the mill.

A device for thus cutting up continuously delivered stock, and adapted to perform its successive cutting operations in the absence of any pause in the movement of the stock, or any reduction in the speed at which it is travelling, is known in the art as a flying shear. Our copending application Serial No. 206,988, filed on July 19, 1927, shows and describes a mechanism for automatically controlling the operation of a flying shear in such manner as to cause the product of a rolling mill, emerging as a succession of long rolled pieces of varying lengths, each the result of the reduction in said mill of a separate ingot, to be cut by said shear into equal-length billets or bars.

According to the disclosure of the aforesaid copending application Serial No. 206,988, a flag or trigger, so situated as to be struck and depressed by the advancing first end of each long uncut rolled piece of stock, in its approach toward the shear, is the means by which said control mechanism is, for each such piece, set in operation;—the maintenance of said flag or trigger in depressed position, by the passage thereover of the full length of the piece, causes a flying shear first to cut off a short crop from the front end of the piece and then to divide the remainder of the piece into bars or billets of a predetermined length. The flag or trigger, as soon as the tail end of the piece being cut has passed over it, moves up into a position where it will be struck and depressed by the front end of the following long uncut piece of stock that represents the next ingot undergoing reduction in the mill, for the repetition on said following piece of the cropping and billet-cutting operations that were performed on the preceding piece of stock.

The above described control mechanism of the aforesaid copending application Serial No. 206,988 is recognized to be governed and limited in its operation by a certain definite law or principle. This law or principle, which is satisfied by the usual and ordinary conditions of rolling mill practice, is that the gaps between the long uncut pieces emerging from the mill should not be less than the billet lengths into which said pieces are to be divided by the shear; in other words, assuming the shear to be set for the cutting of thirty-foot billets, the distance by which the rear end of each long piece being cut leads the front end of the next succeeding piece emerging from the mill, should not be less than thirty feet, because the control mechanism of said copending application Serial No. 206,988 may require, as a maximum, this distance in which to reset itself between the last cut taken on one piece and the first or crop cut taken on the next succeeding piece.

Under ordinary conditions of rolling mill practice the above described limitation as to the necessary gap between each piece of stock being cut and the one that follows it imposes no hardship, but there arise, nevertheless, conditions under which it is desired to cut extraordinarily long billets having a length of 100 feet or more, in which event it is impracticable to have the gaps between successive pieces delivered by the mill equal to the length of such long billets. The object of the present invention is to provide an improved control mechanism embodying the principles of the mechanism shown and described in the aforesaid copending application Serial No. 206,988 and so perfected that the control mechanism will function successfully under any and all conditions of operation irrespective of the length of the billets that it may be desired to cut, or of the gaps between successive pieces of stock, as delivered by the mill.

In carrying out the present invention it is proposed to employ two shear control mechanisms of the same general type as shown in the aforesaid copending application Serial No. 206,988, the invention providing means for automatically causing first one control mechanism to cut up the long piece resulting from the reduction of one ingot, and then causing the other control mechanism to cut

up the length of stock resulting from the reduction of the next succeeding ingot, and so on. The two control mechanisms are thus alternately operative and inoperative, thereby providing plenty of time for each control mechanism to reset during its inoperative periods and rendering the control of the shear entirely automatic under any and all conditions of mill operation, no matter how closely the lengths of stock follow each other, in their delivery from the mill or how long the billets may be that are cut from such stock.

The above and other advantageous features of our invention will hereinafter more fully appear, reference being had to the accompanying drawings in which for the sake of brevity of description, certain portions of the control mechanism shown in Serial No. 206,988 have been shown more or less diagrammatically; all structural details being fully shown and described in the aforesaid copending application.

In the drawings—

Fig. 1 is a wiring diagram showing the electrical connections of the two separate control mechanisms with relation to the control pulpit and the shear.

Fig. 2 is a schematic view of the electrical circuit connections and associated devices arranged to show the functioning of the control mechanisms certain of the parts shown in Fig. 1 being omitted.

Fig. 3 is a simplified wiring diagram based on Fig. 1, showing one control mechanism governing the operation of the shear on a given piece of stock.

Fig. 4 is a simplified wiring diagram similar to Fig. 3 showing the other control mechanism governing the operation of the shear on the next succeeding piece of stock.

Fig. 5 is a diagram illustrating the angular relation between the parts operated by the control disks of each mechanism.

Fig. 6 is a view in plan showing the drive for both of the control boxes.

Fig. 7 is a fragmentary perspective view illustrating the functioning of the flag controlled mechanism.

Figs. 8 and 9 are enlarged fragmentary views showing parts of the flag controlled mechanism in different positions.

Figs. 10 to 13 inclusive are diagrammatic views showing the operation of the selector which cooperates with the flag.

Fig. 14 is a simplified wiring diagram similar to Fig. 3 showing a modification in the means for shifting from one control mechanism to another.

Fig. 15 is a diagram similar to Fig. 14 showing the shear governed by one control mechanism while the other is held in readiness for operation.

Fig. 16 is a fragmentary perspective view showing the modified flag controlled mechanism shown in Fig. 14.

Fig. 17 is a developed plan view illustrating the layout of contacts on the selector cylinder shown in Fig. 16.

Fig. 18 is a view in end elevation of the selector cylinder shown in Fig. 16.

Figs. 19 to 22 inclusive are diagrammatic views showing the functioning of the ratchet and pawl device for intermittently rotating the selector cylinder shown in Fig. 16.

Like reference characters refer to like parts in the different figures.

Referring first to Figs. 1 and 2 our invention is shown as employing the use of two separate control mechanisms of the type shown and described in the aforesaid copending application Serial No. 206,988 and in order that the operation of each control mechanism may be more readily understood the same reference numerals are employed wherever possible to designate parts having the same functions as described in the aforesaid copending application. In illustrating the two control mechanisms employed in the present invention, certain structural details are omitted, for these details are clearly shown and described in the aforesaid copending application No. 206,988 and form no part of the present invention, other than to provide means for carrying out the results desired when effecting the dual control of the shear, which is the essence of the present invention.

For purposes of illustration our invention is shown in connection with a flying shear of the type shown and described in Patent No. 1,521,514 issued December 30, 1924 to Victor E. Edwards, although it is to be understood that our improved control may as well be employed in connection with other types of flying shears, without departing from the principles thereof. The shear, as illustrated in Fig. 1 consists primarily of a swinging shear frame 1 pivoted at 2, the frame providing an opening, or mouth 3 for receiving the moving rolled product between a fixed blade 4 and a movable blade 5. In the operation of this type of shear, the frame 1 is adapted to be thrown in the direction of movement of the rolled product, as indicated by the arrow, by means of a rod 6 operated by a piston movable in a cylinder 7; this movement of the frame 1 causing operation of the movable blade 5 to cut off the billet by means not shown herein, since it forms no part of the present invention and is fully shown in the above mentioned Patent No. 1,521,514.

