ROTARY FLYING SHEAR MECHANISM FOR ROD ROLLING MILLS OR THE LIKE

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

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This invention relates to a rotary flying shear mechanism for rod rolling mills or the like in which a plurality of cuts may be made in each rod by a single rotary flying shears unit. More particularly, it relates to the provision of a single rotary flying shears swingably mounted relative to a rod line so that a predetermined plurality of cuts may be made on each rod without any relative translatory movement of the shafts of the shears. The term "rod" as used herein includes elongated metal forms such as the small bars and strips which are capable of being readily sheared by conventional rotary flying shears.

Rotary flying shears in and of themselves are broadly old. They enable the material line to be cut while traveling at the relatively high rates of speed utilized today in rod rolling mills. Such rods customarily run through the cusp or immediately outside the cusp between the circular knives of the shears out of reach of the bite or nip of the knives. A swinging pipe adjacent to the knives usually guides the running line of material and at the appropriate time forces the material into the bite of the knives effectively shearing it while its travel continues. The body of the rod then runs on the other side of the bite of the same knives.

Heretofore, in one form of rotary flying shear mechanism in order to return the swingable guide to the approach side of the bite of the knives, relative translatory movement was effected between the shafts turning the knives. The machinery necessary to effect this translatory return was cumbersome and relatively complex. Further, another factor into the necessary registry between the knives of the shears and the synchronization therewith the movement of the rod line. Moreover, the adjustment of the shears in some instances to compensate for wear was rendered more of a problem.

In the present invention, these problems are overcome. A single rotary flying shear unit is swingably mounted on the line of the rod at the point in which shearing is effected by movement of the rod line in a horizontal plane; Figure 10 is a plan view of the embodiment illustrated in Figure 9;

Figure 11 is a side view, partly in cross section, of the rotary flying shears unit illustrated in Figures 9 and 10; Figure 12 is a view taken along line XII—XII of Figure 11; and

Figure 13 is a detailed view taken substantially along line XIII—XIII of Figure 12 to illustrate the adjustment of one of the front end cap plates of the shears unit.

Illustrative operational sequence

An operational sequence of this invention for a vertically swinging shears unit is illustrated in Figures 1 to 8 inclusive. In the shearing of steel rods from a mill, the employment of rotary flying shears to effect such shearing without interrupting the forward progress of the rod along the rod line is broadly old. However, hereinafter the returning of the circle knives to an initial shearing position has involved in one well-known device the intermittent separation of such knives. To effect such separation of the knives necessitated the use of cumbersome and expensive equipment, and involved generally eccentric movements with consequent problems of dynamic balance. In the instant invention the circular knives and their shafts can be maintained in fixed cutting and linear distance relation, respectively, to one another whether a single cut or a multiplicity of shearing are performed on any rod passing through the device of this invention.

In Figures 1 to 8 inclusive, a rod 10 in moving along a rod line 10a enters from a mill to the left through a fixed guide pipe 11, and passes into a transfer or switch pipe 12 which is movable in a vertical plane about a pivotal center 13. A rod running through flying shears 14 and 15 disposed in tangential cutting relation with their respective shafts and axes of rotation side by side in a common plane adapted to pivot about the horizontal line 16 connecting the centers of the knives. Suitable bearings (not shown) are disposed on each side of the unit for swingable support and movement. The movement of switch pipe 12 and rod line 10 is in a plane normal to the plane of the shafts of unit 13a and bisecting the distance between said shafts. Each such movement carries a rod 10 through the bite of knives 14 and 15 and effects a separation of shears of the rod passing through them.

Each knife as shown in connection with knife 14 is rigidly fastened to a rotatable spindle or shaft 17 which revolves within a journal barrel fitted into a casing 18. An aligned motor 19 is mounted on the casing 18, the motor being so placed with its lower end of casing 18 completes the nearer half of the shearing unit 13a. The opposite rotation of knife 15 in the other half of the unit is similarly effected but for purposes of clarity of illustration knife 15 and the driving mechanism associated therewith are omitted from the figures in question. A guiding quadrant 21 may be employed in engagement on each side of unit 13a.

Normally, the planes of the knives 14 and 15 relative a horizontal plane through rod line 10a is at an angle of about 30° to the horizontal measured in a counterclockwise direction from a point below axis 16 where unit 13a is swung all the way to the right as shown in Figure 1; parallel when unit 13a is substantially vertical as shown in Figure 3; and at an angle of about 120° to the horizontal measured in a counterclockwise direction where unit 13a is swung all the way to the left as shown in Figure 4. Immediately to the right of knives 14 and 15 are a guide pipe 22, a lower guide pipe 23 and a scrap chute 24.

Upper pipe 22 is provided with a bell mouth 26, a common bell mouth 26 serves both chutes 23 and 24. A diverter gate 27 at the junction of chutes 23 and 24 is operable to guide any rod entering bell mouth 26 into one of the other of the two chutes 23 and 24.

