

July 30, 1935.

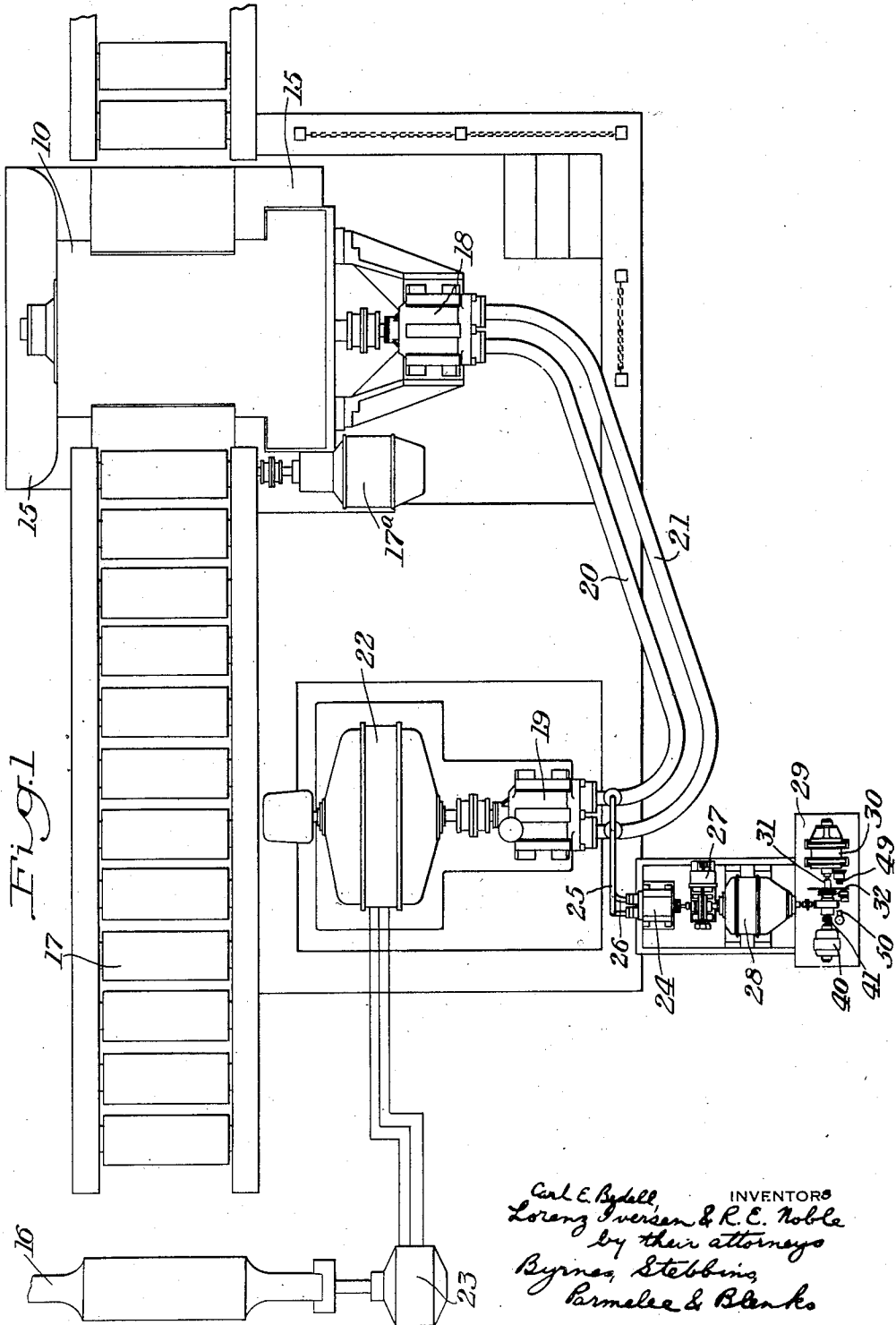
L. IVERSEN ET AL

2,009,695

SHEARING APPARATUS

Filed Nov. 27, 1934

8 Sheets-Sheet 1



July 30, 1935.

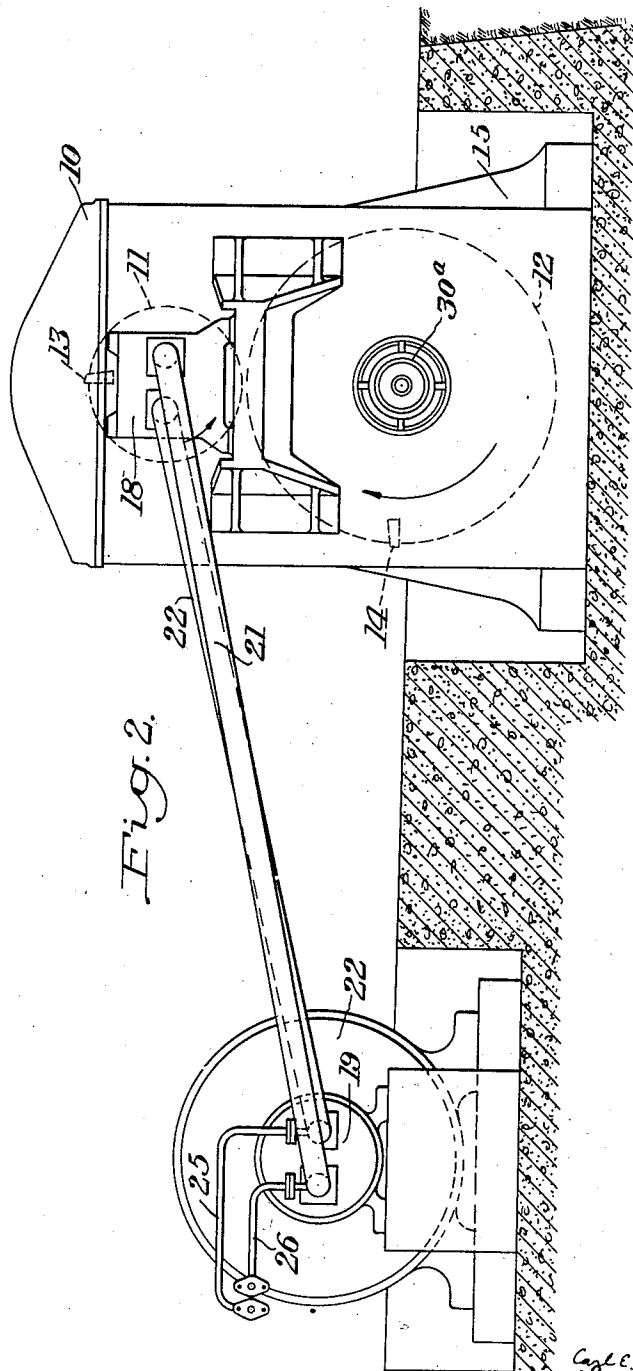
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SHEARING APPARATUS

