Sept. 18, 1956 H. C. MEDLEY 2,763,438

APPARATUS FOR REDUCING MATERIAL IN BAR FORM

Filed Aug. 18, 1954 2 Sheets-Sheet 1

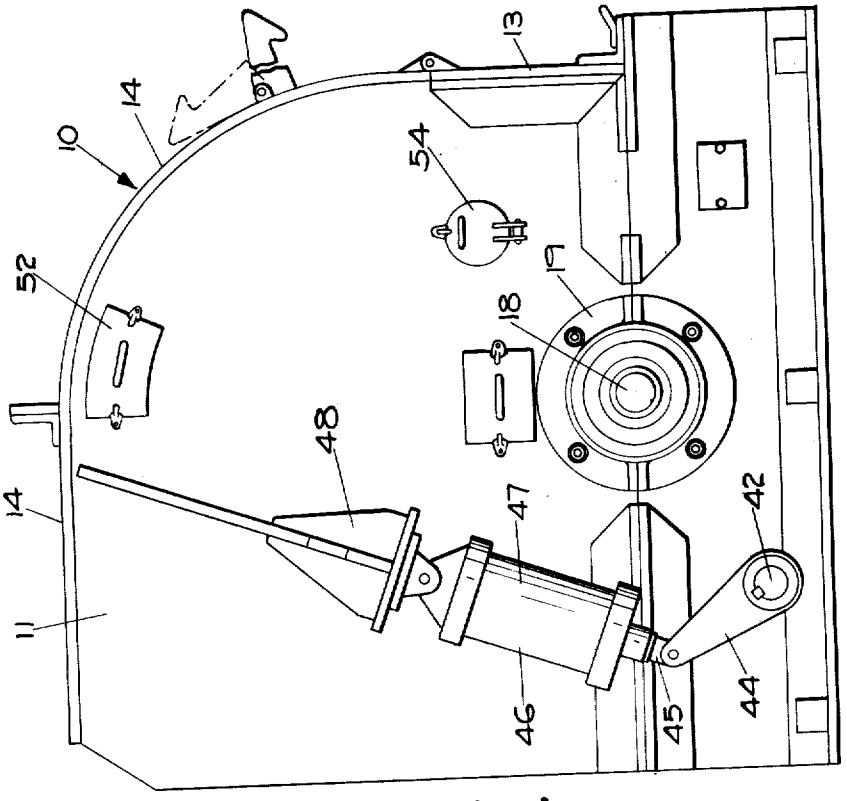

Fig. 1

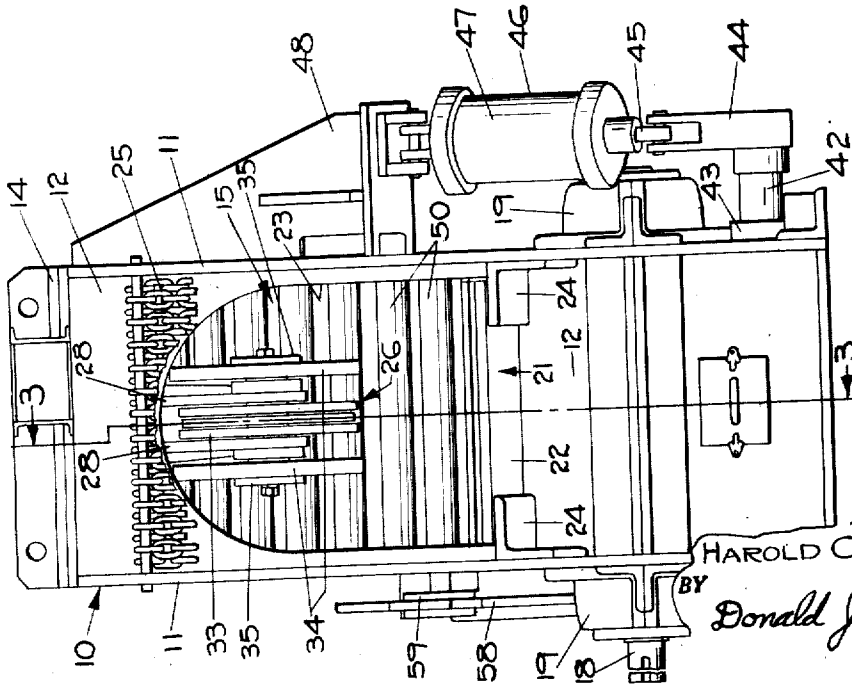

Fig. 2

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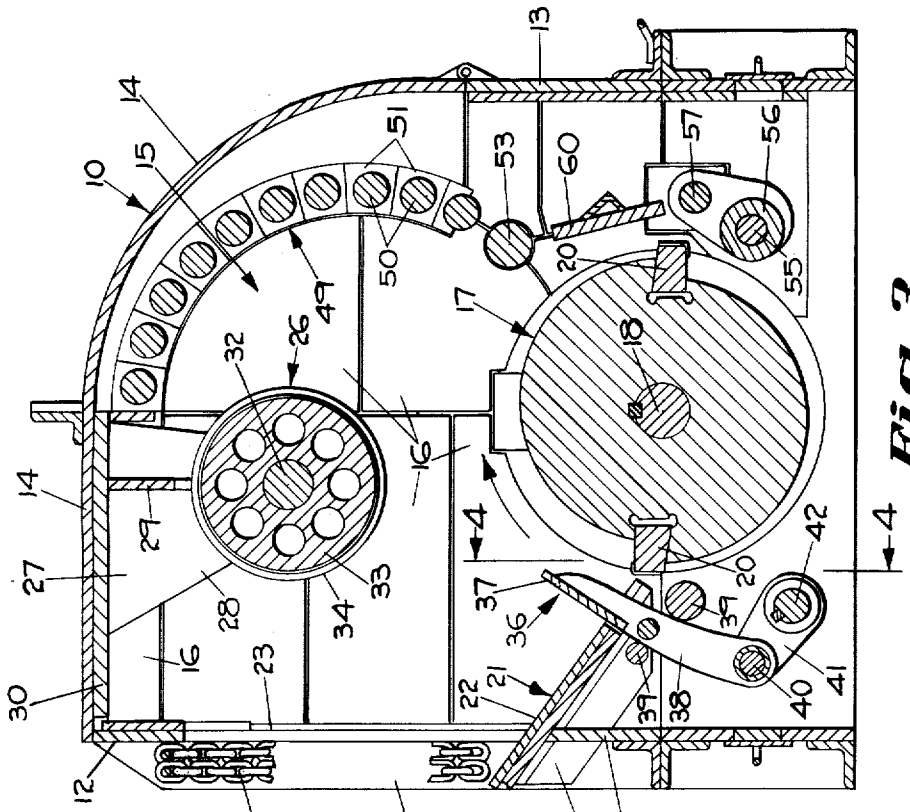

Fig. 3

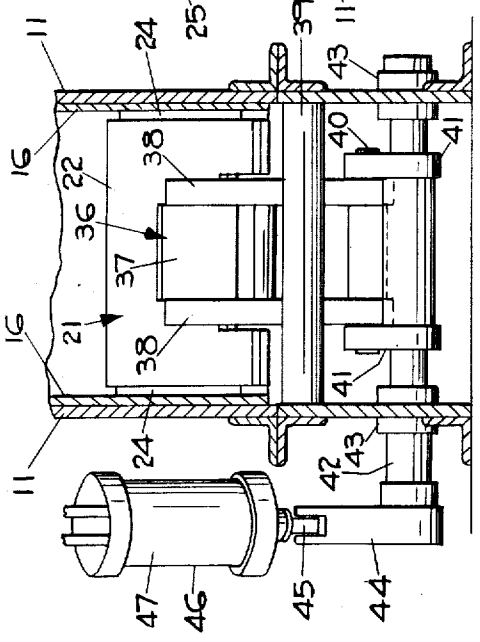

Fig. 4

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APPARATUS FOR REDUCING MATERIAL IN BAR FORM

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Application August 18, 1954, Serial No. 450,758

9 Claims. (Cl. 241—186)

This invention relates generally to apparatus for reducing materials and more particularly to apparatus which may be used with facility in grinding or otherwise reducing materials which are in bar or lump form.