The cylinder 7 is provided with a valve casing 8 and the valve therein is adapted to be operated by means of a lever 9. The lever 9 is connected to the plunger 10 of a solenoid 11, so that when solenoid 11 is energized, the plunger 10 will be drawn upwardly to open the valve 8 and cause the shear to operate and cut a piece or billet from the material

passing through the shear. The valve lever 9 is also connected to an operating rod 12, the upper end of which has a slotted head 12*a* for receiving a pin 13*a* carried at the end of a bell crank control handle 13 pivotally mounted in a control pulpit 14 located adjacent to the shear, where an operator may observe the functioning of the shear. In the position shown in Fig. 1, the control handle 13 is set for automatic operation of the shear and owing to the length of the slot in the head 12*a*, the movement of the plunger 10 when the shear solenoid 11 is energized has no effect on the handle 13. However, when the handle 13 is thrown to the extreme right, the rod 12 is adapted to turn the valve lever 9 to manually operate the shear, independently of the solenoid 11, as will be hereinafter described.

Referring now to Fig. 2 there is shown schematically the relation of the various parts of the control apparatus as actually wired in Fig. 1, and the showing of Fig. 2 will be considered first in order to make clear the essential principle of operation of the invention, without reference to structural details which will be hereinafter considered. In Fig. 2, the solenoid 11 has one terminal thereof permanently connected to the + side of a suitable source of electrical energy indicated at 15, while the other terminal thereof is connected in parallel circuit relation to suitable resistances 16 and 16′, which are included in separate control mechanisms, either of which is adapted to bring about the energization of the solenoid 11 by completing the circuit of the solenoid 11 to the − side of the source at 15′. As clearly indicated in the drawings, the separate control mechanisms are identical in construction so that only one of said mechanisms need be described in detail.

The lead from the resistance 16 is connected in parallel to pivotally mounted triggers 17 and 18 mounted in spaced relation on a common pivot and provided with tail portions 17*a* and 18*a* that extend in the direction of a pair of control disks 19 and 20 respectively. The disks 19 and 20 are mounted on a shaft 21 and are adapted to rotate with this shaft 21 by means of suitable frictional clutches, in the absence of any force tending to oppose rotation of the disks 19 and 20. The shaft 21 is adapted to be continuously driven in synchronism with the rollers 22 which convey the stock 23 in the direction of the shear, so that the speed of each disk bears a fixed relation to the speed of travel of the stock, as will hereinafter more fully appear. In other words, the turning of either disk 19 or 20 through a given angle represents the movement of a predetermined length of stock 23 on the rollers 22, so that there is always a fixed relation between the speed of the stock 23 and the angular velocity of each disk 19 and 20. The disks 19 and 20 are provided with dogs 24 and 25 respectively projecting from the periphery thereof and in the particular position of parts shown in Fig. 2 the disk 19 is prevented from rotating with the shaft 21 by the engagement of its dog 24 with one end of a pivoted stop lever 26 held by a spring 27 in the path of the dog 24, but adapted to be withdrawn upon energization of a solenoid 28. A similar stop lever 29 is mounted adjacent to the other disk 20 in the same relative position that the lever 26 bears to the disk 19 and this lever 29 is held away from the disk 20 against the action of its spring 30 by reason of the fact that the corresponding solenoid 31 is then energized. The dog 25 on the second disk 20 is shown as being in engagement with a trip lever 32 held in the path of dog 25 by a trip solenoid 33 acting against the pull of a spring 34, and a similar trip lever 35 for the first disk 19 is shown as being held out of the path of movement of the dog 24 by the spring 37, the second trip solenoid 36 then being deenergized. Both trip levers 32 and 35 are mounted on an adjustable support 38 turnable about the axis of the shaft 21 by an arm 39.

A second support 40 also turnable about the axis of the shaft 21 carries the triggers 17 and 18 as well as two other triggers 41 and 42 all mounted on a common pivot shaft 43. The triggers 41 and 42 also provide tail portions 41*a* and 42*a* extending toward the disks 19 and 20, and normally the current carrying ends of each pair of triggers 17 and 41 and 18 and 42 respectively are maintained out of engagement with each other. The trigger 41 is connected to one terminal of the stop solenoid 31 of the disk 20 while the trigger 42 is connected to one terminal of the stop solenoid 28 of the disk 19 and as the other terminals of these solenoids 28 and 31 are connected to the − side of the source at 15′, it is obvious that closing of either pair of triggers 17 and 41, or 18 and 42, will cause energiation of the shear solenoid 11, as well as energization of the shear solenoid 11, as well as energization of one or the other of the stop solenoids 28 and 31 by completing a series circuit through the shear solenoid 11 and one or the other of the stop solenoids 28 and 31.

As previously pointed out, our invention contemplates the use of two separate control mechanisms for operating the shear and the parts of the control mechanism of which the resistance 16′ forms a part are designated by the same reference numerals as those used to designate the control mechanism of which the resistance 16 forms a part. It is therefore evident that the shear solenoid 11 can be energized by any one of four pairs of contacts and there will now be described the arrangement whereby the solenoid 11 is first adapted to be energized by the closing of the triggers 17

and 41 or 18 and 42 when operating on one piece of rolled stock, and then is adapted to be energized by the closing of the triggers 17′ and 41′, or 18′ and 42′ when operating the shear to cut the next succeeding piece of rolled stock and so on, alternately, as long as the mill is in operation.

As shown in both Figs. 2 and 3, a suitable detector device responsive to the movement of the stock 23 is placed between two of the rollers 22 in advance of the shear and, for purposes of illustration, this detector device is shown as comprising a flag 45 pivotally mounted on a shaft 45*a* and extending upwardly between two of the rollers 22 so that it will be depressed by the passage of stock 23 over the rollers 22. In the control device covered by the aforesaid copending application Serial No. 206,988, a flag similar to the flag 45 is employed directly in connection with an electrical contact to set the single control mechanism in operation upon passage of stock over the rolls, whereas the present invention contemplates the use of the flag 45 in connection with two sets of electrical contacts to alternately set the duplicate shear control mechanisms in operation. To this end, there is provided two pairs of stationary contacts 46, 46 and 47, 47, one contact of each pair being connected to the + side of the source at 15 through normally closed push buttons 48 and 49, the purpose of which will hereinafter more fully appear. The other contact 46 is connected through a resistance 50 to the pivoted arm 51 of a relay so constructed that the ends of the pivoted arm 51 will engage one or the other of spaced stationary contacts 52 and 53. As shown in Fig. 2, the contact 52 is engaged by the arm 51 so that with the contacts 46 connected by a pivoted bridging member 54, current is adapted to flow from one side of the line through the contacts 46, contact 52 and from thence in series through the trip solenoid 33 and stop solenoid 31 back to the other side of the source at 15′ as shown by arrows. At this time the trip arm 32 prevents the disk 20 from rotating with the shaft 21, while the stop 29 of the same disk 20 is held out of the path of the dog 25. Also the trip solenoid 36 and stop solenoid 28 are at this time deenergized, since these solenoids are in series with the stationary contact 53 of the relay, thereby permitting the spring 27 to hold the stop 26 against the dog 24 of the disk 19.