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8 Sheets-Sheet 2



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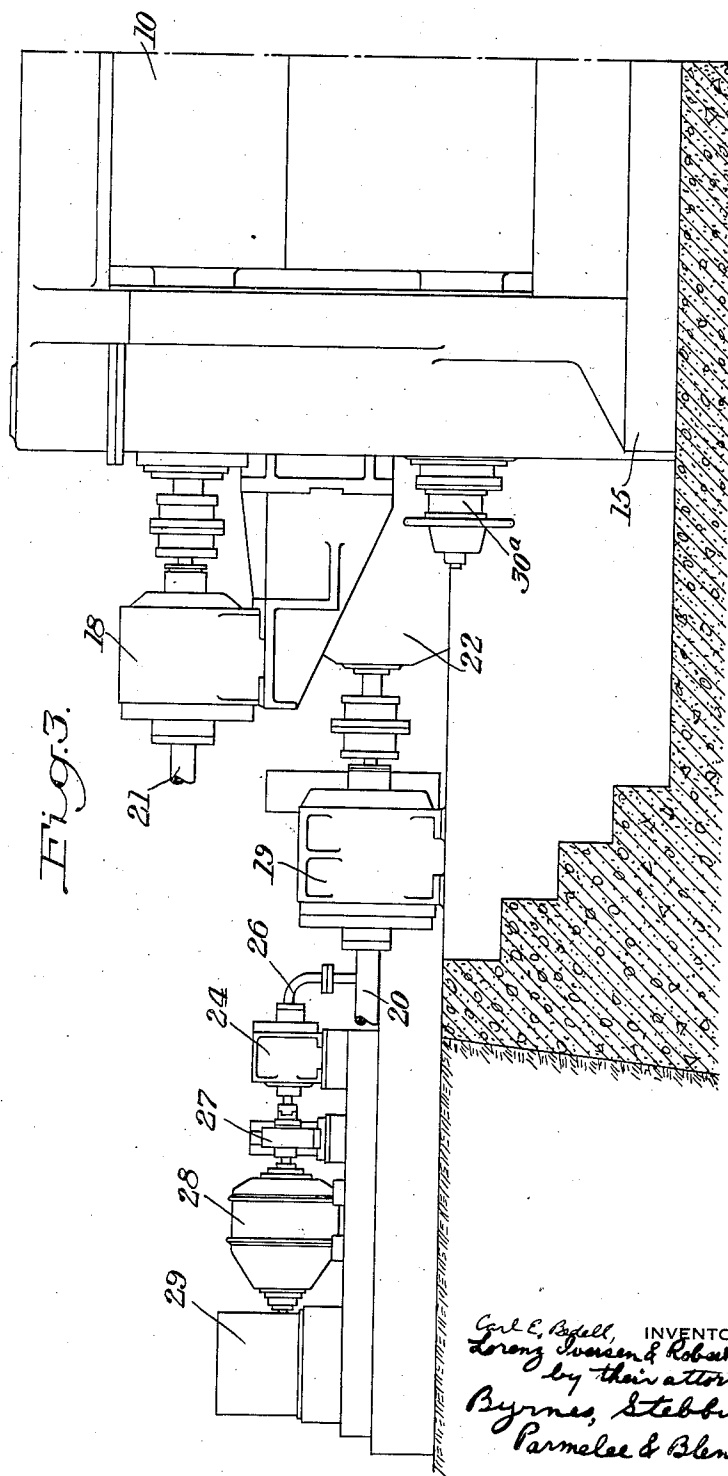
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SHEARING APPARATUS

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8 Sheets-Sheet 3



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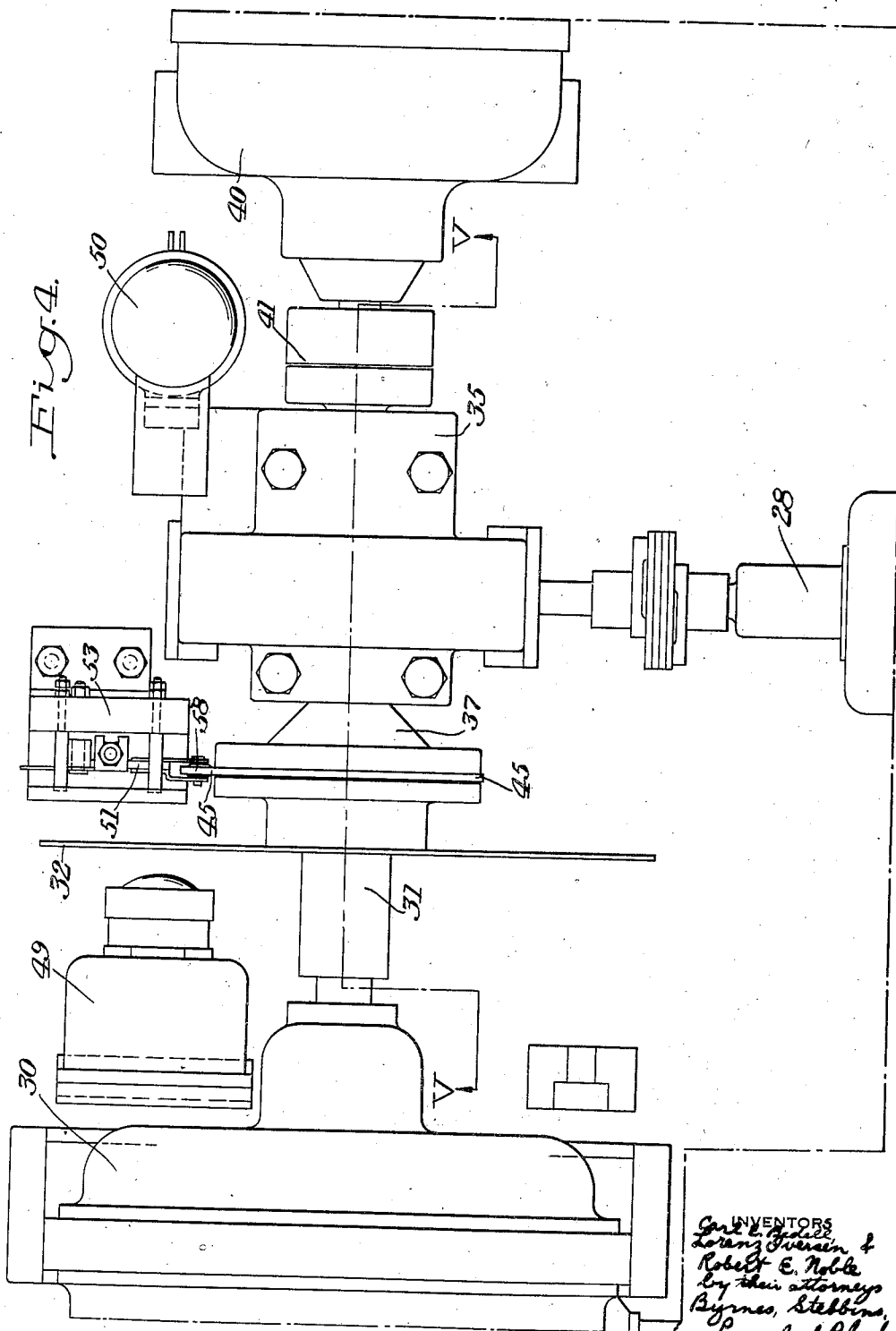
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SHEARING APPARATUS

