June 27, 1939. M. L. STRAWN ET AL 2,163,967

CUT-OFF MACHINE

Filed Jan. 12, 1938 4 Sheets-Sheet 1

Fig. 1

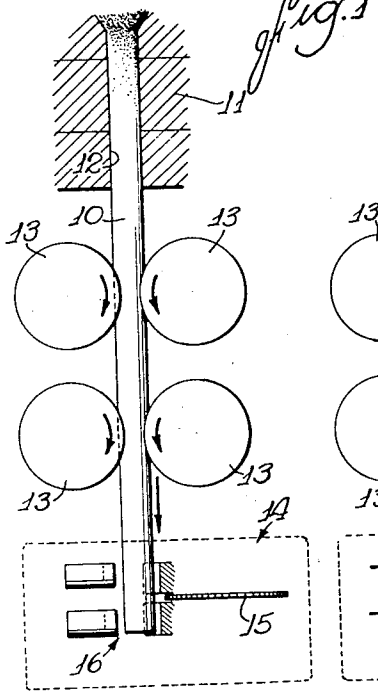



Fig. 2

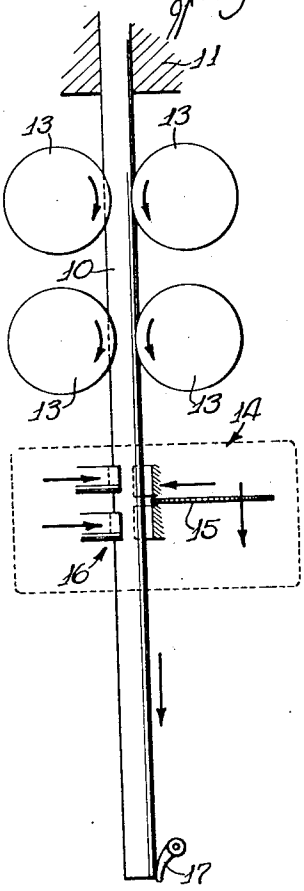
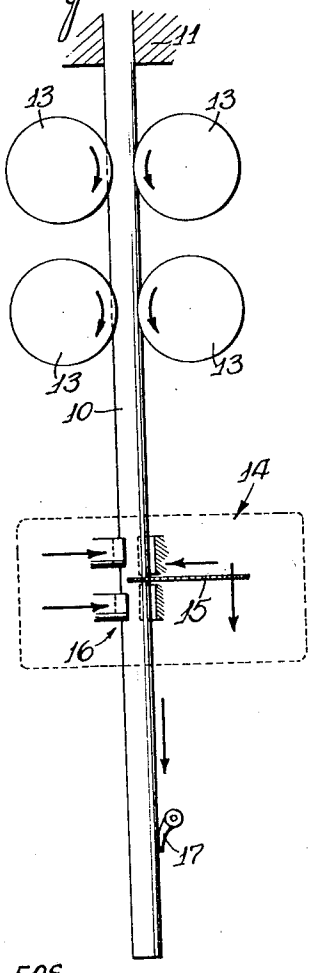



Fig. 3



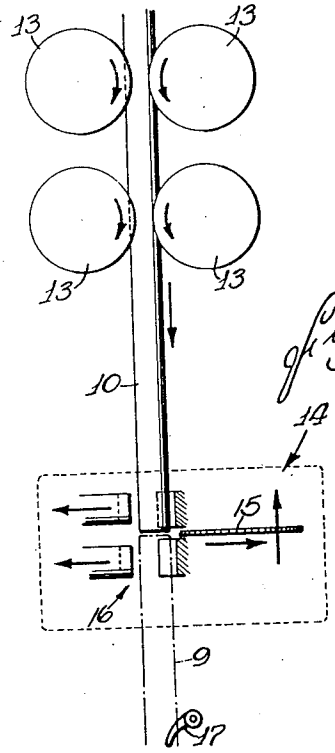
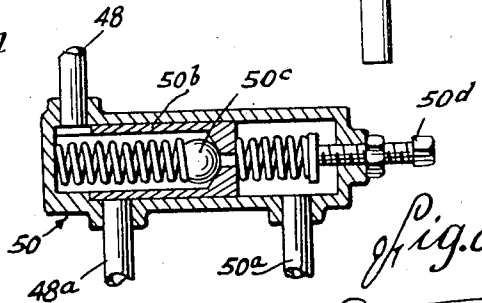




Fig. 4

Fig. 8.