One object of the invention is to provide an improved material reducing apparatus of the type set forth.

Another object of the invention is to provide an improved reducing apparatus of the type set forth which includes improved means for feeding the material to be reduced to a traveling reducing means of the apparatus.

Another object of the invention is to provide an improved material reducing apparatus including a traveling reducing means and an improved means for feeding material thereto, in which said feeding means alternately pinches and releases the material being fed to the traveling reducing means thereby controlling its rate of feed thereto and preferably, but not necessarily, holding the material substantially in a fixed position during the time said material is being pinched whereby said traveling material reducing means may act more efficiently in carrying out its reducing operation.

Another object of the invention is to provide an improved material reducing apparatus including an improved feed means which may first halt the motion of the material to be fed to the material reducing means of the apparatus thereby preventing a heavy impact between the material and the material reducing means and, which improved feed apparatus thereafter may control the rate of feed of the material to said material reducing means in such manner that said material reducing means may carry out its reducing function more efficiently.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings:

Fig. 1 is a view in elevation of a material reducing apparatus in the form of a rigid hammer crusher which includes the invention;

Fig. 2 is a side view in elevation of the crusher seen in Fig. 1 with parts broken away; and

Figs. 3 and 4 are views in section, the sections being taken on line 3—3 of Fig. 2 and line 4—4 of Fig. 3, respectively.

The crusher shown in the drawings was particularly designed to reduce large, hard and tough carbon electrodes in bar form having diameters ranging from approximately 1½ feet to 2½ feet, but it will, of course, be evident that it may be employed to reduce different materials which may be in either bar or lump form.

The crusher includes a housing **10** formed of spaced side walls **11** and end walls **12** and **13**. End wall **13** merges into a curved top wall **14** and all of these walls cooperate in providing a material reducing chamber **15**, provided where necessary with removable liner plates **16**. Top wall **14** is connected to end wall **13** through hinges whereby the wall **14** and its appurtenances may be opened to gain access to the interior of housing **10**. Mounted for rotation within the housing **10** and in the bottom of the material reducing chamber **15** on a transversely extending horizontal axis is a material reducing rotor **17** having a shaft **18** carried at opposite ends in bearings **19** attached to the outer sides of the housing walls **11**.

The rotor **17** includes a pair of similar diametrically opposite axially extending material reducing elements in the form of rigid hammers **20** which are mounted on the rotor **17** adjacent its periphery. Rotor **17** is constructed to provide a reinforcing backing for said hammers **20**. to enable the hammers and the rotor to withstand heavy impact forces developed when the hammers strike material while the rotor **17** is rotated in the direction of the arrow seen in Fig. 3 of the drawings.

The housing **10** includes a feed conveyor in the form of a feed chute **21**, the sides of which are formed by certain of the upright liner plates **16** on the side walls **11**, some of which are seen in Fig. 3 of the drawings, and a bottom plate or slide **22** which slopes downwardly through a feed opening **23** formed in wall **12** toward the rotor **17** and down which material in bar or lump form slides under the influence of gravity toward the rotor **17** to be reduced thereby. The bottom plate or slide **22** is supported by angle members **24** carried by the opposite side walls **11**. Feed opening **23** is closed by a curtain **25** formed by a plurality of heavy chains hung from a pair of rods or bars that extend transversely between the side walls **11** and above the feed opening **23**. Curtain **25** effectively prevents lumps, chips and the like, of material being acted upon in the material reducing chamber **15** from being thrown out of the housing **10** through the feed opening **23**.