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8 Sheets-Sheet 4



July 30, 1935.

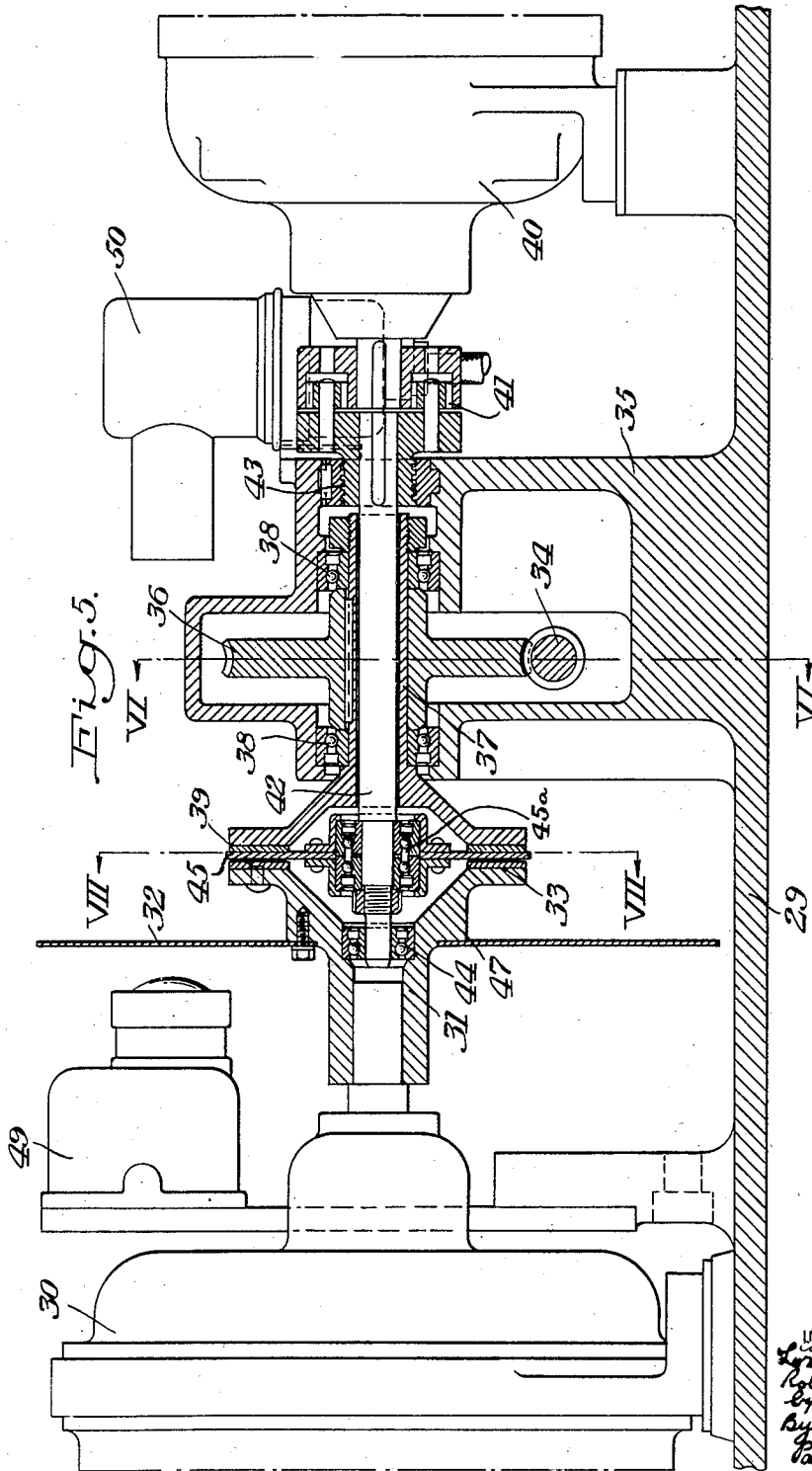
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SHEARING APPARATUS