INVENTORS

Marion L. Strawn

Alexander Oberhoffken

By Parker, Carlson, Pitzer & Hubbard

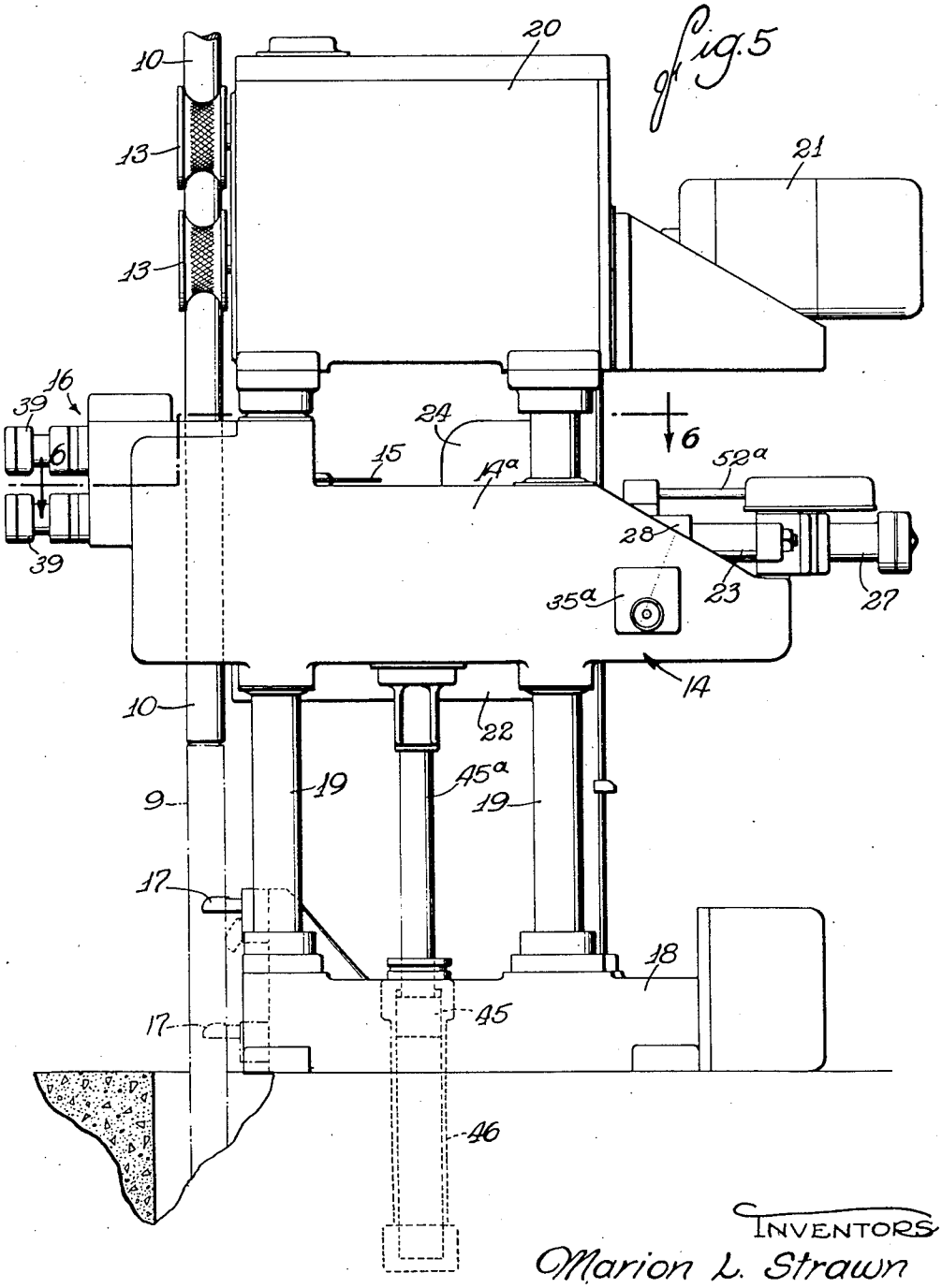
ATTORNEYS

June 27, 1939. M. L. STRAWN ET AL 2,163,967

CUT-OFF MACHINE

Filed Jan. 12, 1938 4 Sheets-Sheet 2

Fig. 5




INVENTORS

Marion L. Strawn

Alexander Oberhoffken

By Parker, Carlson, Pegues & Hubbard

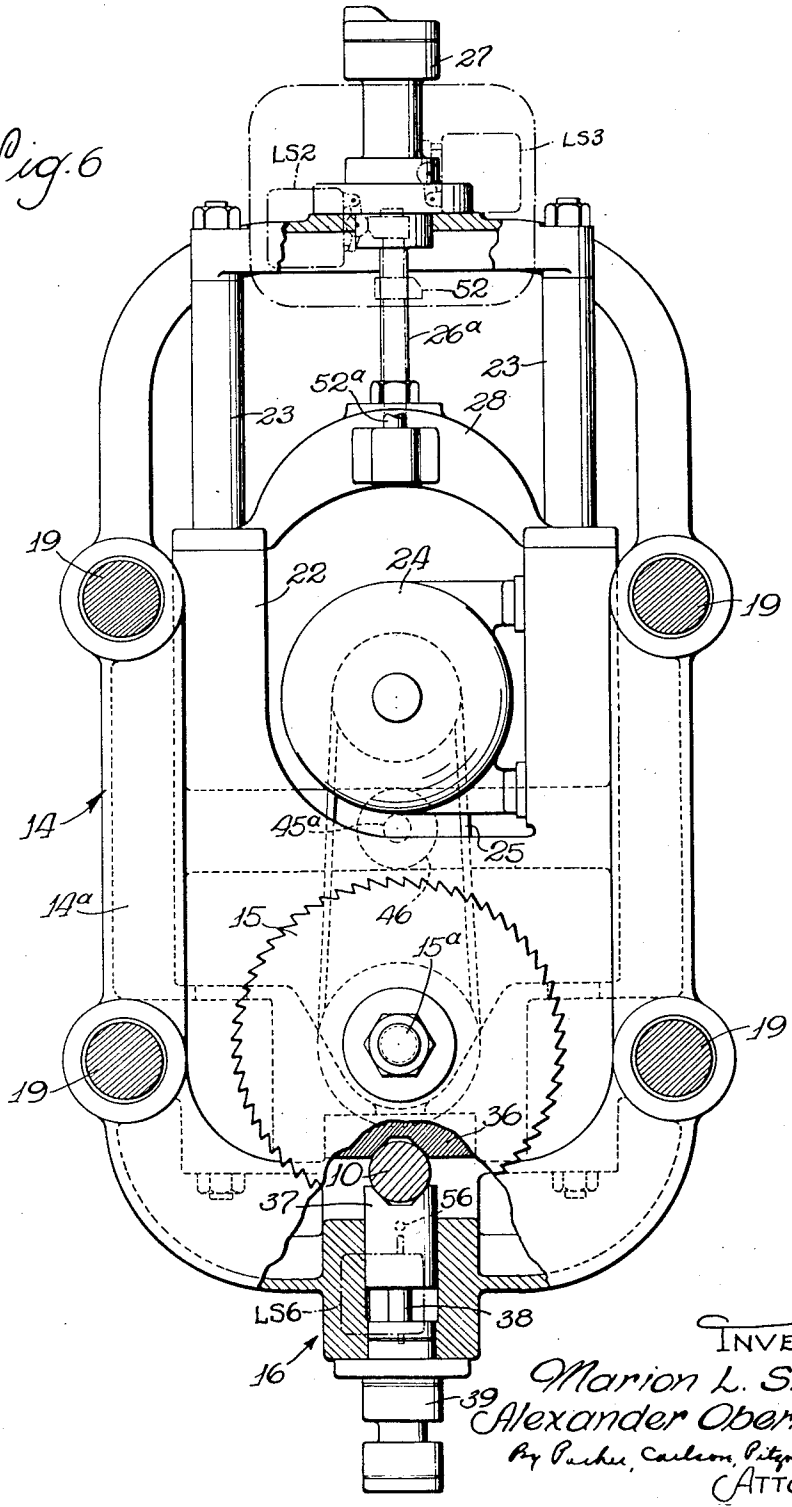
ATTORNEYS

June 27, 1939. M. L. STRAWN ET AL 2,163,967

CUT-OFF MACHINE

Filed Jan. 12, 1938 4 Sheets-Sheet 3

Fig. 6




INVENTORS
Marion L. Strawn
Alexander Oberhoffken
By Parker, Carlson, Pitzer & Hubbard
ATTORNEYS