Associated with the conveyer or chute **21**, and in one aspect forming a part of it, is apparatus for controlling the feed of material in bar or lump form to the rotor **17**. This apparatus includes an anvil assembly **26** which may be considered as a top element of the feed chute and also as a means against which said bar or lump material may be held while it is operated on by the hammers **20** of the rotor **17**, or, stated another way, this anvil assembly **26** has the triple function of forming a top element of the feed conveyer or chute **21**, or functioning as a rest or anvil against which material being reduced by the rotor **17** may be held, and of forming a part of the means for controlling the rate of feed of material through the chute **21** toward the rotor **17**.

The anvil assembly **26** includes a bracket, main frame or support **27** in the form of a pair of spaced legs **28** interconnected by a cross plate **29** and rigidly attached to and forming a part of a top liner plate **30** of reducing chamber **15** from which said frame **27** extends downwardly into the material reducing chamber **15** above the rotor **17** and feed conveyor or chute **21**.

The depending legs **28** cooperate to carry a removable bar or shaft **32** which extends between and through them and rotatably carries a plurality of disks. As seen in Fig. 2, there are five of these disks, three disks **33** of which are positioned upon the bar or shaft **32** between the legs **28** and two disks **34** of which are carried one upon each end of the shaft **32** at one side of each leg **28**. Endwise movement of bar or shaft **32** is prevented by large washers **35** that abut the end disks **34** and cap screws which are threaded into and locked to shaft **32**. It is to be noted that, as seen in Fig. 2 of the drawings, the diameters of the disks **33** and **34** are such that their peripheries form points on a segment of a circle whereby a round bar of material passing through the conveyor **21** and urged upwardly against them will be centered in the conveyor or feed chute **21** and, of course, also centered with respect to the length of the rotor **17**. Disks **33** and **34** are rotatable upon shaft **32** to distribute wear substantially equally throughout their entire peripheral surfaces and so that

they may rotate thereby eliminating catching or jamming between them and the bar or lump material being fed through the conveyor or chute **21**.

The apparatus for controlling the rate of feed of material to the rotor **17** also includes a stop mechanism **36** on which there is a reciprocable stop plate **37** located adjacent and at one side of the rotor **17** and adjacent the lowermost end of the conveyor or feed chute **21**. Stop plate **37** is carried between a pair of arms **38** which are welded to it and which project downwardly below the slide plate **22** between a pair of fixed guide bars **39** that extend generally horizontally between side walls **11** and are rigidly attached thereto. The bottom ends of arms **38** are interconnected by a tube through which a shaft **40** extends to interconnect them pivotally with a pair of spaced arms **41** carried by a rock shaft **42** which extends through aligned bearings **43** carried by the spaced side walls **11**. One end of the rock shaft **42** carries an operating arm or lever **44** the free end of which is attached to one end of the piston rod **45** of a double acting fluid motor **46**, the cylinder **47** of which is pivotally connected to a bracket **48** which is rigidly attached to one side wall **11** of the housing **10**. Motor **46** is preferably caused to reciprocate, that is, to extend and contract its piston rod **45**, by air under pressure supplied from any suitable source and under the control of any conventional control means, not shown, whereby the motor **46** may be caused to operate cylically, or may be controlled manually by an operator, as desired, to rotate the shaft **42** in reverse directions thereby to raise and lower the stop plate **37**.

Within the material reducing chamber **15** there is a breaker bar screen **49** which, as seen in Fig. 3 of the drawings, extends from adjacent the bracket, main frame or support **27**, and curves downwardly, terminating at a position close to the rotor **17**. The screen **49** is formed by a plurality of breaker bars **50**, the axes of which extend transversely of the housing **10**, or, in other words, parallel with the axis of rotor **17**. The bars **50** are carried at their opposite ends through integral end plates **51** which end plates are received in arcuate slots, or grooves formed in the liner plates **16**. These bars may be removed from the housing **10** by passing them endwise through an opening in one of the side walls **11** when the cover **52** for said opening is removed.