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8 Sheets-Sheet 5



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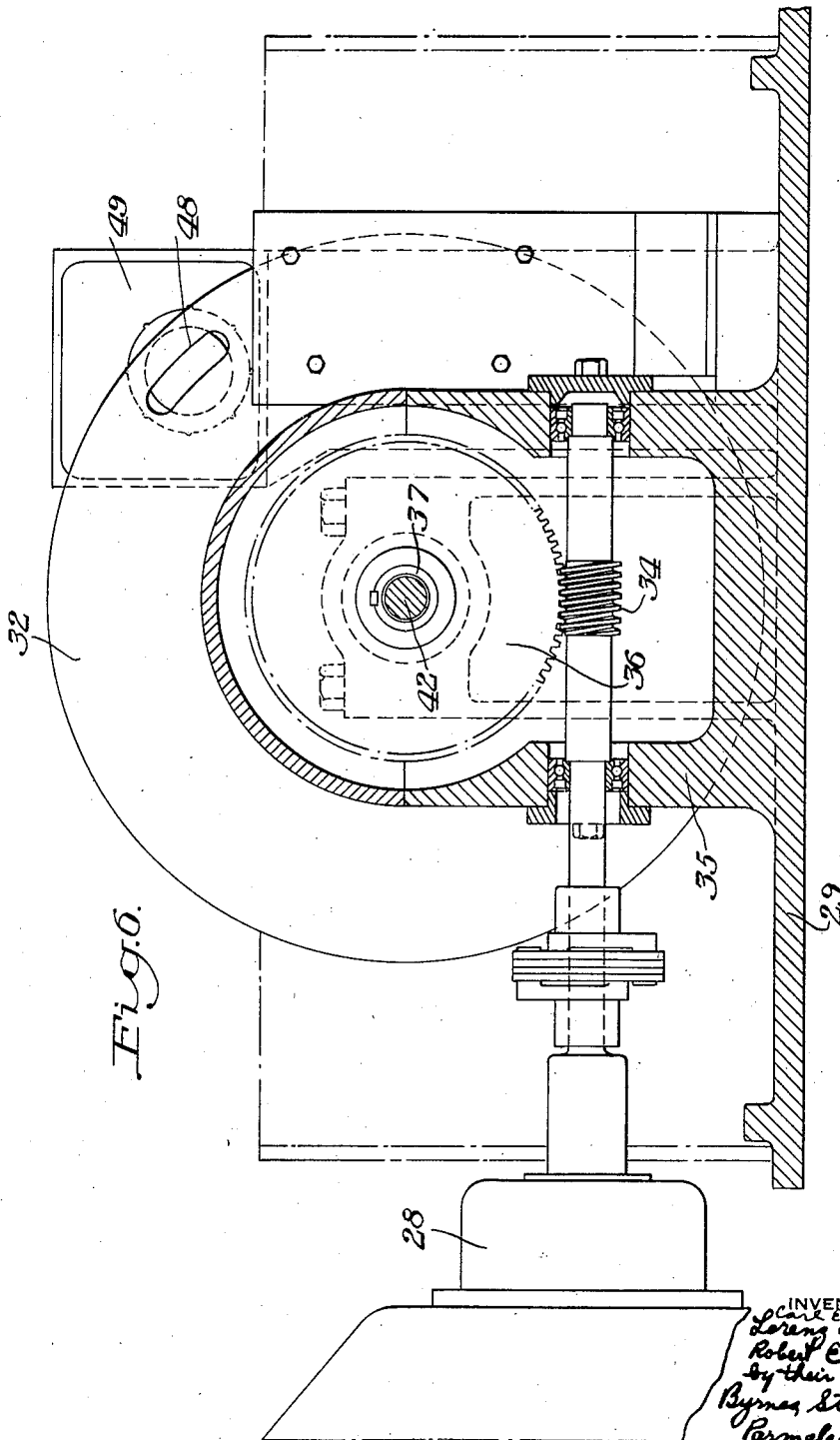
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SHEARING APPARATUS

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8 Sheets-Sheet 6



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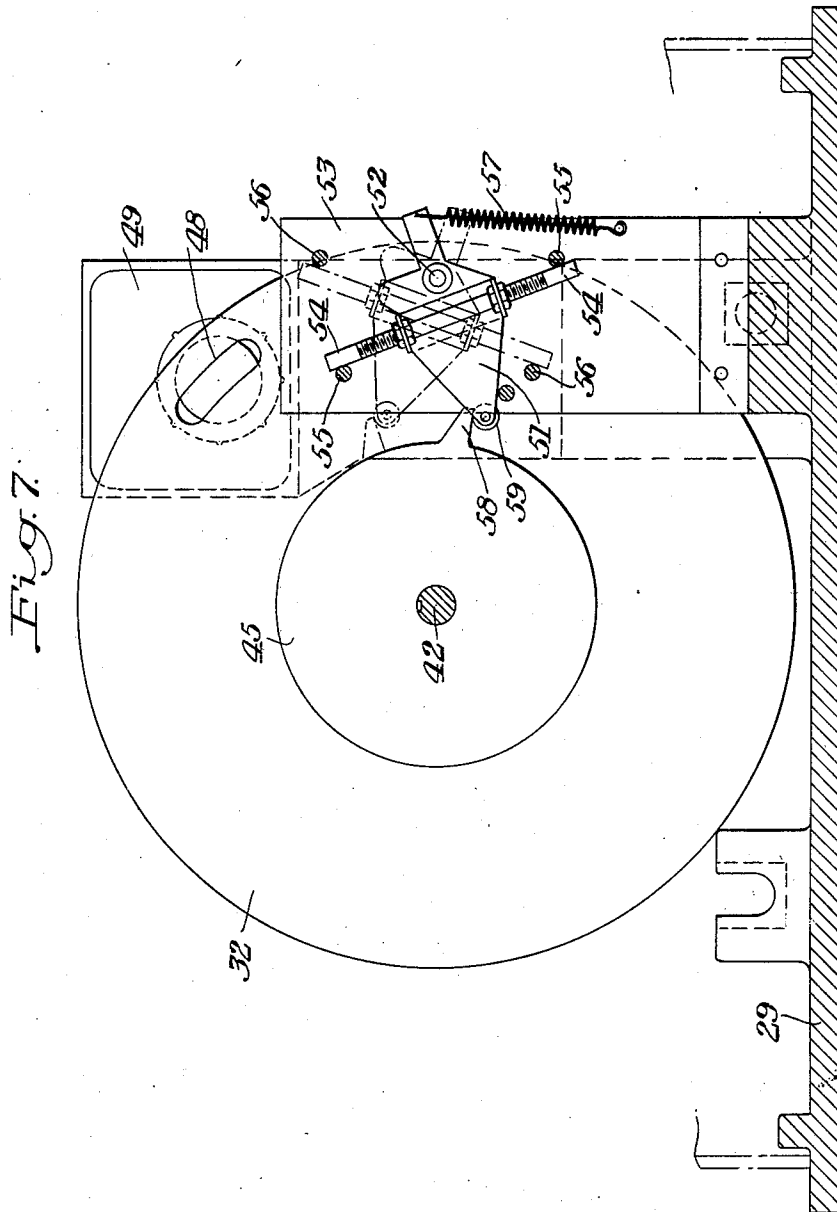
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SHEARING APPARATUS