June 27, 1939. M. L. STRAWN ET AL 2,163,967

CUT-OFF MACHINE

Filed Jan. 12, 1938 4 Sheets-Sheet 4

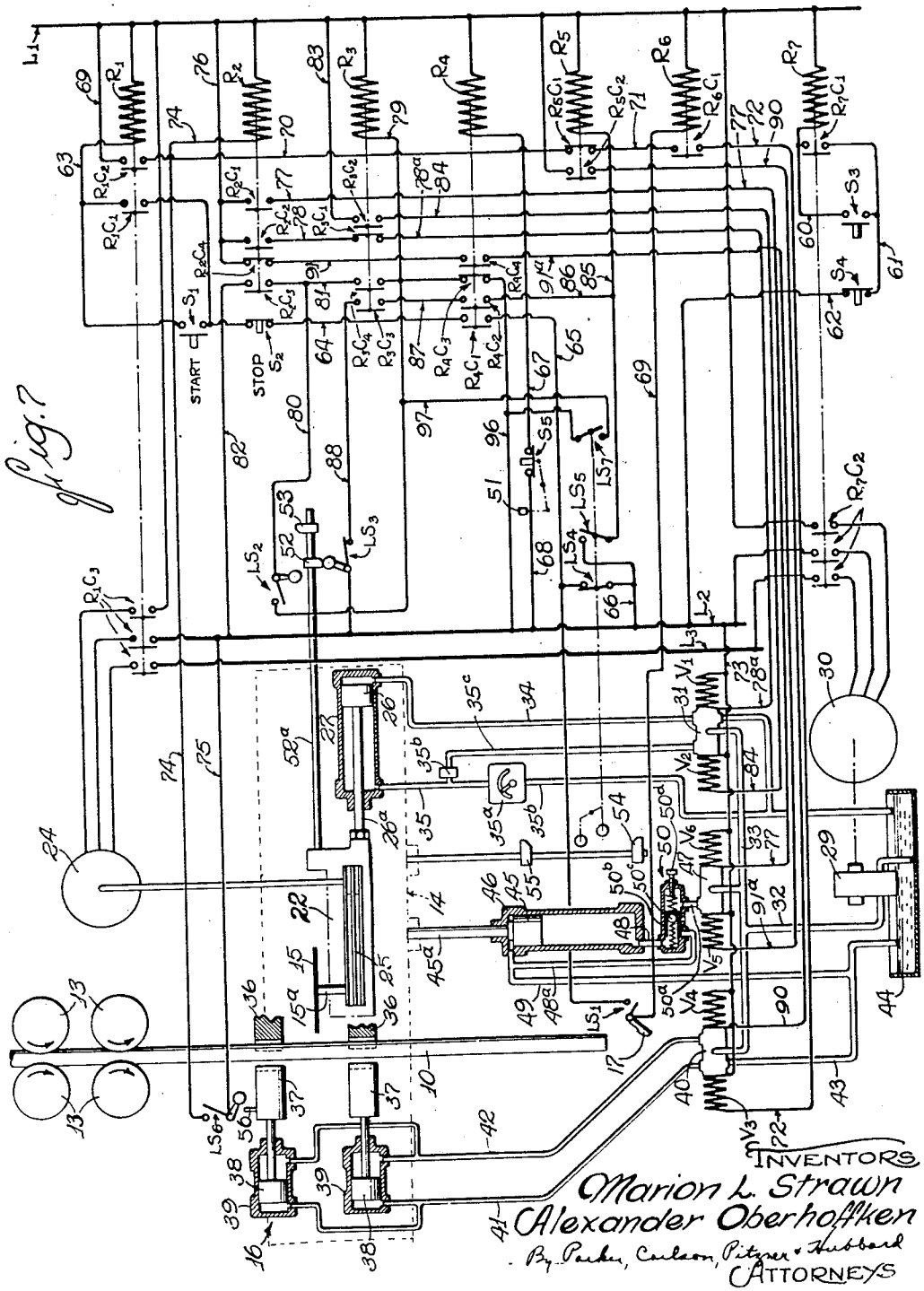



Fig. 7

Patented June 27, 1939 2,163,967

# UNITED STATES PATENT OFFICE

2,163,967

## CUT-OFF MACHINE

Marion L. Strawn and Alexander Oberhoffken, Rockford, Ill., assignors to The Ingersoll Milling Machine Company, Rockford, Ill., a corporation of Illinois

Application January 12, 1938, Serial No. 184,502

14 Claims. (Cl. 29—69)

The invention relates to a cut-off machine for severing successive lengths of material from a continuously moving portion of stock and has more particular reference to such a machine in which the stock is clamped to a movable head carrying a cutter which operates on the stock during movement of the two in unison and is returned to a starting position following severance of the stock.

The general object is to provide a machine of the above character which is simple in construction, reliable and safe in operation, which compensates automatically for variations in operating conditions such as the rate of travel of the stock and the character of the work material, and which avoids placing any substantial strains on the mechanism by which the stock is formed and advanced past the machine.

Another object is to provide a machine of the above character for operating on stock which is moved downwardly in a vertical direction together with a novel means for synchronizing the feed of the cutter head and that of the stock.

A more detailed object is to provide a novel mechanism for counterbalancing the weight of the cutter head and for utilizing such mechanism as a power actuator for returning the head to a starting position.

A further object is to provide arrangement for clamping the stock to the traveling cutter head.

Still another object is to provide for disabling the automatic cycle control mechanism in the event that the cutter is not conditioned for proper operation.

Another object is to provide a novel safety control mechanism for disabling certain of the operating parts in the event that the cut-off operation is not completed while the stock is moving through a predetermined allotted distance.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

Figures 1 to 4 inclusive are diagrammatic illustrations of successive steps in the operation of a cut-off machine embodying the present invention.

Fig. 5 is a side elevation of the cut-off machine.

Fig. 6 is a transverse sectional view taken along the line 6—6 in Fig. 5.

Fig. 7 is a schematic view and wiring diagram.

Fig. 8 is a detailed sectional view of one of the valves included in the control apparatus of Fig. 7.

For convenience of illustration of its various novel features, the invention has been shown herein as embodied in a machine particularly adapted for use in severing lengths of stock from a continuously formed bar of copper or the like as it leaves the casting furnace. It will be understood, however, that the invention is adapted for operation on a wide variety of work pieces and that there is no intention to limit the invention to the particular application described. On the other hand, the appended claims are intended to cover all modifications and alternative arrangements within the spirit and scope of the invention.