The lowermost bar **53** of screen **49** is of larger diameter than the bars **50** and it is spaced a small distance from the outermost path of travel of the rotor hammers **20**. The ends of this bar **53** are supported in socket openings in the spaced side walls **11** and the bar **53** may be removed by sliding it endwise through one side wall **11** of the housing **10** when a cover plate **54** is removed.

Below the lowermost bar **53** at one side of rotor **17** there is a breaker bar **55** the position of which may be adjusted with respect to the outermost path of travel of the rotor hammers **20**. Breaker bar **55** extends transversely of the material reducing chamber **15** and its axis is maintained parallel with respect to the axis of rotation of the rotor **17** at all times. Bar **55** carries a plurality of wear rings **56** made of a hard metal which may rotate upon it and it is carried by arms rigidly mounted on a shaft **57** the ends of which extend through and are pivotally mounted in the spaced walls **11** whereby the shaft **57** may be rotated in reverse directions about its longitudinal axis by a lever **58** which may be locked in different positions of adjustment to an arcuate rack rigidly attached to one of the side walls **11**. It will be seen that by means of the lever **58** the shaft **57** may be rotated and consequently the proximity of the wear rings **56** and the path of travel of the rotor hammers **20** may be adjusted.

A generally upright plate **60** extends transversely of the material reducing chamber **15** between the breaker bar **53** and shaft **57**. Plate **60** directs lumps of material that pass between the bar **53** and rotor **17** downwardly toward shaft **57** and the breaker bar **55** where the material will be further reduced.

As previously set forth, the crusher shown in the drawings was designed for reducing large carbon electrodes in the form of bars or rods. This kind of material is very hard and tough and, therefore, it presents problems quite different from those met when the material to be reduced is relatively friable and in pieces of such size that relatively small lumps of it may be fed slowly into the reducing chamber of a crusher there to be battered and broken into smaller pieces. When a bar of material such as one of the carbon electrodes referred to is fed into an ordinary crusher the material has a tendency to overload and slow or even stop the rotation of the material reducing rotor. This slowing or stopping of the rotation of the rotor is caused partly by pressure exerted by the material on the hammers of the rotor and partly because of the hard, tough, resilient characteristics of the pieces of material within the reducing chamber being acted on by the rotor. The obvious solution to the problem, of course, would be to apply more driving force to the rotor, or, in other words, to drive the rotor with a motor having much greater horsepower. This solution is, of course, objectionable for numerous reasons among which are the increased size of a motor having the required horsepower, its cost of manufacture and its cost of operation.

By this invention the problem is solved by providing feeding mechanism which provides dwell periods in the rate of feed of the bar or lump material to the spinning rotor thereby preventing the rotor from becoming overloaded and permitting the use of a motor of lower horsepower to be employed for driving the rotor.

Feed conveyer **21** may include an extension, not shown, in the form of an elevator which lifts bars of material from floor level to a position wherein the bottom of the elevator aligns with and projects from the end of the plate or slide **22** adjacent the feed opening to increase the length thereof as may be necessary to accommodate the bars of material being reduced.

To reduce material in the crusher shown and described the motor, not shown, which drives the rotor **17** through shaft **18**, is energized, and the fluid motor **46** is operated to retract its piston rod **45** thereby to elevate the stop plate **37** to the position seen in Fig. 3 of the drawings. The elevator is then raised to the position described and a bar or electrode thereon will slide down the conveyer or feed chute **21** until one of its ends abuts the stop plate **37**. At this time, of course, the movement of the bar of material toward the rotor is halted and the material will be caused to rest on feed plate **22** and against stop plate **37**.

When it is desired to begin reducing the bar of material, the fluid motor **46** is operated to retract or lower the stop plate **37** to permit the bar of material to slide down the feed conveyer **21** until its lowermost end is engaged by the traveling hammers **20** of rotor **17**. Hammers **20** function to tear or break pieces of material from the end of the bar of material and to throw these pieces upwardly in the reducing chamber in which they may be further reduced.