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8 Sheets-Sheet 7



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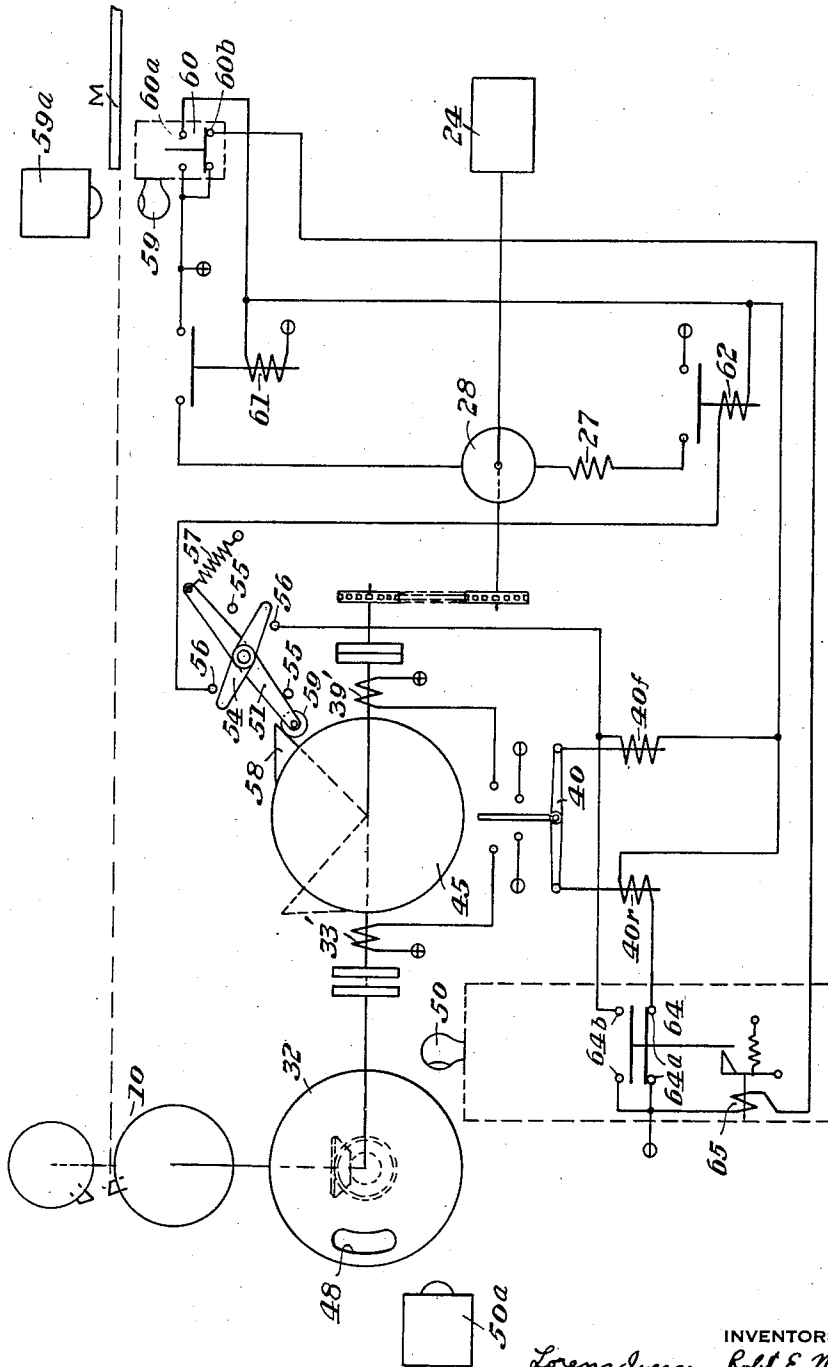
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SHEARING APPARATUS

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8 Sheets-Sheet 8

Fig. 8.



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UNITED STATES PATENT OFFICE

2,009,695

SHEARING APPARATUS

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Application November 27, 1934, Serial No. 754,986

20 Claims. (Cl. 164—68)

Our invention relates to the art of shearing, and more particularly to an apparatus for continuously shearing long metal lengths into pieces of the same size, and having means for insuring that the initial cut from each length will be long enough only to crop the leading rough end.

It has been recognized, for a long time, that in the continuous shearing of long metal lengths, some means for insuring that the initial crop remove only a minimum amount of material from the length should be provided, since the cropped end so removed is scrapped. Such means have been provided for continuous flying shears driven by a direct-connected electric motor, as well as for shears of the intermittent type which are started and stopped for each cut. The means usually provided for shears of this kind include an electrical contact adapted to be actuated by the advancing length when a predetermined distance from the shear. Through suitable relays and other auxiliary apparatus, a shear of the intermittent type may be started so that it will crop the leading end of the length with a minimum scrap loss.

In the Edwards Patent No 1,599,880, furthermore, is disclosed a system for controlling a continuously operating, motor-driven shear so that the shear is accelerated or decelerated to an appropriate extent, to insure that the initial crops shall be taken so as to minimize scrap loss.

Electrically driven shears of both the continuously operating and intermittent types have in many cases been supplanted by shears for continuous mills having an adjustable hydraulic drive connecting the shear and one stand, usually the last stand, of a continuous mill. By this combination of apparatus, the shearing of pieces of the same length is insured since the relation between the speed of the shear and the speed of the material issuing from the mill is fixed for a given set-up. A system of this kind sometimes includes a generator directly connected to one of the mill stands, a motor driven by the generator in synchronism therewith, a pump driven by the motor and a hydraulic motor for driving the shear, actuated by fluid delivered from the pump, or the pump may be mechanically driven from the mill drive. The pump and hydraulic motor are preferably of such character that the ratio of their speeds can be adjusted.