A general understanding of the type of machine and operation contemplated is afforded by a reference to the diagrammatic illustrations in Figs. 1 to 4 inclusive. The numeral 10 designates a solid cylindrical bar of cast copper discharged continuously through the outlet 12 in the lower end 11 of a suitable casting furnace. The cast bar or portion of stock is advanced continuously by two pairs of power actuated rollers 13 engaging its opposite sides and operable at variable speeds according to furnace operating conditions.

The present machine operates automatically to cut off the stock leaving the furnace into billets 9 of any desired lengths, and this without interfering with the continuity of the casting or other process by which the stock is formed. Generally stated, the machine comprises a tool head 14 mounted for movement lengthwise of the formed bar 10 and carrying a tool 15 for cutting off the bar. When a predetermined length of bar has been discharged from the furnace, the lower or free end engages a trip dog 17 which initiates an automatic cycle of the machine by causing actuation of a mechanism 16 for clamping the bar and tool head together for movement in unison. At the same time, the feeding of the tool 15 into the bar is initiated. As the severing operation continues, the tool head 14, together with the saw and clamping mechanism is moved downwardly as shown in Fig. 3 at a speed corresponding to the rate of formation of the bar. Severance of the bar is normally completed before the tool head has advanced a distance equal to the length of the bar being cut off. In response to complete cutting of the bar, the saw 15 is retracted as shown in Fig. 4 and the clamping mechanism 16 released. Thereupon, the head 14 is returned to its initial position. When the cut-off end of the bar 10 again strikes the dog 17, the cycle is repeated.

The machine selected for purposes of illustration includes a fixed bed 18 disposed below the furnace 11 and supporting four vertical columns

or posts 19 on which the saddle 14 is mounted for vertical sliding movement. A housing 20 on the upper ends of the columns 19 carries the stock advancing rollers 13 together with a power actuating mechanism therefor including an electric driving motor 21. This motor may be controlled by suitable mechanism (not shown) associated with the stock molded in the furnace 11 so that the stock will be advanced at a rate commensurate with the operating capacity of the furnace, this rate being adjustable automatically or manually.

The tool head 14 includes a generally rectangular open-center frame 14a disposed horizontally and slidably mounted on the vertical columns 19. The tool 15 which comprises a disk-shaped saw is fast on a vertical shaft 15a journaled in bearings which are supported by a carriage 22. The latter is mounted for endwise sliding movement on a pair of spaced horizontal guides 23 extending lengthwise of the frame 14a and secured to opposite ends of the latter. An electric motor 24 mounted on the carriage 22 drives the saw 15 through the medium of belts 25.

Movement of the saw supporting carriage 22 toward and away from the work piece or stock 10 is effected by means of hydraulic mechanism including a piston 26 slidable in a cylinder 27 and secured to a rod 26a having its outer ends secured to a yoke 28 on the carriage 22. As is diagrammatically illustrated in Fig. 7, pressure fluid is supplied to the cylinder 27 by a pump 29 driven by an electric motor 30, the flow of fluid being controlled by the control valve 31 which is in turn actuated through the medium of a pair of oppositely acting valve solenoids $V_1$ and $V_2$. When the solenoid $V_1$ is energized, the valve 31 is shifted to cause a flow of fluid from the pump 29 through conduits 32—33, valve 31, and conduit 34 to the outer end of piston 26. The saw 15 is then advanced toward the bar 10. The rate of such feed is controlled by the escape pressure fluid from the forward end of the cylinder through conduit 35 to a sump 44, the rate of escape being governed by a manually adjustable valve 35a. Changes in setting of this valve regulate the feed rate. A check valve 35b permits the flow of fluid from the valve 31 through the conduit 35c to the forward end of the cylinder for returning the saw but forces the fluid exhausted from the forward end of the cylinder 27 through the valve 35a.

Energization of the other solenoid $V_2$ and deenergization of $V_1$ shifts the member of the valve 31 to effect a rapid return movement of the saw carriage 22. When the valve member is so shifted, pressure fluid from the pump 29 is delivered through conduits 32, 33, valve 31, conduit 35c, valve 35b, and conduit 35 to the forward end of piston 26 without restriction by the orifice 35a. Similarly, fluid is drained to the sump 44 without restriction from the rear end of the cylinder 27 through a conduit 34.

The clamping mechanism 16, which preferably is actuated hydraulically, includes a pair of spaced clamping jaws 36 (Fig. 6) fixed on the saddle 14 and arranged respectively above and below the saw 15. These jaws cooperate with a pair of opposed movable jaws 37 secured to the ends of rods on pistons 38. These pistons are slidable in cylinders 39 secured to the outer end of the tool head frame 14. The cylinders 39 are also supplied with pressure fluid from the pump 29, the supply being under the control of a valve 40 operated by a pair of oppositely acting solenoids $V_3$ and $V_4$. When the solenoid $V_3$ is energized, the valve member is shifted to permit the flow of pressure fluid from the pump 29 through conduits 32—33, valve 40, and conduit 41 to the outer ends of the pistons 38 hereby the jaws 37 are moved into clamping engagement with the stock 10. Pressure fluid is exhausted from the inner faces of the pistons 38 through conduit 42, valve 40, and conduit 43 to a sump 44. Similarly, when the solenoid $V_4$ is energized, a valve member is shifted in the opposite direction to permit the flow of pressure fluid from the pump 29 through conduits 32—33, valve 40, and conduit 42 to the inner faces of the pistons 38 thereby retracting the jaws 37 and unclamping the bar 10. In such position of the valve, fluid is exhausted from the outer faces of the pistons 38 through conduit 41, valve 40, and conduit 43, through which it returns to the sump 44.

By employing clamps engageable with the stock below as well as above the line of severance, the lower end portion of the stock is held rigidly in place throughout the entire period of active engagement of the cutter and the stock. As a result, movement of the lower end of the stock which might pinch the cutter or otherwise interfere with its operation is eliminated and a clean cut is produced.