As shown in Fig. 2, the pair of stationary contacts 47 are also adapted to be connected by a pivoted bridging member 55, so that when the contacts 47 are bridged by the member 55 the circuit is established from the + side of the source at 15 to the pivoted arm 51′ of a relay device forming part of the other control mechanism. The relay arm 51′ cooperates with stationary contacts 52′ and 53′ in the same manner as does the relay arm 51 so as to control the flow of current to the solenoids 33′ and 31′ and 36′ and 28′ respectively. Fig. 2 represents diagrammatically the condition of affairs when an ingot bar is approaching with the flag 45 in a raised position and with both pairs of contacts 46 and 47 engaged by their respective bridging members 54 and 55. At this time the disk 20 of one mechanism and the disk 19′ of the other mechanism are positively held against rotation by energization of their respective solenoids 33 and 36′ as indicated by the circuits shown with arrowheads so that one control mechanism or the other, is adapted to be set in operation should either bridging member 54 or 55 be moved to break the circuit between the respective pairs of contacts 46 and 47. But before proceeding any further in a description of the manner in which the individual control mechanisms function separately to operate the shear, there will be first described a mechanical arrangement whereby depression of the trigger 45 will automatically operate first one and then the other of the bridging members 54 and 55.

Referring now to Fig. 7, it will be seen that the bridging members 54 and 55 are adapted to be maintained in engagement with their respective pairs of contacts 46 and 47 by means of a spring 56 connected between downwardly projecting lugs 54*a* and 55*a* provided by the bridging members 54 and 55 below their pivots 57. The bridging members 54 and 55 also provide oppositely projecting lugs 58 and 59 either of which is adapted to be engaged by an operating rod 60 adapted to be moved in the space between the lugs 58 and 59. The rod 60 is carried at the lower end of an arm 61 pivotally connected to the end of a lever 62 by means of a pin 63. The lever 62 is adapted to turn with a shaft 64 which also carries an upwardly extending arm 65 extending in the path of movement of an arm 66 projecting downwardly from the shaft 45*a* carrying the flag 45. The shaft 64 carrying the lever 62 and the arm 65 is acted upon by a spring 67 which tends to turn the shaft 64 in a counterclockwise direction as viewed in Fig. 7, but when the flag 45 is raised this turning movement of the shaft 64 is opposed by the arm 66 which is held against the arm 65 by a spring 68 which also tends to maintain the flag 45 in a raised position. The spring 68 is more powerful than the spring 67 so that with the flag 45 in a raised position, the lever 62 is maintained in the position shown in Fig. 7 with the operating rod 60 suspended above the oppositely extending lugs 58 and 59 of the bridging members 54 and 55. In this position a second rod 69 extending oppositely from the rod 60 at the lower end of the arm 61 is positioned above a selector 70, pivotally mounted on a shaft 71.

As best shown in Fig. 10, the selector 70 provides a pair of notches 72 and 73 separated

by a tongue 74 and since the selector 70 is symmetrical about an axis passing through the shaft 71 and the middle of the tongue 74, it is apparent that the selector 70 will always occupy a position at rest in which it is tilted to one side or the other into engagement with stops 75 and 76 equally spaced from the shaft 71. In the position shown in Fig. 10, the selector 70 is resting in engagement with the right hand stop 76 so that the left hand notch 72 is disposed immediately below the rod 69 carried by the arm 61.

Let it now be assumed that rolled material 23 in the form of an uncut reduced ingot approaches the shear over the rollers 22 and depresses the flag 45. When this occurs, the turning movement of the flag arm 66 in a clockwise direction as viewed in Fig. 7 permits the spring 67 acting on the arm 65 to turn the shaft 64 in a counterclockwise direction. The resulting downward movement of the lever 62 from the position shown in Fig. 10 causes the rod 69 to enter the left-hand notch 72 of the selector 70 and as this downward movement of the rod 69 continues the selector 70 is turned about its pivot 71 from the position shown in Fig. 10 to the position shown in Fig. 11. As the lever 62 moves downwardly with the rod 61 engaged in the notch 72, the reaction between the rod 69 and the selector 70 turning about its pivot shaft 71 serves to turn the arm 61 about its pivot pin 63 and so cause the front operating rod 60 to engage the lug 58 on the left-hand bridging member 54 as shown in Fig. 9. Therefore as the lever 62 completes its downward movement, the rod 60 pressing on the lug 58 turns the bridging member 54 about its pivot 57 in a clockwise direction thereby moving the bridging member 54 out of engagement with the spaced contacts 46.

This disengagement of the bridging member 54 from the contacts 46 serves to interrupt the previously described circuit through the relay contact 52 and the solenoids 33 and 31. Upon deenergization of the solenoid 33 the spring 34 withdraws the trip 32 from the dog 25 on the disk 20, whereupon the disk 20 starts to rotate in the direction indicated by the arrow in Fig. 2. At the same time deenergization of the solenoid 31 permits the stop 29 to be drawn by the spring 30 into the path of movement of the then moving dog 25. Rotation of the disk 20 through a predetermined angle, brings a pair of dogs 77*a* and 77*b* carried by the disk 20 into engagement with tail portions 18*a* and 42*a* of the triggers 18 and 42, thereby moving the current carrying ends of these triggers into engagement and establishing a circuit through the shear solenoid 11. This condition of affairs is shown by the heavy circuit lines in Fig. 3, from which it is apparent that by the time the dogs 77*a* and 77*b* engage the triggers 18 and 42, the advancing end of the stock 23 has passed between the blades of the shear, so that operation of the blades 4 and 5 upon energization of the shear solenoid 11 will cause a short crop end to be cut off from the front of the piece.

As previously pointed out, current flowing through the shear solenoid 11 will also flow in series through the stop solenoid 28 of the disk 19, so as the shear operates to cut the crop end, the stop 26 will be withdrawn from the dog 24 to permit rotation of the disk 19. At this time the trip 35 is still held retracted by its spring 37 so as the disk 19 rotates its dog 24 will pass the stop 35 without engagement and the disk 19 will continue to rotate until a pair of dogs 78*a* and 78*b* on opposite sides of the disk 19 engage the tail ends 17*a* and 41*a* of the pair of triggers 17 and 41, thereby again energizing the shear control solenoid 11 and causing the stock to be severed. When the stock 23 is cut the second time upon engagement of the triggers 17 and 41, it is obvious that the length of the second piece or billet will be several times greater than the length of the crop end previously severed owing to the fact that the disk 19 travelled through a considerably wider angle than did the disk 20 in moving the trigger operating dogs 78*a* and 78*b* from their starting position to the point where they engaged the triggers 17 and 41.