One object of our invention is to provide shearing apparatus of this character with means for effecting an initial crop from lengths fed thereto so that the scrap represented by the material cropped from the leading end will be a

minimum. Obviously, the cropping control of a shear positively driven from the mill delivering material to the shear is not so simple as that of an intermittent or a continuously operating shear driven by an independent electric motor.

In accordance with our invention, we provide, in addition to the main pump supplying fluid to the hydraulic motor for operating the shear, an auxiliary pump connected in parallel therewith. The auxiliary pump is normally idle but, upon the approach of a length to the shear, the auxiliary pump is driven to the extent necessary to so adjust the position of the shear blades that they will be in shearing position just after the leading end of a length has passed through the bite of the shear. For controlling the adjustment of the shear, we utilize a member moving at the speed of the shear whereby an indication of the position of the shear blades is always afforded. In combination with said member, we provide means for driving the auxiliary pump to exert the required corrective effect upon the movement of the shear so that the blades thereof will be in the proper position at the proper time.

For a complete understanding of our invention, reference is made to the accompanying drawings illustrating a present preferred embodiment thereof. It is to be understood, of course, that changes in the apparatus described and illustrated herein as a preferred embodiment may be made within the scope of our broader claims. In the drawings:—

Figure 1 is a top plan view, partly diagrammatic, showing the apparatus constituting the invention;

Figure 2 is a side elevation of the apparatus of Figure 1, certain parts being omitted for clearness;

Figure 3 is an end view of the apparatus shown in Figure 1;

Figure 4 is a plan view to enlarged scale illustrating the control apparatus;

Figure 5 is a sectional view taken along the line V—V of Figure 4;

Figure 6 is a sectional view taken along the line VI—VI of Figure 5;

Figure 7 is a sectional view taken along the line VII—VII of Figure 5 showing parts in elevation; and—

Figure 8 is a schematic diagram of the invention, certain mechanical elements being represented by their electrical equivalents, or vice versa, for convenience.

Referring in detail to the drawings and, for the present, to Figures 1 through 3, a shear

including drums 11 and 12 having shear blades 13 and 14, and mounted in suitable housings 15, is adapted to shear material issuing from a rolling mill, the last stand of which is illustrated diagrammatically at 16. A run-out table 17 driven by a motor 17a extends from the mill to the shear for delivering material thereto. The shear 10 is driven by a hydraulic motor 18 which has connection with a pump 19 supplying fluid thereto through supply and return conduits 20 and 21. The pump 19 is driven by a synchronous motor 22 directly coupled thereto. The motor 22 is driven by current supplied from a generator 23 directly coupled to the mill stand 16. The generator 23 and the motor 22 operate in synchronism, and the speeds of the motor 18 and the pump 19 have a definite ratio, although this may be changed by suitable adjusting means. As a result, the shear 10 is driven at a speed having a definite ratio to that of the material issuing from the mill.

In order to adjust the position of the blades of the shear 10 while the shear is operating, we provide an auxiliary pump 24 adapted to deliver fluid to and receive fluid from the motor 18 through conduits 25 and 26 branching from the conduits 20 and 21. Preferably the pump 24 is designed so that a predetermined number of revolutions, e. g. 50, will effect a complete revolution of the shear blades. The pump 24 is normally idle except during the short periods in which adjustment of the position of the shear blades is being effected. An electromagnetic brake 27 holds the pump stationary during periods of idleness. This brake is of the usual type and may be released by energizing its electromagnet. A motor 28 for driving the auxiliary pump 24 is controlled by apparatus indicated generally at 29 and illustrated in detail in Figures 4 through 7.

The control apparatus 29 includes a synchronous motor 30, the shaft of which is provided with a sleeve 31 carrying a light control disc 32 and a friction ring 33. The motor 30 is driven in synchronism with a generator 30a (Figure 3), coupled directly to the shear 10. This generator preferably has an adjustable stator so that the position of the disc 32 relative to the shear blades may be adjusted. The disc 32, however, always rotates in synchronism with the shear.

The shaft of the motor 28 is coupled to a worm 34, (Figure 6) journaled in a pedestal 35 on the base of the control mechanism 29. The worm 34 meshes with the worm wheel 36 keyed to a sleeve 37. The sleeve 37 is rotatably supported by the pedestal 35 in bearings 38 and the outer end of the sleeve is provided with a friction driving ring 39, axially aligned with the friction ring 33.

A reversible torque motor 40 is mounted coaxially with the motor 30 and has a coupling 41 connecting it to a shaft 42 which extends through the sleeve 37. The coupling 41 is of such construction as to permit axial movement of the shaft 42 relative to the motor 40. The hub portion of the coupling 41 is threaded for cooperation with a nut 43 keyed in the pedestal 35, so that rotation of the shaft 42 in opposite directions will cause it to move axially in the nut 43. The free end of the shaft 42 is supported in an end bearing 44 carried in the sleeve 31.

A switch control disc 45 is freely mounted in bearings 45a on the shaft 42 between the friction rings 33 and 39.

The light control disc 32 is provided with a slot 48 through which light from a lamp box 49 shines upon a photoelectric cell 50 to control the

operation of the system in a manner to be explained more fully hereafter. The disc 45 controls a switch element 51 (Figure 7) pivoted at 52 on a panel 53 forming part of the control device 29. The switch member 51 carries fingers 54 adapted to engage a pair of stops 55 or a pair of contact studs 56 in its two extreme positions. A spring 57 tends to urge the switch element clockwise, as viewed in Figure 7, but a projection 58 on the disc 45, cooperating with a roller 59 on the switch element, normally maintains the latter in the solid line position as shown in Figure 7.

In addition to the elements already described, a number of auxiliary pieces of apparatus of 15 standard design are shown diagrammatically in Figure 8. A photocell 59 actuated by a light source 59a controls a relay 60. The relay 60 controls contactors 61 and 62, as well as the windings 40r and 40f representing forward and reverse field windings of the motor 40. If these windings are simultaneously energized, they neutralize each other and, since the net field flux is zero, no torque is exerted on the motor armature and it remains stationary. If neither winding is energized, it remains in the position to which it was last actuated. A relay 64 is controlled by the photocell 59. The light source 49 is adapted to illuminate the photocell. A mechanical latch holds the relay 64 in operative position until released by the energization of a reset coil 65.