In order to avoid objectionable strain on the clamping mechanism and possible slippage which might result if the tool head 14 were supported entirely through the medium of the clamping mechanism and the clamped bar, means is provided for counterbalancing the weight of the tool head. Preferably, this means also performs the additional function of raising the tool head to its upper or starting position upon the completion of the stock severing operations. The counterbalancing means includes a hydraulic piston 45 (Fig. 5) slidably mounted in a vertical cylinder 46 fixed to the bed 18. The piston is on the lower end of a vertical rod 45a the upper end of which is attached to the tool head frame 14a. When the tool head is in the uppermost or starting position shown in Figs. 5 and 7, the lower portion of the cylinder 46 is filled with pressure fluid which is permitted to drain from the cylinder at a controlled rate in such manner that the tool head 14 will descend at a speed substantially equal to the rate of downward movement of the stock 10. The clamping mechanism 16 which engages the stock prevents any slight relative movement between the head and stock which might otherwise occur due to variations in rate of movement or slight inequalities in the rates, thereby preventing undue strain on or possible breakage of the saw.

As shown in Fig. 7, pressure fluid is supplied to the cylinder 46 from the pump 29 through a control valve 47 actuated by a pair of oppositely acting solenoids $V_5$ and $V_6$. When the solenoid $V_5$ is energized, the valve 47 is shifted to permit the flow of fluid from the pump 29 through conduits 32—33, valve 47, a conduit 50a, a check valve 50, and conduit 48 to the lower side of the piston 45, thus forcing the same upwardly and raising the carriage 14. The construction of the valve 50 is such (see Fig. 8) that fluid entering the inlet 50a will force a movable member 50b into the position shown, open the spring closed valve element 50c and flow into the conduit 48. At the same time, fluid is exhausted from the upper end of the piston to the sump 44 through a conduit 49 (Fig. 7). Upon the energization of the other solenoid $V_6$ and deenergization of $V_5$, the supply of pressure fluid to the lower end of

the cylinder 46 is cut off and the fluid in the cylinder is permitted to drain into the sump at a rate controlled by the valve 50 which may be adjusted manually by turning a knob 50d. Fluid entering the valve through the conduit 48 forces the member 50b to the right thereby opening the outlet port leading to the conduit 48a to a degree determined by the valve adjustment. The conduit 48a leads through the conduit 49 to the sump. Preferably, the valve is so adjusted that the pressure acting upwardly on the tool head is slightly less than the weight of the head. In this way, only the unbalanced weight of the head is imposed upon the clamping mechanism and the feed rolls.

Automatic control of the cut-off machine through repeated cycles of operation is effected by means of an electrical control system associated with the valve actuating solenoids. As best shown in Fig. 7, this system embodies manualy operable push button switches $S_1$ and $S_2$ for starting and stopping the machine in response to their respective momentary closure as well as a similar pair of start and stop switches $S_3$ and $S_4$ for the hydraulic pump motor 30, and an emergency stop switch $S_5$ provided with a manually operable reset button 51. In addition to these manual switches, the system also includes a limit switch $LS_1$ actuated by the dog 17 when the latter is engaged by the work piece 10, a pair of limit switches $LS_1$ and $LS_3$ actuated by dogs 52 and 53 attached to a rod 52a carried by the horizontally movable saw carriage 22, a second pair of limit switches $LS_4$—$LS_5$ actuated by dogs 54—55 attached to the tool head 14, and a limit switch $LS_6$ actuated by a dog 56 on one of the movable clamping jaws 37. These various manually and dog operated switches control the several valve actuating solenoids through the medium of a series of control relays $R_1$ to $R_7$ inclusive. The sets of contacts for these various relays have been designated as RC with a subscript which includes as its first number the corresponding relay subscript number and as its second number a designation of the set of contacts. Current is supplied to the pump motor 30 and saw driving motor 24 from supply lines $L_1$, $L_2$ and $L_3$ while the lines $L_1$ and $L_2$ also supply the various control and valve actuating solenoid circuits.

The automatic control system when once set in operation is adapted to maintain the machine operating through repeated cycles each including the steps of (1) actuation of the clamping mechanism 16 to grip the moving bar of stock 10; (2) initiation of the downward movement of the tool head 14 by means of the hydraulic piston mechanism 45; (3) initiation of the forward movement of the saw 15 into engagement with the stock; (4) retraction of the saw 15 out of engagement with the stock upon completion of the severing operation; (5) unclamping of the mechanism 16; and (6) return of the saddle 14 to its initial position. The frequency with which the cycle is repeated is of course a function of the rate of movement of the stock.

In order to prepare the machine for operation, the pump motor starting switch $S_3$ is closed momentarily, thereby actuating the pump motor control relay $R_7$ (through a circuit

$$L_1—R_7—60—S_3—61—S_4—62—L_2),$$

this relay being maintained in its closed position by its sealing contact $R_7C_1$ which complete a shunt circuit around the momentarily closed starting switch $S_3$. This actuation of the relay $R_7$ also closes its main contacts $R_7C_2$, thereby connecting the pump motor 30 to its three phase supply lines $L_1$, $L_2$, $L_3$ and starting the same in operation. The driving motor 21 for the stock advancing rollers 13 is controlled through the medium of a separate circuit.

The automatic cyclic operation of the cut-off machine is initiated by a momentary closure of the cycle starting switch $S_1$ which serves to actuate the self-sealing main control circuit relay $R_1$ (through a circuit

$$L_1—R_1—63—S_1—S_2—64—R_4C_1—65—LS_4—66—L_2).$$

Closure of the main contacts $R_1C_3$ of the relay $R_1$ connects the saw driving motor 24 to the supply lines $L_1$—$L_2$—$L_3$, thereby starting the same in operation. It will be noted that the energizing circuit for the relay $R_1$ includes contacts $R_4C_1$ of the normally energized emergency stop relay $R_4$, which in turn includes in its energizing circuit ($L_1$—$R_4$—67—$S_5$—68—$L_2$) the emergency stop switch $S_5$ so that the saw motor cannot be started unless the emergency stop switch is closed and the relay $R_4$ energized.

After the machine has thus been conditioned for operation, the automatic cycle is initiated by closure of the switch $LS_1$ which occurs when the lowermost end of the stock 10 has been advanced into engagement with and has actuated the dog 17. This causes energization of the clamping relay $R_6$ (through a circuit

$$L_1—R_6—69—LS_1—65—LS_4 66—L_2)$$

which relay in turn energizes the solenoid valve actuator $V_3$ (through a circuit

$$L_1—69—R_1C_2—70—R_5C_1—71—R_6C_1—72—V_3—73—L_2).$$

The valve 40 is thus operated to permit the flow of pressure fluid from the pump 29 through the conduit 41 to the outer ends of the pistons 38 which shift the movable clamping jaws 37 forwardly into engagement with the stock and firmly clamp the tool head 14 to the continuously moving bar of stock.