When the flag 45 was first depressed by passage of the stock 23 as previously described, the circuit of the stop solenoid 31 was broken at the same time that the trip solenoid 33 was deenergized to release the dog 25 and set the disk 20 in rotation. Consequently, the spring 30 holds the stop 29 in the path of the dog 25 and the disk 20 comes to rest shortly after the dogs 77*a* and 77*b* engage the triggers 18 and 42. The disk 20 then remains at rest while the disk 19 is turning until the dogs 78*a* and 78*b* close the triggers 17 and 41 whereupon current again flows through the stop solenoid 31 to release the dog 25 from the stop 29. The engagement between the triggers 17 and 41 is only for a very short time, but the engagement is enough to retract the stop 29 to release the dog 25 and thus start the disk 20 on a complete revolution after which opening of the triggers 17 and 41 resets the stop 29 in the path of the dog 25. The second rotative movement of the disk 20 is not arrested by the trip 32 inasmuch as the solenoid 33 is at that time still deenergized by the gap between contacts 46, so that the disk 20 continues to rotate until its dogs 77*a* and 77*b* engage the triggers 18 and 42 thereupon again energizing the shear solenoid 11 to cut another billet from the piece. This billet will be of exactly the same length as the first billet cut due to rotation of the disk 19, owing to the fact that the disk 20 starts from the same relative position with respect

to the shaft 21 as did the disk 19. Obviously the second closure of the triggers 18 and 42 releases the then stationary disk 19 through energization of the solenoid 28, so that rotation of the disk 19 is automatically resumed to cause a third billet of the same length to be cut by the shear.

As a result of the above described automatic operation, the disks 19 and 20 continue to rotate intermittently to measure equal lengths of stock before operating the shear and this operation will continue until the last end of the piece of stock designated bar No. 1 in Fig. 3 passes off of the flag 45. When this occurs, the spring 68 causes the arm 66 to turn the shaft 64 in a clockwise direction thereby raising the arm 62 from the full line position shown in Fig. 9 to the dotted line position. This releases the lug 58 on the bridging member 54, whereupon the spring 56 turns the bridging member 54 and reestablishes the circuit between the contacts 46, as indicated in dotted lines in Fig. 9. Bridging of the contacts 46 reestablishes the circuit of either the solenoid 33 or the solenoid 36 depending upon whether the relay arm 51 is in engagement with the contact 52 or 53. Energization of either trip solenoid 33 or 36 moves the corresponding trip 32 or 35 into the path of movement of one of the disks 19 or 20, so that one disk or the other will be automatically brought to rest shortly after the flag 45 is released by passage therebeyond of the last end of the piece that has just been cut up. In bringing a disk 19 or 20 to rest, the relay arm 51 is actuated by the solenoids 31 and 28 to energize one or the other of the solenoids 33 or 36 so as to stop in position for the next crop cut, the particular disk 19 or 20 whose dog 24 or 25 has been last released by the energization of solenoid 28 or 31, thus resetting the measuring mechanism in the minimum time possible after the release of the flag. It is obvious, however, that an appreciable time must elapse before one or the other of the disks 19 or 20 can be brought to rest in order to reset the corresponding control mechanism and, as previously pointed out, the present invention provides means for automatically shifting the control of the shear solenoid 11 over to the duplicate control mechanism to eliminate the possibility of the next succeeding piece of stock designated bar No. 2 depressing the flag 45 before the control mechanism which has operated on the preceding piece has had a chance to reset itself.

This throw-over from one controlling mechanism to the other is clearly illustrated in Fig. 12 which shows the position of the lever 62 carrying the operating rod 60 immediately after the flag 45 has been released by the rear end of the first long piece of stock. At that time the selector 70 rests in engagement with the left hand stop 75, the selector 70 having been previously moved to that position when the flag 45 was first depressed as indicated in Fig. 11. Consequently, when the second long uncut piece of stock approaches over the rollers 22 and depresses the flag 45, the bar 69 carried by arm 61 is received in the right hand notch 73 and subsequent turning of the lever 62 results in swinging the arm 61 to bring the operating bar 60 into engagement with the lug 59 on the right hand bridging member 55 as indicated in dotted lines in Fig. 9. The resulting turning of the bridging member 55 breaks the circuit between the contacts 47 as shown in Fig. 4 thereby deenergizing the solenoids 36′ and 28′ of the right hand control mechanism. This results in releasing the disk 19′ from the trip 35′ so that the control disk 19′ is set in rotation immediately following the depression of the trigger 45 by the second piece designated bar No. 2. As a result the second piece is cropped and cut into billets in exactly the same manner as the first piece for as previously pointed out, the functioning of the control disks 19′ and 20′ is precisely the same as the functioning of the control disks 19 and 20.

Very shortly after the depression of the flag 45 by the second piece has set the control disk 19′ in rotation, the moving disk of the first mechanism is brought to rest and remains there while the second piece is being cut into equal lengths by the shear through the functioning of the other pair of control disks 19′ and 20′. During operation on the second piece the left hand bridging member 54 remains in engagement with the contacts 46, but when the flag 45 is depressed a third time by the piece designated bar No. 3 following clearing of the second piece, the bridging member 54 is moved away from the contacts 46 in the manner shown in Figs. 9 and 11. Obviously the selector 70 functions to cause the bridging members 54 and 55 to be operated alternately by successive pieces of rolled stock so that the shifting of the shear control from one mechanism to the other is automatically continued as long as stock is delivered over the rollers.

As previously pointed out, it is the primary object of the present invention to provide a shear control whose functioning is not subject to any limitations as to length of billets that may be cut, or as to the length of the gap between successive rolled pieces emerging from the mill, and it is obvious that the above described mechanism is adapted to meet any and all conditions of mill operation. With our improved mechanism functioning as described above, it is obvious that the control of the energization of the shear solenoid 11 is automatically shifted from one set of control contacts and disks to the other set upon each depression of the flag 45, so that no matter how closely the pieces deliv-

ered by the mill may follow each other, the shift is always accomplished before the front end of a piece arrives at the shear.

In order to provide for the control of the apparatus from the pulpit 14, the control handle 13 provides a pair of contact plates 79 and 80 that are adapted to be moved into engagement with pairs of stationary contacts 81 and 82, 83 and 84 when the handle 13 is turned to the automatic control position. In this position the plate 79 bridges the contacts 81 and 82 to connect one terminal of the solenoid 11 to one side of the source 15 while the plate 80 bridges the contacts 83 and 84 to establish the connection of the other terminal of the solenoid 11 in parallel circuit relation with the two sets of triggers in the separate control mechanisms. The same side of the source 15 is permanently connected in parallel to the contacts 46 and 47 through the push buttons 48 and 49, so that at any time the operation of either pair of control disks 19 and 20 or 19′ and 20′ can be tested out by depressing one of the push buttons 48 or 49 to break the circuit through the closed contacts 46 and 47.