It will be seen that because of the great weight of the bar of material, as well as its hard and tough characteristics, should the bar of material be permitted to bear constantly against the rotor hammers **20** it would result in overloading any normal motor employed to drive the rotor. However, the bar of material after being released by the stop plate **37** to slide down the conveyer **21** and into engagement with the hammers **20** passes through or between the feeder mechanism including the anvil assembly **26** and the stop mechanism **36**. After the end of the bar is engaged by the rotor hammers **20**, the fluid motor **46** is operated to retract its piston rod **45**, which causes the stop mechanism **36** to elevate its stop plate **37**. This upward movement of the stop plate **37** lifts the bar of material upwardly against the disks of the anvil assembly

26 and the anvil assembly 26 and the stop mechanism 37 then cooperate to grip, pinch, squeeze or otherwise hold the bar of material thereby arresting feeding movement of it toward the rotor and permitting the rotor to act to reduce lumps of material within the reducing chamber 15 which have been cut, torn, or otherwise broken from the end of the bar during the time or period of dwell in the feeding operation, when the rotor hammers were tearing at the end of the bar of material.

The pieces of material moved from the end of the bar are thrown generally upwardly in the reducing chamber 15 and some of them may pass between the bars 50 of the breaker bar screen 49 while others may be reduced by impact with the bars of said screen. Those pieces of material which do not pass through the bar screen 49 will, of course, fall into the path of travel of the rotor hammers 20 to be further reduced. Material which passes through the bar screen 49 falls between it and the housing walls and passes from the crusher through its open bottom.

Lumps of material which are not reduced to such size that they can pass through bar screen 49 will pass between the rotor 17 and the screen bar 53, plate 60, bar 57 and bar 56 and will be ground into smaller pieces while so doing. When these pieces of material have been ground and at least partially cleared from the grinder the stop mechanism 36 may then be operated by the fluid motor 46 to lower stop plate 37 to release the bar of material and permit it to again be engaged by the rotor hammers 20 for a period of time after which the stop plate 37 will again be raised by motor 46 to arrest feeding movement of the bar of material while the rotor acts upon that material which has been removed from the end of said bar until the material in the reducing chamber is at least partially exhausted or cleared substantially entirely therefrom.

It has been found in practice that, when the feeding of the material herein described is placed under the control of the timed valve mentioned, dwell periods of approximately ten seconds of feed and ten seconds of hold of the material are desirable, but it is to be understood that these dwell periods may be varied as necessary to suit the characteristics of any other material being reduced to obtain optimum results, or that the periods of dwell may be controlled manually if desired.

Obviously those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and applicant therefore wishes not be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of the invention, what it is desired to secure by Letters of Patent of the United States is:

1. Apparatus for reducing material in bar form including a housing forming a material reducing chamber, a material reducing rotor in the bottom of said chamber adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed by gravity to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly in said reducing chamber to be further reduced therein, stop means adjacent said rotor and one end of said feeding means movable upwardly into the path of bar material thereon for halting the movement of a bar of material on said feeding means before it engages said rotor and thereafter for pinching said bar of material between itself and said anvil means to control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar is acted upon by said rotor, and means for operating said stop means as aforesaid including a shaft oscillatible upon an axis, arm means on said shaft adapted to be swung thereby and connected to said stop means, arm means connected to said shaft for oscillating it, and a double acting reciprocating fluid motor connected to said last named arm means.

2. Apparatus for reducing material in bar form including a housing forming a material reducing chamber, a material reducing rotor in the bottom of said chamber adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed by gravity to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly in said reducing chamber to be further reduced therein, stop means adjacent said rotor and one end of said feeding means movable laterally of the feeding means into the path of bar material thereon for halting the movement of a bar of material on said feeding means before it engages said rotor, means for operating said stop means to withdraw the stop means from the path of the bar material and thereafter moving the stop means laterally of the feeding means to engage the bar material and press the bar material against said anvil means to stop the feed of the bar material and thereby control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar is acted upon by said rotor, and motor means for actuating the operating means for said stop means as aforesaid.