The second step in the cycle of operation, namely, downward movement of the tool head in synchronism with the moving bar 10, is of course initiated substantially simultaneously with completion of the clamping operation. The control circuits are so arranged that the movement of the clamping jaws 37 into clamped position will also serve to initiate downward movement of the piston 45 of the counterbalancing mechanism through the medium of control relay $R_2$. Thus, as the clamping jaws 37 move into clamped position, the dog 56 on one of the jaws closes switch $LS_6$, thereby energizing the relay $R_2$ (through a circuit $L_1R_2$—74—$LS_6$—75—$L_2$). Energization of this relay in turn serves to energize the valve operating solenoid $V_6$ (through a circuit

$$L_1—76—R_2C_1—77—V_6—73—L_2)$$

thereby shifting the control valve 47 to permit pressure fluid to be exhausted from the lower side of the piston 45. With the valve 50 adjusted as described above, the tool head is permitted to descend at a rate substantially equal to the rate of movement of the stock.

It will be observed that the counterbalancing mechanism responds substantially instantly to energization of the solenoid $V_6$ while a brief interval is required for the pressure in the clamping

cylinders to build up and cause effective gripping of the bar following actuation of the switch $LS_6$. Thus, the counterbalance is conditioned for downward feeding of the tool head at a time not later than the full or effective clamping of the bar. As a result, clamping of the head to the stock and starting of the head movement occurs without shock or danger of displacing the bar relative to the feed rolls 13.

Closure of the relay $R_2$ in response to clamping of the bar also initiates the third step in the cycle of operation, namely, the forward feed movement of the saw 15. Thus, closure of relay $R_2$ causes the valve actuating solenoid $V_1$ to be energized (through a circuit

$L_1$—76—$R_2C_2$—78—$R_3C_1$—78$^a$—$V_1$—73—$L_2$)

to shift the control valve 31 in order to admit pressure fluid to the outer end of the piston 26 and thereby cause an advancing movement of the saw supporting carriage 22 at a relatively slow feed rate controlled by the regulating orifice 35$^a$. The rotating saw 15 thus cuts off a length 9 of the bar predetermined by the distance the dog 17 is spaced, from the clamping mechanism 16 in the uppermost position of the latter.

Upon the completion of the severing operation the fourth step in the cycle of operation, namely, retraction of the saw 15 out of engagement with the bar, is initiated by closure of switch $LS_2$ which occurs when the dog 53 on the saw carriage 22 engages the follower by which the switch is actuated. The self-sealing control relay $R_3$ is thus energized through a circuit

$L_1$—$R_3$—79—$LS_2$—80—81—$R_2C_3$—82—$L_2$)

which deenergizes the solenoid $V_1$ by opening the contacts $R_3C_1$ and energizes the opposed solenoid $V_2$ (through a circuit

$L_1$—83—$R_3C_2$—84—$V_2$—72—$L_2$).

This shifts the valve 31 to admit pressure fluid to the cylinder 27 for effecting a rapid return movement of the saw carriage 22 relative to the tool head. The relay seals itself in closed position by means of contacts $R_3C_4$ in shunt with $LS_2$.

After the saw 15 has cleared the bar 10, the clamping mechanism is released for the fifth step in the cycle of operation. The release of the clamping mechanism is initiated in response to complete retraction of the saw carriage 22 whereupon a dog 52 closes the switch $LS_3$ thereby energizing the relay $R_5$ (through a circuit

$L_1$—$R_5$—85—86—$R_4C_2$—87—$R_3C_3$—88—$LS_3$—$L_2$)

which in turn interrupts the energizing circuit for the clamp valve solenoid $V_3$ by the opening of its contacts $R_5C_1$ and energizes the associated solenoid $V_4$ by closure of its contacts $R_5C_2$ through circuit $L_1$—89—$R_5C_2$—90—$V_4$—73—$L_2$). Energization of the solenoid $V_4$ and accompanying deenergization of the solenoid $V_3$ serve to shift the control valve 40 so that the pistons 38 retract the clamping jaws 37 thereby disconnecting the tool head from the bar 10. The severed portion of the bar thus falls free. As an incident to this, the trip switch $LC_1$ is allowed to open thereby deenergizing the relay $R_6$.

The sixth and final step in the cycle of operation, namely, return of the tool head 14 upwardly to its initial position is initiated in response to unclamping. Thus, as the movable jaws 37 reach their fully retracted position, the dog 56 permits the switch $LS_6$ to open again thereby interrupting the energizing circuit for relay $R_2$ which consequently opens. Such deenergization serves to complete an energizing circuit

($L_1$—76—$R_2C_4$—91—$R_4C_4$—91$^a$—$V_5$—73—$L_2$)

for the solenoid $V_5$ associated with the control valve 47, the solenoid $V_6$ being simultaneously deenergized by opening of the relay contacts $R_2C_1$. The valve 47 is thus conditioned to admit pressure fluid to the bottom of the piston 45 so that the tool head is raised to its initial position, this movement being arrested when the piston 45 contacts the upper end of the cylinder 46.

It will be noted that the deenergization of the relay $R_2$ which results from opening of the switch $LS_6$ during unclamping also causes deenergization of relay $R_3$ by the opening of the contacts $R_2C_3$ interposed in the sealing circuit of the relay $R_3$. In turn, deenergizattion of the relay $R_3$ open-circuits the relay $R_5$ since the contacts $R_3C_3$ are included in the energizing circuit of the relay $R_5$. This dropping out of the relay $R_5$ does not, however, cause a re-clamping movement of the jaws 37 since the relay $R_4$ has in the interim opened due to the opening of switch $LS_1$ as described above when the severed and unclamped work piece falls free. In general then it will be seen that the relays $R_2$, $R_3$, $R_5$ and $R_6$ are all opened at the end of the unclamping movement of the jaws 37 so that the circuits are conditioned for a repetition of the cycle described upon a reclosure of the dog operated switch $LS_1$. Only the main relay $R_1$, the emergency control circuit $R_4$, and the pump driving motor relay $R_7$ remain closed and these relays are normally maintained in their closed positions during the entire operation of the machine.