In Fig. 1 there is also shown on each control panel an arrangement of condensers 109 and 110 and resistances 111 and 112 connected in series circuit relation across the pairs of triggers 41 and 17 and 42 and 18 and also across the contacts 52 and 53 and the movable relay arm 51. The condensers 109 are in parallel circuit relation with the resistance 16, while the condensers 110 are in parallel circuit relation with the resistance 50, each separate condenser 109 and 110 being connected in series with a corresponding resistance 111 or 112 of relatively low value. The function of these condensers and resistances is to restrict arcing between the several pairs of triggers 41 and 17 and 42 and 18, as well as between the stationary contacts 52 and 53 and the movable relay arm 51. The above described arrangement of condensers and resistances is omitted from the diagrammatic showing of Figs. 2, 3, and 4 in order to simplify the drawings and the description of the operation of the control mechanism.

The handle 13 also carries a third contact plate 85 which is adapted to bridge three contact segments 86, 87, and 88 when the handle 13 is moved to an "off" position out of engagement with the contacts 81 to 84 inclusive which control the solenoid 11. The segment 86 is connected to one side of the line at 15 while the segments 87 and 88 are connected directly to the resistances 50 and 50′ respectively to provide separate current paths short circuiting the pairs of contacts 46 and 47. Therefore, when the control handle is moved to the "off" position as shown in dotted lines, Fig. 1, the holding circuits for the control disk trip solenoids 33 and 36 are maintained independently of the bridging members 54 and 55 thus keeping the control apparatus in such a condition that the control disks will be held ready for tripping when the apparatus is next automatically operated following a suspension of the shear operation. In other words, the particular disk 19 or 20 that is turning will be stopped after the handle is moved to "off". It will be noted also that the contact segments 86, 87 and 88 are long enough so that the plate 85 remains in engagement therewith should the handle 13 be moved from the middle "off" position to the extreme right hand position in which the shear is operated manually by means of the rod 12 as previously pointed out. Thus one measuring disk of each control device is always held in readiness for operation in any position of the control handle 13.

Before proceeding with a further discussion of the operation of the present apparatus, the manner of setting the separate control mechanisms for cutting billets of different lengths from the rolled product will be briefly described, bearing in mind the fact that the structural details of each mechanism are fully shown and described in the aforesaid copending application, Serial No. 206,988. As previously pointed out, the two pairs of triggers 17 and 41 and 18 and 42 of each mechanism are mounted on a common pivot shaft that is angularly adjustable with respect to the axis of the shaft 21 and since the stops 26 and 29 are fixed with respect to the axis of the shaft 21, it is evident that with the shaft 21 rotating in a clockwise direction the angle A between the trigger operating dogs and the triggers will substantially determine the lengths of the billets cut from the moving pieces of stock. The angular relations involved are shown diagrammatically in Fig. 5 and since this figure is reproduced from the drawings in Serial No. 206,988 it is not believed necessary to burden the present application with an involved discussion of the various factors included in determining the maximum and minimum angles and the calibration of the scale which is set to determine the billet lengths. It is believed sufficient for the present purposes merely to state that variation of the angle A between the minimum and maximum values indicated on the scales gives a considerable range of billet lengths depending on the speed of the shaft 21.

As shown in Fig. 6, the shafts 21 and 21′ of the control mechanisms are mounted in housings 89 and 89′ and the respective pairs of disks 19 and 20 and 19′ and 20′ are adapted to be clutched to the shaft driven spiders 90 and 90′ by frictional blocks, as described in detail in the aforesaid copending application, except when rotation of the disks is prevented by the various stops. The shafts 21 and 21′ are adapted to be driven in synchro-

nism with the mill, and a preferred form of drive for the shafts 21 and 21′ consists in utilizing a synchronous motor 91 driven from an alternating current generator 91*a* connected to the shaft of the main motor 92 which drives the last mill rolls 22*a*, as indicated in Fig. 6. Reduction gearing 93 is interposed between the auxiliary motor shaft and the shafts 21 and 21′ and the ratio of this gearing 93 is determined by the maximum delivery speed of the stock which will be cut by the shears and the maximum length of the billets it is desired to cut. For example, assuming a maximum delivery speed of 750 feet per minute and a maximum billet length of 150 feet, it follows that the shafts 21 and 21′ must be driven at a maximum speed of

$$\frac{750}{150}\times\frac{341}{360}$$

or 2.9 R. P. M.; 341 being the maximum value of the angle A in Fig. 5 which represents the billet lengths.

When this speed ratio has been once established as indicated above, variations of the billet lengths can be effected by moving the triggers about the disk shafts to vary the angle A, all as set forth in detail in the application No. 206,988. Obviously, changes in the delivery speed of the stock will not affect the speed ratio previously established, since the motor 91 will operate in synchronism with the main mill motor 92, as explained above.

As previously pointed out the trips 32 and 35 are adjustable about the axis of the shaft 21 in order to vary the length of the crop end cut off each newly arriving piece of stock and the range of this adjustment is indicated by the angle C. This angle C represents the angular displacement of each disk 19 and 20 in order to measure the distance between the flag 45 and the shears. For purposes of illustration in Fig. 5, the angle C in shown as including two other angles designated D and E. The angle D represents the angular displacement of the shaft 21 while the stock is moving from the flag to the shear while the angle E represents the length of material passed between shear blades before the triggers are closed to actuate the shear. Obviously the distance between the flag and the shear arbitrarily determines the angle D so that the markings on the crop scales represent only the movement of the control disks through the angle E. In other words the markings on the crop end scales are a true measure of the amount of crop end that will be cut off for a given setting of the angle E.