In Figure 8, instead of attempting to represent schematically the mechanism by which the disc 45 is driven either by the motor 30 or the motor 28, we have shown electromagnets 33' and 39' controlled by the torque motor 40 for actuating the friction driving rings 33 and 39, respectively, into engagement with the disc 45. The motor 40 is shown schematically as a tilting beam with actuating solenoids 40f and 40r. These electromagnetic clutches, of course, are the electrical equivalent of mechanical clutches previously described, and the tilting beam, of the motor 40.

Figure 8 illustrates the normal condition of the apparatus prior to the execution of an initial cropping cut on a piece of material issuing from the mill. For any given delivery speed of the material and any given distance A of the photocell 59 from the axis of the shear 10, there is a certain instantaneous position of the shear blades corresponding to the position of the piece as shown in Figure 8, which will produce the desired initial cropping cut with a minimum of scrap. Obviously, since the delivery of the material from the rolls of the mill is purely at random with respect to the instantaneous position of the continuously driven shear blades, the aforesaid conditions will occur very infrequently.

Our invention, however, provides means for insuring that the shear blades, regardless of their position when the leading end of the piece intercepts the light falling on the photocell 59, will engage the piece at the proper distance from its leading end to effect the desired initial cropping. If the arc of travel between the position of the shear blade illustrated in Figure 8 and the cutting position is of length b, the linear speed of the shear blade m feet per second, the speed of travel of the piece n feet per second, and the permissible length of the initial crop a, then the time required for the shear blade to reach cutting position, or b/m , should be equal to the time required for the leading end of the piece to pass through the shear by the distance a, or $(A+a)/n$.

The operation of the control system of Figure 75

8 will be described, assuming that the parts are in their illustrated position. The piece of material indicated at M is moved from the mill toward the shear 10 by any convenient means, for example, a roll table. As the leading end of the piece reaches the photocell 59, the relay 60 is operated. The opening of the back contact 60b of the relay deenergizes the resetting coil 65 of the relay 64. The closing of the front contact 60a of the relay completes a circuit to energize the contactor 61. A similar circuit is prepared for the contactor 62 but is not yet completed. At the same time, the winding 40r is energized through a circuit including the back contact 64a of the relay 64. The effect of the energization of the winding 40r is to operate the motor 40 so as to energize the clutch coil 33'.

The disc 45 is thus connected to the shear drive. The connection is actually through the motor 30 but is indicated schematically in Figure 8 as constituting gearing. As soon as the disc 45 starts to move counterclockwise with the shear, the fingers 54 of the switch 51 bridge the contacts 56. Nothing further happens, however, until the slot 48 in the disc 32 crosses the line between the light source 49 and the photocell 50. Illumination of the photocell 50 causes operation of the relay 64, which is thereupon locked in operative position. The opening of the back contact 64a of the relay deenergizes the winding 40r. The closing of the front contact 64b energizes the winding 40f and also completes a circuit for the contactor 62, including the contacts 56. The motor 28 is thus started to effect the desired correction of the shear rotor position.

The energization of the winding 40f, furthermore, causes the energization of the coil 39'. The coil 33' is deenergized as the motor 40 shifts on operation of the relay 64. The disc 45 is thus reset by operation of the motor 28 and when the correction has been completed, the operation of the switch 51 opens the circuit for the contactor 62 to stop the motor 28.

After the motor 28 stops, conditions remain unchanged until the trailing end of the piece M passes over the photocell 59. The relay 60 is thereupon again operated to its illustrated position. The circuit for the contactor 61 is broken, as well as that for the winding 40f. The motor 40, however, remains in its former position, that is, so that the coil 39' remains energized. The reclosing of the contacts 60b energizes the resetting magnet 65 of the relay 64, which is thereby restored to its initial position.

If it should happen that the piece M is in the proper position for making the desired cropping cut so that no correction is required, the slot 48 will illuminate the cell 50 and cause operation of the relay 64 before the disc 45 has started to move counterclockwise.

It will thus be seen that the amount of correction required is measured by the counterclockwise motion of the disc 45 and that the measured amount of correction is applied as the disc returns to its initial position.

Since the position of the slot 48 at the time the disc 45 starts to move with the disc 32 controls the amount of correction to be applied by adjusting the shear blade position, the actual length of the initial cropping cut may be controlled by adjusting the position of the slot 48 relative to the shear blades. This may be done most conveniently by providing the generator 39a connected to the shear for driving the disc 32 through the motor 30, with an adjustable stator.

By adjusting the stator, of course, the corresponding position of the slot 48 in the disc 32 is changed relative to the shear blades. Thus, adjustment of the length of the cropping cut may be easily made.

It will be apparent from the foregoing that the amount of correction applied to the shear by adjusting it is dependent upon the amount of lag of the shear blades behind the proper position. It is thus possible to correct the position of the shear blade regardless of its instantaneous position when the piece passes the photocell 59. Since corrections up to a full revolution of the shear blades may be necessary, the photocell must be spaced sufficiently from the shear to provide time for the auxiliary pump motor to effect the required correction.

It will be apparent that the described invention provides means for insuring that the blades of the hydraulically driven shear will always engage the material to be sheared, for the initial cut, at a predetermined minimum distance from the leading end of the piece. After the initial cut, of course, the shear continues to operate depending upon the adjustment of its hydraulic drive, which times the shear operation with the speed of the material issuing from the mill. The system of our invention, therefore, while it provides for temporary adjustment of the shear to position the blades properly for the initial cut, does not interfere with the continued operation of the shear in accordance with present practice.

Although we have illustrated and described herein but one embodiment of our invention, it will be obvious that changes therein may be made without departing from the scope of the appended claims.

We claim:

1. In a shear control system, light control means operating in synchronism with the shear for indicating the position of the blades, means actuated when the material to be sheared is at a predetermined distance from the shear, and means controlled jointly by said aforementioned means for changing the position of the shear blades to effect an initial cropping operation on the material.