Means is provided which operates automatically to disable the cycle control mechanism and thereby prevent the execution of a cycle in the event that the switch mechanism for energizing the saw motor is not conditioned for operation of the motor. In the present instance, this means includes the switch $R_1$—$C_2$ which is interposed in the energizing circuit for the solenoid $V_3$ which controls the first step in a cycle. In the event that the relay $R_1$ is not energized and the switch $R_1$—$C_2$ is thereby held open indicating that the saw motor 24 is not operating, the solenoid $V_3$ will remain deenergized when the normal cycle starting switch $LS_1$ becomes closed by the advance end of the stock. By thus disabling the cycle control mechanism, any possibility of injury of the saw or other parts is effectually eliminated.

Normally, the saw will cut off the bar 10 and be retracted before the piston 45 reaches the lower end of the cylinder 46. In the event, however, that the bar is not completely severed during the interval thus allotted, provision is made for retracting the saw and unclamping the bar so that no damage will result to the machine due to over-travel of the tool head. For this purpose, a dog 55 carried by the tool head 14 is arranged to open a switch $LS_4$ and close the associated switches $LS_5$ and $LS_7$ when the head reaches the lower extremity of its safe path of travel. The opening of the switch $LS_4$ breaks the sealing circuit of the saw motor relay $R_1$ thereby causing its contacts $R_1C_3$ to open and the saw motor to be stopped. Similarly, the closing of the switch $LS_5$ energizes the clamping mechanism control relay $R_6$

(through a circuit $L_1$—$R_5$—85—$LS_5$—66—$L_2$

thereby closing its contacts $R_6C_2$ and opening its

contacts $R_6C_1$ to respectively energize the unclamping solenoid $V_4$ and deenergize the clamping solenoid $V_3$. The switch $LS_7$ closes at the same time as $LS_5$ and completes a circuit to rapidly return the saw. Thus, when the switch $LS_7$ closes, the relay $R_3$ is energized

(through $L_1$—$R_3$—79—97—$LS_7$—96—$L_2$)

which closes the contact $R_3C_2$ to energize the solenoid $V_2$. The valve 31 is thereby shifted to direct fluid into the forward end of the cylinder 27 to return the saw. As previously described, the return of the clamp 37 opens the switch $LS_6$ to deenergize $R_2$ and close the switch $R_2C_4$ which energizes the solenoid $V_5$ and causes the upward return of the saddle. Deenergization of $R_1$ also opens the energized contacts $R_1C_2$ which prevents the solenoid $V_3$ from being energized until the start switch $S_1$ is again depressed. The starting switch $S_1$ is restored to effectiveness as soon as the saddle reaches its upper limit where the dog 54 closes the switch $LS_4$ and opens $LS_6$ and $LS_7$.

The machine may be stopped at will at any time by opening the emergency stop switch $S_5$ which interrupts the energizing circuit for relay $R_4$. This deenergization of the relay $R_4$ causes its contacts $R_4C_1$ to be opened thereby breaking the sealing circuit for the saw motor relay $R_1$ to stop the saw motor and also closes its contacts $R_4C_3$ to complete an alternative energizing circuit for the relay $R_3$

(through $L_1$—$R_3$—79—95—$R_4C_3$—96—$L_2$)

which in turn causes solenoid $V_1$ to be deenergized and $V_2$ to actuate the valve 31 for a retractive movement of the saw carriage 22 as heretofore described. The opening of contacts $R_4C_2$ in the energizing circuit of the relay $R_5$ prevents its reenergization, however, until the saddle has lowered to the position where the dog 55 closes the switch $LS_5$ which again energizes $R_5$ and causes unclamping. The saddle remains in its lowered position until the reset button 51 is depressed as the opening of contacts $R_4C_4$ interrupts the circuit of the saddle return solenoid $V_5$.

The machine may be similarly stopped at will by the momentary opening of the stop switch $S_2$ which also interrupts the sealing circuit of the saw motor relay $R_1$.

We claim as our invention:

1. A machine for cutting a continuously moving length of stock successively into longitudinal sections of predetermined lengths, said machine having, in combination, a head movable longitudinally of the stock, stock clamping means on said head, means responsive to movement of the previously cut-off end of the stock to a predetermined point past said head to actuate said clamping means, a cutter on said head operable during movement thereof with the clamped stock to cut off the stock, means responsive to complete severance of the stock by said cutter to retract the cutter out of engagement with the stock and then release said clamping means, and independent means operable automatically in response to movement of said head to a predetermined position beyond its normal range of movement to effect withdrawal of said cutter from engagement with the work and release said clamping means.

2. A machine for cutting a continuously moving length of stock successively into longitudinal sections of predetermined lengths, said machine having, in combination, a head movable longitudinally of the stock, stock clamping means on said head, means responsive to movement of the previously cut-off end of the stock to a predetermined point past said head to actuate said clamping means, a cutter on said head operable during movement thereof with the clamped stock to cut off the stock, and means operable automatically upon failure of said cutter to sever the stock during movement of said head to a predetermined point to retract said cutter out of engagement with the stock and release said clamping means.

3. A machine for cutting off successive longitudinal sections from a length of stock moving continuously in a downward direction, said machine having, in combination, a vertically movable tool head, a power actuated cutter thereon, a vertical hydraulic cylinder, a piston in said cylinder connected to said head, means for restricting the flow of pressure fluid from said cylinder at a controlled rate such as to cause downward movement of said head substantially in synchronism with said stock, means on said head for clamping the stock and head together during operation of said cutter on the stock, and means for supplying pressure fluid to said cylinder to raise the head following cutting off of the stock.

4. A machine for cutting off successive longitudinal sections from a length of stock moving continuously in a downward direction, said machine having, in combination, a vertically movable tool head, a power actuated cutter thereon, means on said head for clamping the stock and head together during operation of said cutter on the stock, and hydraulic means for substantially counterbalancing the weight of said head during downward movement thereof.

5. A machine for cutting off successive longitudinal sections from a length of stock moving continuously in a downward direction, said machine having, in combination, a vertically movable tool head, a power actuated cutter thereon, means on said head for clamping the stock and head together during operation of said cutter on the stock, hydraulic means for at least partially counterbalancing the weight of said head during downward movement thereof, and means to actuate said hydraulic means to raise said head to starting position.

6. A machine for cutting off successive longitudinal sections from a length of stock moving continuously in a downward direction, said machine having, in combination, a tool head guided for vertical movement adjacent and parallel to the advancing stock and tending to move downwardly by gravity, a power actuated cutter carried by said head and movable relative thereto across the path of the stock to cut off the leading end portion of the latter, mechanism releasably opposing downward gravitational movement of said head and overcoming the weight thereof to hold the head in an upper starting position, means on said head for clamping the latter and said stock together for movement of the two in unison, means responsive to the movement of said stock for actuating said clamping means and substantially simultaneously decreasing the opposing force exerted by said mechanism whereby the latter operates to counter-balance at least a substantial proportion of the weight of said head during downward movement thereof.