Let it now be assumed that it is desired to operate the mechanism so as to cut the mill product into billets 100 feet long with a crop end one foot in length and that the spacing between successive pieces of rolled stock as delivered by the mill will run as close as one or two feet. In order to accomplish this result, the crop and billet scale pointers 94 are set as indicated in Fig. 5 and the control handle 13 is then moved to the automatic position at the extreme left in Fig. 1. With the handle 13 in the automatic position everything is in order for the automatic operation of the shear by the measuring devices both of which are in readiness to be set in operation by the depression of the flag 45 by the first piece. Assuming that the selector 70 is resting in engagement with its right hand stop 76 as shown in Fig. 10, the first depression of the flag 45 will cause the bridging member 54 to be moved out of engagement with the contacts 46 thereby setting in rotation the control disk 20. The functioning of the control disks 19 and 20 to cause the shear to first cut a predetermined crop end from the bar and then cut the remainder thereof into billets of equal length has all been previously described and it is not necessary to go into the details of these operations at this point except to state that with the settings indicated in Fig. 5 a crop end of one foot will first be severed and then the shear solenoid 11 will be energized alternately by the disks 19 and 20 to cause the shear to cut the No. 1 bar into billets each 100 feet long. As soon as the rear end of the first No. 1 bar clears the flag 45, the raising of the flag permits the bridging member 54 to again engage the contacts 46 and set one or the other of the trips 32 or 35 to stop the corresponding disk 19 or 20. This necessary resetting of the disk 19 or 20 occupies an appreciable time and assuming that the pieces or bars are spaced closely together and that the tail end of the first bar is short it might well happen that the second bar would depress the flag 45 before disks 19 and 20 have had time to reset. However, as previously pointed out, this would make no difference in the operation of the present mechanism for the reason that when the flag 45 is raised after clearing the end of the first bar, the rod 69 on the flag control arm 61 is positioned above the notch 73 on the selector 70. Therefore, when the front end of the second bar depresses the flag 45 a second time the operating rod 60 is directed by the selector 70 so as to engage the lug 59 on the bridging member 55 and thus break the circuit between contacts 47, see Figs. 9 and 13. When this occurs, the control disk 19′ of the other mechanism is set in operation and as indicated in Fig. 4 the automatic cutting of the second piece or bar into billets of equal length following the severance of a crop end proceeds entirely under the control of the disks 19′ and 20′. When the tail end of the second bar releases the flag 45, one or the other of the trips 32′ and 35′ is reset to arrest rotation of the disks 19′ and 20′ after an interval that depends upon the length of the tail end of the second bar. But should the front end of the third bar depress the flag

45 before the disks 19′ and 20′ are reset, this would make no difference because the third depression of the flag 45 would automatically set in operation the first control disks 19 and 20 upon turning of the bridging member 54 in response to the third depression of the flag 45. The reason for this is evident from Fig. 13 which shows the selector 70 being turned into engagement with its right hand stop 76 as the lever 62 moves downwardly to depress the bridging member 55; so that when the second bar clears the flag 45, the notch 72 is again presented to the rod 69 as indicated in Fig. 10.

From the foregoing then it will be apparent that as long as the mill continues to operate, the energization of the shear solenoid 11 will be alternately under the control of first the disks 19, 20 and then the disks 19′ and 20′, one pair of disks serving to accomplish the cutting up of the entire length of one piece of stock. With this automatic shifting of the control, the functioning of the entire mechanism is made free of any limitations whatsoever as to the length of billets cut and the length of the gaps between successive pieces of stock.

Referring now to Figs. 14 to 22 inclusive, there is shown a modification in the means for shifting from one pair of control disks to the other in response to successive depressions of the trigger 45′ by the moving material. In this modified arrangement two pairs of stationary contacts 95 and 96 are connected in parallel to the source 15 and to the relay arms 51 and 51′ in exactly the same manner as the contacts 46 and 47 are connected in parallel to the source 15 and the relay arms 51 and 51′. The contacts 95 and 96 are adapted to operate upon the surface of a selector cylinder 97 rotatably mounted on a shaft 98 and providing two series of contact plates 99 and 100 adapted to be engaged by the contacts 95 and 96 respectively as the cylinder 97 rotates. As clearly shown in Fig. 17 which is a developed view of the surface of the cylinder 97, the contact plates 99 and 100 are staggered with respect to each other, each contact plate 99 or 100 being separated from the adjacent contact plate 99 or 100 by gaps 101 of insulating material of equal width in each case.

The shaft 98 which carries the cylinder 97 provides a ratchet wheel 102, the teeth 103 of which are adapted to be engaged by a pair of pawls 104 and 105 pivotally mounted at the opposite ends of a rocker arm 106. The rocker arm 106 is mounted at the end of a shaft 107 which carries the flange 45′, a coil spring 108 surrounding the shaft 107 serving to maintain the flag 45′ in a raised position between two adjacent conveyor rollers 22′. When a given piece of stock 23 moving over the rolls 22′ depresses the flag 45′, the shaft 107 is turned in a clockwise direction to cause the longer pawl 104 to turn the ratchet wheel 102 through an angle equal to one half the pitch between adjacent teeth 103. Upon the release of the flange 45′ by the tail end of said given piece, the upward movement of the flag 45′ and the resulting counterclockwise rotation of the shaft 107 causes the shorter pawl 105 to turn the ratchet wheel 102 through the distance of another half tooth 103.

The fact that the pawls 104 and 105 are carried at the opposite ends of the rocker arm 106 results in the pawls being moved in opposite directions whenever the shaft 107 is turned by the flag 45′. Consequently when the long pawl 104 turns the ratchet wheel 102 as indicated in Fig. 20, the short pawl 105 is moved in the opposite direction to cause the pawl 105 to jump a whole tooth, since the throw of the pawl is measured against the direction of rotation of the ratchet wheel 102 under the thrust of the long pawl 104. When the flag 45′ moves to its upper position between the rolls 22′, the reverse occurs, the short pawl 105 then being the driver through a half tooth, while the long pawl 104 is moved a half tooth in the opposite direction to engage the tooth behind the tooth with which it was originally in engagement as indicated in Fig. 21. In Fig. 22 the long pawl 104 is shown as again turning the ratchet wheel 102 upon the next depression of the flag 45′ so it is apparent that for each complete up and down movement of the flag 45′ the ratchet wheel 102 is turned through the pitch of one ratchet tooth 103. In other words, the complete passage of a given piece or bar over the flag 45′ causes two separate half pitch turning movements to be imparted to the ratchet wheel 102, one movement when the flag is depressed and a second one when the flag 45′ is raised following the release of the flag by the tail end of the bar.

Referring now to Figs. 16, 17 and 18, it will be seen that the angular displacement of each contact plate 99 or 100, measured along the periphery of the cylinder 97 is slightly more than the angular displacement of the ratchet teeth 103, so that one complete up and down movement of the flag 45′ will cause a cylinder 97 to be turned through less than the displacement of one contact plate. As shown in Fig. 17, the contact plates 99 and 100 are so staggered with relation to each other that when the stationary contacts 96 are near the end of one cylinder contact plate 100 the other pair of contacts 95 have just made engagement with the contact plate 99 immediately beside the plate 100 with which the contacts 96 are in engagement. Assuming that this is the condition of affairs when the flag 45′ is raised, it is apparent that at this time the circuits to the separate control mechanisms through the

contacts 95 and 96 remain closed, so that both mechanisms are in readiness for operation as illustrated in Fig. 14 by the arrows which indicate the flow of current through the trip solenoids 33 and 36′ respectively which serve to hold the disks 20 and 19′ against rotation with the shafts 21 and 21′. Therefore, when the moving bar 23 depresses the flag 45′ and causes the long pawl 104 to turn the ratchet wheel 102 through the space of one half tooth the resulting movement of the cylinder 97 will cause the contacts 96 to clear the plate 100 with which they were initially in engagement thereby breaking the circuit through the contacts 96, deenergizing the trip coil 36′ and setting the control disk 19′ in rotation to cause the shear to first sever a crop end of predetermined length from the bar 23 and then to automatically cut the remainder of the bar into billets of equal length, all as fully set forth and described in the previous description of Fig. 2. When the cylinder 97 is turned to break the circuit between the contacts 96, it is apparent from Fig. 14 that the circuit between the contacts 95 is still maintained by the contact plate 99, thereby holding the circuit through the trip solenoid 33 to the No. 1 control mechanism and this condition of affairs is maintained while the No. 2 control mechanism is operating the shear to cut up the first bar.