2. In combination with a hydraulically driven shear, means for varying the shear blade position comprising an auxiliary pump, means for measuring the departure of the position of the shear blades from the position required to produce a predetermined initial cropping cut, and means for correcting the shear blade position by operating said auxiliary pump in accordance with the magnitude of said departure.

3. The combination with a driven shear, means for changing the instantaneous position of the shear blades while the shear is in motion, and control means for said means, of means responsive to the approach of the material to the shear for causing the control means to move with the shear, and means responsive to movement of the shear to a predetermined position for causing said control means to become free of the shear, reverse its movement, and effect a corrective adjustment of the shear while returning to its initial position.

4. A shear control system comprising driving means for the shear, means for accelerating the driving means, and a control device for the accelerating means including a member selectively movable with the shear and with the controlling means, means responsive to the approach of material to the shear for connecting the control

mechanism to move with the shear, and means responsive to the passage of the shear blades through a predetermined position for connecting the control means to the accelerating means and
 5 operating the latter to return the control means to its initial position.

5. The combination with a continuous shear, a table for feeding material thereto, means for accelerating the shear, and a control device for
 10 said accelerating means, of means responsive to the approach of material to the shear on said table for causing said control device to move with said shear, means responsive to the passage of the shear blades through a predetermined position
 15 for causing the control device to start said accelerating means and move therewith to its initial position.

6. A shear control system comprising a hydraulic drive for the shear, an auxiliary pump
 20 for accelerating the shear, a motor for driving said pump, a control mechanism for said motor, means for moving said control mechanism with the shear in one direction, in response to approach of material to the shear, and means responsive
 25 to the subsequent passage of the shear blades through a predetermined position, for causing said control means to start the pump motor and return therewith to its initial position.

7. A control system for a shear having a hydraulic motor, comprising an auxiliary pump for
 30 accelerating the shear, means responsive to the approach of material to within a predetermined distance of the shear for shifting a control mechanism for the pump in one direction with the
 35 movement of the shear, and means responsive to the passage of the shear blades past a predetermined point for causing the reversal of said control mechanism and the operation of said
 40 pump while said mechanism returns to its initial position.

8. In combination, a shear having rotary blades for cutting moving material, a motor for
 45 driving the shear at a speed approximating that of the material, means for changing the position of the shear blades while being driven by the motor to obtain the desired initial cut, and means responsive to the magnitude of the departure of the
 50 position of the shear blades from the required distance from the shear, for controlling said changing means, said second-mentioned means including light-responsive means actuated on
 55 passage of the blades through a predetermined position.

9. In combination, a shear for cutting moving material, means for driving the shear, means for temporarily accelerating the shear, and light-responsive means for causing the operation of said
 60 accelerating means for a period proportional to the distance of the shear blades behind the position required to give the desired initial cut, when the material is at a predetermined distance from the shear.

10. In combination, a shear adapted to cut
 65 moving material, hydraulic means for driving the shear, means for changing the position of the shear blades while in motion including an auxiliary pump connected to said hydraulic driving
 70 means, and means for rendering the position-changing means effective for a period proportional to the departure of the shear blades from the position necessary to give the desired
 75 initial cut when the material is at a predetermined distance from the shear.

11. In combination, a shear adapted to cut
 moving material, means for driving the shear, there being a predetermined position of the shear
 blades corresponding to a predetermined distance
 5 of the leading end of the material from the shear resulting in the desired initial shear cut, means for changing the shear blade position, and means including light-responsive means operable when
 the blades reach a predetermined position for
 10 controlling the position-changing means in proportion to the departure of the position of the shear blades from said first-mentioned position when the material is at said predetermined distance from the shear.

12. In combination, a shear adapted to cut
 15 moving material, a hydraulic drive for operating the shear, means for measuring the distance of the shear blades away from the position required to give the desired initial cut when the material is at a predetermined distance from the mill, and
 20 means including an auxiliary pump connected to said drive for proportionally changing the position of said shear blades.

13. In combination, a rotary shear for cutting
 moving material, means actuated when the material is at a predetermined distance from the
 25 shear for measuring the departure of the shear blades from the position required to give the desired initial shear cut, including light-responsive means operable when the blades reach a predetermined position, and means responsive to said
 30 measurement for applying a corrective change to the position of said shear blades.

14. In combination, a continuous shear, a hydraulic motor for driving the shear, means for
 35 controlling the position of the shear blades, comprising means for determining the amount of adjustment of the shear-blade position required to effect an initial cropping cut of predetermined
 40 length, and an auxiliary pump connected to the motor and controlled by said means for effecting the required adjustment of the shear-blade position.

15. The combination with a shear for cutting
 material, and a hydraulic motor for driving the
 45 shear, of means for adjusting the position of the shear blades while the shear is operating including means for determining the amount of adjustment of the shear necessary to insure a cropping
 50 cut of predetermined length, and a pump connected to said motor for effecting the required adjustment of the shear.

16. Shearing apparatus comprising a rotary
 shear, means for driving the shear, means for
 55 adjusting the position of the shear blades while in motion to effect a cropping cut of the desired length, and light-responsive means controlled by material advancing to the shear for controlling
 said adjusting means.

17. Shearing apparatus including a rotary
 60 shear, means for driving the shear, means for adjusting the position of the shear blades while in motion, means adapted to rotate with said shear, means operative upon the passage of the
 65 shear blades through a predetermined position for causing said last-mentioned means to return to a predetermined normal position while causing operation of said adjusting means.

18. Shearing apparatus comprising a rotary
 shear, a drive therefor including a hydraulic
 70 system, and means for adjusting the position of the blades of the shear while in motion including an auxiliary pump connected to said hydraulic system.

19. The combination with a fluid drive includ- 75

ing a fluid motor having a shaft adapted to deliver energy, a pump adapted to deliver fluid to said motor, said pump having a shaft adapted to be driven, of an auxiliary pump connected between said motor and said first-mentioned pump and effective for changing the angular position of the motor shaft relative to that of the shaft of the first-mentioned pump.

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shear, means for adjusting the position of the shear blades while in motion, and means responsive jointly to the approach of a piece of stock to the shear and the passage of the shear blades through a predetermined position, for controlling said position-adjusting means.

5

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20. Shearing apparatus comprising a rotary