7. A machine for cutting off successive longitudinal portions from a length of stock moving continuously and endwise in a downward direc-

tion, said machine having, in combination, a tool head guided for vertical movement adjacent and parallel to the advancing stock and tending to move downwardly by gravity, a power actuated cutter carried by said head and movable relative thereto across the path of the stock to cut off the leading end portion of the latter, mechanism releasably opposing downward gravitational movement of said head and overcoming the weight thereof to hold the head in a starting position, means on said head for clamping the latter and said stock together for movement of the two in unison, and means responsive to the movement of said stock for actuating said clamping means and releasing said mechanism substantially simultaneously.

8. A machine for cutting off successive longitudinal sections from a length of stock moving in a downward direction, said machine having, in combination, a tool head guided for vertical movement adjacent and parallel to the advancing stock and tending to move downwardly by gravity, a power actuated cutter carried by said head and movable relative thereto across the path of the stock to cut off the leading end portion of the latter, piston and cylinder elements containing pressure fluid and coacting to oppose downward gravitational movement of said head and overcome the weight thereof whereby to hold the head in an upper starting position, means on said head for clamping the latter and said stock together for downward movement in unison, means responsive to the movement of said stock for actuating said clamping means and releasing the fluid in said cylinder, and manually adjustable means for regulating the flow of fluid out of said cylinder to cause a controlled counterbalancing effect to be exerted on the head throughout the downward movement thereof.

9. A machine for cutting off successive longitudinal sections from a length of stock, said machine having, in combination, means engaging the stock and feeding same endwise in a downward direction at a variably controlled rate, a tool head guided for vertical movement adjacent and parallel to the advancing stock and tending to move downwardly by gravity, a power actuated cutter carried by said head and movable relative thereto across the path of the stock to cut off the leading end portion of the latter, means on said head for clamping the latter and said stock together, mechanism adapted, when rendered operative, to exert an upwardly directed force on said head and thereby counterbalance at least a substantial portion of the weight of said head so that the force required to be exerted by said feeding means to advance the head when the head and stock are clamped together is only the difference between the weight of the head and said upwardly directed force, and means responsive to the movement of said stock for actuating said clamping means and rendering said mechanism operative.

10. A cut-off machine for severing successive lengths from a moving portion of stock comprising, in combination, a tool head mounted for movement along the path of the stock, a power actuated cutter mounted on said tool head for feeding movement transversely of said path to cut off the stock, two power actuated clamps carried by said tool head and engageable with the stock on opposite sides of said cutter to clamp the stock to the head for movement with the latter, means responsive to movement of a predetermined length of stock past said cutter to cause gripping of the stock by each of said clamps and feeding of said cutter across said path, means operable by movement of said cutter completely across said path and while said clamps are still effective to initiate automatic retraction of said cutter, and means responsive to and conditioned upon full retraction of said cutter out of engaging relation with respect to the stock to unclamp the stock from said head and return the latter reversely along said path to starting position.

11. A cut-off machine for severing successive lengths of material from a moving portion of stock comprising, in combination, a tool head mounted for movement along the path of the stock, clamping means engageable with the stock at points spaced along the latter to clamp such points rigidly to the head for movement of the latter with the stock, a power actuated cutter mounted on said tool head for feeding movement transversely of said path to cut off the stock along a line of severance disposed between said points of clamping, means operable by movement of said cutter completely through the stock to initiate automatic retraction of the cutter, and means responsive to and conditioned upon movement of said cutter out of engaging relation with respect to the stock to release said clamping means and free the stock from said head.

12. A cut-off machine for severing successive portions of stock from a length of stock moving downwardly continuously in an endwise direction, said machine comprising, in combination, a tool head mounted for vertical movement along the path of the stock, a clamp engageable with the stock to clamp the latter rigidly to the head for movement of the latter with the stock, a power actuated cutter mounted on said tool head for feeding movement transversely of said path to cut off the stock along a line of severance disposed below said clamp, means operable by movement of said cutter completely through the stock to initiate automatic retraction of the cutter, means conditioned upon movement of said cutter out of engaging relation with respect to the stock to release said clamp and free the stock from said head, and an auxiliary clamp applied and released automatically and operable during engagement of said cutter with the stock to grip the latter at a point disposed below but adjacent said line of severance and clamp the lower end portion of the latter rigidly against movement relative to said head.

13. A cut-off machine for severing successive longitudinal portions from a moving length of stock, said machine having, in combination, a tool head mounted for movement along the path of said stock, a power rotated cutter mounted on said head for movement relative to the head transversely across said path, a power actuator for feeding and returning said cutter across said path, a clamp for rigidly connecting said head to the stock for movement of the two in unison, a power actuator for applying and releasing said clamp, an independent power operator for moving said head to a starting position in a direction reverse to the advance of the stock, means responsive to the advance of a predetermined length of the stock past said cutter when the head is in starting position to operate said actuators whereby to apply said clamp and initiate feeding of the cutter toward said stock, means operable upon severance of the stock by said cutter to energize said head actuator and initiate retraction of the head, and means responsive to and conditioned upon full retraction of said cutter

out of said path to operate said clamp actuator and said operator to release said clamp and immediately intiate return of said head to said starting position.

14. A cut-off machine for severing successive longitudinal portions from a moving length of stock, said machine having, in combination, a tool head mounted for movement along the path of said stock, a rotary cutter mounted on said head for movement forth and back across said path, an electric motor for rotating said cutter, a clamp for connecting said head to said stock, individual power actuators respectively operable to apply and release said clamp, to advance and return said cutter relative to said head and to return the head to starting position in a direction reverse to stock movement, mechanism automatically responsive to the advance of a predetermined length of stock past said cutter to cause said actuators to execute an automatic cycle including, in succession, clamping of the stock, advance of the head with the stock, feeding of the cutter across said path, return of the cutter out of said path, release of said clamp, and return of said head to starting position, means controlling the application of current to said cutter motor, and automatically operating means to disable said mechanism against initiation of said cycle except when said last mentioned means is conditioned for the application of current to said motor.

MARION L. STRAWN.
ALEXANDER OBERHOFFKEN.