When however the tail end of the sheared bar releases the flag 45′, the turning movement of the cylinder 97 through one half a tooth by the short pawl 105, reestablishes the circuit between the contacts 96 thereby reenergizing either of the trip solenoids 33′ or 36′ so as to place the trips 32′ or 35′ into position to arrest rotation of either the disk 19′ or 20′ of the No. 2 control mechanism, at which time the circuit between the contacts 95 is still maintained by the plate 99. After the raising of the trigger 45′ has caused the holding circuit of the No. 2 control mechanism to be reestablished, it is apparent in Fig. 17 that the contacts 95 are then positioned near the end of the bridging contact 99, so that when the front end of the next succeeding ingot bar depresses the flag 45′ the turning of the cylinder 97 causes the contact plate 99 to break the circuit between the contacts 95, see Fig. 15. When this occurs, the disk 19 or 20 of the No. 1 control mechanism is immediately set in rotation so that the No. 1 control mechanism governs the operation of the shear in cropping and cutting up the second bar. It is apparent that this control of the cutting up of the second bar by the No. 1 control mechanism is automatically carried out even though the gap between successive bars be very short. Therefore it is immaterial whether or not the No. 2 control mechanism is reset before the second depression of the flag 45′. From the foregoing then it is apparent that the modified arrangement just described with reference to Figs. 14 to 22 inclusive, functions in precisely the same manner as the mechanism described with reference to the preceding figures and that the invention is susceptible of other modifications without departing from the essential principle thereof, namely the control of the shear by first one mechanism and then the other, so that the shear will always function properly irrespective of the distance between successively delivered pieces of stock and of the length of billets that are required to be cut.

We claim:

1. In apparatus for shearing metal bars while in motion, the combination with a shearing device and means for conveying metal bars to said shearing device, of a pair of shear-control mechanisms, each adapted to produce a succession of shear operations in timed relation to the movement of a bar, said mechanisms adapted to be alternately set in operation by movement of successive metal bars towards said shearing device.

2. In apparatus for shearing metal bars while in motion, the combination with a shearing device, and means for conveying metal bars to said shearing device, of a shear-control mechanism set in operation by movement of a bar toward said shearing device, for automatically producing a succession of shear operations in timed relation to the movement of said bar, means for interrupting the operation of said shear-control mechanism following the complete passage of a bar through the shear and a second shear-control mechanism adapted to be set in opertaion by movement of the next succeeding bar, irrespective of whether or not the first shear-control mechanism has come to rest.

3. In apparatus for shearing metal bars, the combination with a shearing device, and means for conveying metal bars to said shearing device, of a pair of shear-control devices adapted to be driven in synchronism with said metal conveying means for separately producing a succession of shear operations in timed reltaion to the movement of a bar, and selective means adapted to be actuated by the front end of a bar in its movement to said shearing device for initiating the operation of one of said devices while the other of said devices remains inoperative during the passage of said bar through said shearing device.

4. In apparatus for shearing metal bars while in motion, the combination with a shearing device, and means for conveying metal bars to said shearing device, of a pair of shear-control devices adapted to be driven in synchronism with said metal conveying means for separately producing a succession of shear operations in timed relation to the movement of a bar, and a movable flag adapted to be engaged by a moving bar in

advance of its arrival at said shearing device for setting one of said control devices in operation and selective means under the control of said flag for setting the other control device in operation upon depression of said flag by the next succeeding bar.

5. In apparatus for shearing metal bars while in motion, the combination with a shearing device, means for conveying successive bars to said shearing device, an electro-magnet for causing operation of said shearing device and a source of electrical energy, of a pair of shear-control devices adapted to be driven in synchronism with said conveying means for separately controlling the energization of said magnet from said source to cause operation of said shearing device, and selective means operated by the arrival of successive bars at a point in advance of said shearing device for alternately rendering said control devices operative for the energizing of said electro-magnet.

6. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, a pair of electrical control devices adapted to be energized from said source for causing operation of said shearing device and means for conveying material, of means operable by movement of successive pieces of material over said conveying means for automatically altering the circuit relations of first one and then the other of said shear control devices, preparatory to operating said shearing device.

7. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, a pair of electrical shear control devices adapted to be energized from said source for causing the operations of said shearing device and means for conveying material, of means operable by the arrival of successive pieces of material at a given point for alternately causing changes in the circuits of said shear control devices so as to cause operation of said shearing device by first one and then the other of said control devices.

8. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, of a pair of electrical shear control devices adapted to be energized from said source for producing a succession of shear operations in timed relation to the movement of the material to be sheared, a switch connected in the circuit of each of said shear control devices and means operable by the arrival of successive pieces of material at a given point for alternately operating said switches to shift the control of said shearing device from one control device to the other.

9. In apparatus of the class described, the combination with a shearing device, of means for conveying material thereto, a pair of electrical shear-control devices each adapted to produce a succession of shear operations in timed relation to the movement of the material, a switch in the circuit of each control device for determining the operation of said shearing device thereby and selective means operable by movement of successive pieces of material on said conveying means for automatically operating first one switch and then the other.

10. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, a pair of electrical shear-control devices each adapted to produce a succession of shear operations in timed relation to the movement of the material to be sheared, and each providing a pair of normally closed contacts, a member adapted to be engaged by moving material for alternately opening and closing the circuit between either one of said pairs of contacts, whereby control of said shearing device is first by one control device and then by the other.

11. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, a pair of electrical shear-control devices each adapted to produce a succession of shear operations in timed relation to the movement of the material to be sheared, and each providing a pair of normally closed contacts and a member adapted to be engaged by moving material for opening the circuit between one pair of contacts while the circuit between the other pair of contacts remains closed, opening of said circuit being adapted to place the control of said shearing device under the control of the corresponding control device.

12. In apparatus of the class described, the combination with a shearing device, a source of electrical energy, a pair of electrical shear-control devices, each adapted to produce a succession of shear operations in timed relation to the movement of the material being sheared, and each providing a pair of normally closed contacts and a member adapted to be engaged by moving pieces of material for alternately opening the circuit between said pairs of contacts in response to engagement by successive pieces of material, whereby the operation of said shearing device is controlled first by one and then by the other of said control devices.