3. Apparatus for reducing material in bar form including a housing forming a material reducing chamber, a material reducing rotor in the bottom of said chamber adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed by gravity to said rotor, anvil means above said feeding means against which a bar of material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed thereby from said bar are impelled upwardly in said reducing chamber to be further reduced therein, and stop means adjacent said rotor and one of said feeding means movable laterally of the feeding means into the path of bar material thereon for halting the movement of a bar of material on said feeding means before it engages said rotor, means for op erating said stop means to withdraw the stop means from the path of the bar material and thereafter moving the stop means laterally of the feeding means to engage the bar material and press the bar material against said anvil means to stop the feed of the bar material and thereby control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar of material is acted upon by said rotor.

4. Apparatus for reducing material in bar form including a housing forming a material reducing chamber, a material reducing rotor in the bottom of said chamber adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed to said rotor, anvil means above said feeding means against which a bar of material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed thereby from said bar are impelled upwardly in said reducing chamber to be further reduced therein, and feed control means for said bar material adapted to arrest the feed of the material on the feeding means by pressing the bar material against said anvil means to thereby control the rate of feed of said bar of material toward said rotor and to hold said bar of material stationary against said anvil means while one end of said bar of material is acted upon by said rotor.

5. Apparatus for reducing material in bar form including a housing forming a material reducing chamber, a material reducing rotor in the bottom of said chamber

adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed to said rotor, anvil means above said feeding means against which a bar of material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed thereby from said bar are impelled upwardly in said reducing chamber to be further reduced therein, and feed control means for said bar material adapted to engage the material for pressing said material against said anvil means to arrest the feed of the bar material and thereby control the rate of feed of said bar of material toward said rotor.

6. Apparatus for reducing material in bar form including a material reducing rotor adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed by gravity to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly, stop means adjacent said rotor and one end of said feeding means movable upwardly into the path of bar material thereon for halting the movement of a bar of material on said feeding means before it engages said rotor and thereafter for pinching said bar of material between itself and said anvil means to control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar is acted upon by said rotor, and means for operating said stop means as aforesaid including a shaft oscillatible upon an axis, arm means on said shaft adapted to be swung thereby and connected to said stop means, arm means connected to said shaft for oscillating it, and a double acting reciprocatory fluid motor connected to said last named arm means.

7. Apparatus for reducing material in bar form including a material reducing rotor adapter to rotate on a generally horizontal axis, material feeding means on which said bar material is fed by gravity to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly, stop means adjacent said rotor and one end of said feeding means movable laterally of said feeding means into the path of bar material thereon for halting the movement of a bar of material on said feeding means before it engages said rotor, means for releasing the stop means

to permit the feed of said bar material to said rotor and for thereafter engaging the stop means with the material to press the material against said anvil means to arrest the feed of the material and thereby to control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar is acted upon by said rotor, and motor means for operating said stop means as aforesaid.

8. Apparatus for reducing material in bar form including a material reducing rotor adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly, and feed control means for said bar of material for pressing the material against said anvil means to arrest the feed of the material and thereby to control the rate of feed of said bar of material toward said rotor and to hold said bar of material against said anvil means while one end of said bar is acted upon by said rotor.

9. Apparatus for reducing material in bar form including a material reducing rotor adapted to rotate on a generally horizontal axis, material feeding means on which said bar material is fed to said rotor, anvil means above said feeding means against which said bar material may bear while being acted upon by said rotor, said rotor rotating in such direction that pieces of material removed from said bar thereby are impelled upwardly, and feed control means for said bar of material for pressing said material against said anvil means to arrest the feed of said material and thereby to control the rate of feed of said bar of material toward said rotor.

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