13. In apparatus of the class described, the combination with a shearing device, of a pair of electrical shear-control devices for causing operation of said shear in timed relation to the movement of the material being sheared, each of said control devices providing a pair of normally closed contacts, and a pivotally mounted member adapted to be engaged by successive pieces of material, turning movement of said member in one direction being adapted to open the circuit between one, or the other, of said pairs of contacts, thereby to determine which of

said control devices will cause operation of said shearing device.

14. In apparatus of the class described, the combination with a shearing device, of a pair of electrical shear-control devices, each adapted to produce a succession of shear operations in timed relation to the movement of the material to be sheared, and each of said control devices providing a pair of spaced contacts in its circuit normally bridged by a movable contact member, and a pivotally mounted member adapted by its turning movement to operate one of said contact members to open the circuit between one of said pairs of contacts and thus bring about operation of said shearing device by the corresponding control device while the circuit between the other pair of contacts remains closed.

15. In apparatus of the class described, the combination with a shearing device, of a pair of electrical shear-control devices, each adapted to produce a succession of shear operations in timed relation to the movement of the material to be sheared, and each of said control devices providing a pair of normally closed spaced contacts in its circuit, and a pivotally mounted operating member and a selector interposed between said operating member and said pairs of contacts, whereby successive movements of said operating member in the same direction are adapted to alternately open the contacts in the circuits of said control devices and cause operation of said shearing device first by one control device and then by the other.

16. In apparatus of the class described, the combination with a shearing device, of a pair of electrical shear-control devices, each adapted to produce a succession of shear operations in timed relation to the movement of the material to be sheared, and each of said control devices providing a pair of fixed contacts in its circuit, a pivotally mounted member adapted to be engaged by moving material, movable contact members normally maintaining the circuit between each pair of fixed contacts and a selector cooperating with said pivoted member adapted to move one of said contact members out of engagement with one pair of contacts upon the engagement of said pivoted member by one piece of moving material and adapted to cause the other contact member to be moved out of engagement with the other pair of contacts upon engagement of the pivoted member by the next succeeding piece of moving material.

17. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control mechanisms each adapted to produce a succession of shear operations in timed relation to the movement of the material, and means for alternating the control of said shear, for its operations on successively-arriving pieces of material, between said pair of control mechanisms.

18. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control mechanisms, each providing elements adapted for rotation in step with the travel of the material to produce a succession of shear operations thereon, means responsive to the arrival of a piece of material at a predetermined point for inaugurating the rotation of the elements of one of said mechanisms, to control the shearing operations on said piece, and means for shifting the control of the shear to said other mechanism, in response to the arrival of the next-following piece at said predetermined point.

19. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control mechanisms, one or the other of which is set in operation by the arrival of a moving piece at a predetermined point, to produce a succession of shear operations on said piece in timed relation to its movement, and means responsive to the passage of said piece beyond said predetermined point for transferring the control of the operations of said shear to said other control mechanism, in advance of the arrival of the next following piece of material at said predetermined point.

20. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each providing elements rotatable to produce a succession of shear operations in timed relation to the movement of said material, means responsive to the arrival of a moving piece of material at a predetermined point for procuring operation of one of said devices, to cause the shear to function for the division of said piece, means for maintaining the rotatable elements of the other shear control device stationary and inoperative during the aforesaid operation of the first-mentioned shear-control device, and means responsive to the passage of the last end of said piece of material beyond said predetermined point for shifting the control of the shear operations to said other device, whereby the next-following piece of material, on its arrival at said predetermined point, sets said other device in operation.

21. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, either one of which, as set in operation from rest position by the arrival of a moving piece at a predetermined point, pro-

duces a succession of shear operations on said piece in timed relation to the latter's movement, means responsive to the passage of said piece beyond said predetermined point for restoring the so-operated control device to said rest position, and means for transferring the control of the shear, for its operations on the next-following piece of material, to the other control device, whereby the return of the first control device to rest position is not interrupted by the premature arrival of the next-following piece of material at said predetermined point.

22. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each operable to produce a succession of shear operations on the material in timed relation to the latter's movement, and means for rendering said devices alternately operative and inoperative in timed relation to the arrival of successive pieces at a predetermined point, whereby the control of the shear operations on one piece is effected by one of said devices and the control of the shear operations on the next-following piece is effected by the other of said devices.

23. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each operable to produce a succession of shear operations on the material in timed relation to the latter's movement, a movable member adapted in one position to render one of said devices operative, and in another position to render the other device operative, and means brought into action by the gap between successive pieces of material for moving said member from one position to its other position, thereby to shift the control of the shear from one to the other of said devices, as each successive unsheared piece arrives in shearing position.

24. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, either one of which, as set in operation from rest position by the arrival of a moving piece at a predetermined point, produces a succession of shear operations on said piece in timed relation to the latter's movement, a movable member adapted in one position to render one of said devices operative, and in another position to render the other device operative, and means responsive to passage of one piece past said predetermined point and the arrival of the next piece at said predetermined point for moving said member from one position to its other position, thereby to shift the control of the shear from one to the other of said devices, as each successive unsheared piece arrives in shearing position.

25. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each operable to produce a succession of shear operations on the material in timed relation to the latter's movement, a movable member adapted in one position to render one of said devices operative, and in another position to render the other device operative, a trigger in the path of the moving material, and moved thereby, and connections between said trigger and said member for moving the latter from one position to its other position, in response to said trigger's release by one piece of material and its engagement by the next-following piece.

26. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each operable to produce a succession of shear operations on the material in timed relation to the latter's movement, a rotary member adapted in successive angular positions to render said devices alternately operative, and means brought into action by the gap between successive pieces for angularly advancing said rotary member, step by step, thereby to shift the control of the shear from one to the other of said devices, as each successive unsheared piece arrives in shearing position.

27. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, either one of which, as set in operation from rest position by the arrival of a moving piece at a predetermined point, produces a succession of shear operations on said piece in timed relation to the latter's movement, a rotary member adapted in successive angular positions to render said devices alternately operative, and means responsive to passage of one piece past said predetermined point and the arrival of the next piece at said predetermined point for angularly advancing said rotary member, step by step, thereby to shift the control of the shear from one to the other of said devices, as each successive unsheared piece arrives in shearing position.

28. In apparatus of the class described, the combination with a shear for operation on successively-arriving elongated pieces of moving material, of a pair of shear-control devices, each operable to produce a succession of shear operations on the material in timed relation to the latter's movement, a rotary member adapted in successive angular positions to render said devices alternately operative, a trigger in the path of the moving

material, and moved thereby, and connections between said trigger and said rotary member for moving the latter to shift the control of the shear from one control device to the other when said trigger is released by one piece of material and engaged by the next-following piece.

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