In the operational sequence schematically shown in these figures in their ascending numerical order, a rod 10 passes between knives 14 and 15 below the bite or nip thereof as shown in Figure 1 to be behind gate 27 which is raised to direct the front of the rod to be cropped into scrap chute 24. Transfer pipe...
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3

12 is elevated to the position shown in Figure 2 to effect such cropping of the said front end which is shown passing along pipe 22. The succeeding portion of a rod 10 which is now above the bite passes into mouth 25 and pipe 22 where it proceeds to another mill or some other further handling station. After this front cropping, rod 10 is run under unit 13a to swing into the position shown in Figure 3. If an intermediate cut is then to be made through the rod, the unit is moved into the position shown in Figure 4 and gate 27 may be moved to other station which leads to a further mill or other further handling station. Thereupon, the lowering of switch pipe 12 makes an intermediate shear through the rod 10. The portion leading the far end 11 is elevated to the position shown in Figure 5. Again, the rotary flying shear unit may be returned to a position as shown in Figure 6 during the continued running of the rod for an additional period before the next cut is to be made. A further intermediate cut may then be made by moving the two ends of a window of Fig. 4 forward and then raising pipe 12. The portion of rod 10 following the new cut is caught by mouth 25 and travels along pipe 22. Final or end cropping of rod 10 is achieved after the adjustable delay relay so that air is admitted in Fig. 8 and switch gate 27 moved to open chute 24. Then by lowering transfer pipe 12 rod 10 is cut and the final end is caught by mouth 26 and passes into pipe 24 for disposal. For that it is noted that in such a process it will be employed to make such cuts on successive rods as is desired to either avoid an interruption in the progress of a rod along the rod line or to divide a rod into shorter lengths or for other purposes.

Preferred embodiment

A preferred embodiment of the invention is representative and exclusive. A rod line 35 passes out of the rear of guide tube 36 past a photoelectric cell 37 and into a bell mouth 38 of a further guide tube 39. A bracket 40 rigidly supports guide tube 39. Bracket 40 is connected to a pedestal 41 mounted on a base 42 which is immovably fastened to a floor 43 in the mill. The rod line 35 then enters a bell mouth 44 having vertical journals 45 movable in bearing blocks 46. These bearing blocks in turn are fastened in a bracket 47 by keys 48. Bracket 47 is also affixed to pedestal 41. A switch pipe 49 engages a telescoping section 50 connected to bell mouth 44 to continue the guiding of rod line 35. An ear 51 integral with switch pipe 49 intermediate the ends thereof is pivotally connected by a link 52 to an actuating pneumatic or hydraulic cylinder assembly 53. A second switch pipe 54 is provided to move switch pipe 49 in a horizontal plane parallel to floor 43 and by means of such movement to effect the shearing of a rod traveling along rod line 35 while such rod continues its travel. Actuating cylinder 53 having a piston 56 and piston rod 57 therein. A pedestal 57 supports assembly 53 and in turn is supported on a bed plate 59 to which it is bolted. Bushing brackets 60 guide piston rod 56 which has a reduced section 58, the outer end of which is pivotally connected to the other end of link 52. Appropriate ports and valves (not shown) are provided in switch pipe 54 to move piston rod 56 and thereby switch pipe 49 in a horizontal plane. Photoelectric cell 37 is connected to a conventional solenoid operated valve through an adjustable delay relay so that air is admitted to the head end of piston 55 to effect a cropping stroke just as a preselected length of a rod passing along rod line 35 is opposite the bite of the rotary flying shear unit of this invention. When the end of the rod 55 comes in contact with line 44. Other conventional control circuits of a mechanical, pneumatic or hydraulic nature may be employed to effect the necessary synchronized movement of piston rod 56 and thereby of switch pipe 49. Switch pipe 49 is constrained to swing through a preselected arcuate portion by a lateral guiding bracket 61 affixed to a pedestal 62 supported on the main bed plate 63. Bed plate 59 is rigidly connected to main bed plate 63 by being laterally bolted thereto. A series of clamps 64 hold top strip 65 against the upper side of switch pipe 49 to assist in steadying it and prevent it from bowing during a shearing stroke. Rod line 35 continues past a rotary flying shear unit 66 and then divides in the event of a shearing action by unit 66 so that the severed portions of a rod moving along the rod line 35 are cropped along line 35 and a bell mouth 68. Bell mouth 68 is connected to a guide pipe or tube 69 which is strengthened by an overlying strip 70 held thereto by clamps 71. Bell mouth 68, on the other hand, leads to a guide pipe 72 which is strengthened by a top strip 73 held thereto by a clamp 74 when a diverter gate 75 is in its lowestmost position. When the diverter gate is in its uppermost position, a horizontal pipe 76 is provided which may run beneath gate 75 passes beneath gate 75 into a chute 76 having a downwardly inclined bottom 77. The sides of chute 76 are bounded by the sides of a path 78 of a bed plate 80. Bed plate 80 is a reciprocating cylinder assembly 79 actuates chute 75. The rod line passing through guide pipes 69 and 72 respectively enters further guides 80 and 81 supported in a bracket 82 on pedestal 78. These guides lead to a further mill such as a finishing mill or to some other working or handling station for the rods and rod portions passing therethrough. The rotary flying shear unit 66 is supported on a sliding base 83 which has a sliding underface 84 which is arcuate in plan and adapted to move over a sliding finished quadrant surface 85 integral with bed plate 86. Base 83 has integral in Fig. 8 and on the side thereof opposite underface 84, the center of the arc of which coincides with the axis of a vertical opening 87 drilled through bracket 88. Opening 87 permits the coaxial wires unit 89 to be thereby formed in back plate 86. A massive pivot 89 fits into openings 87 and 88 and is locked in socket 88 by a set screw 90. Base 83 is thereby free to rotate about the pivot 89 during operation. An arcuate gear 91 is rigidly bolted by bolts 92 to the underside of base 83, the center of gear 91 coinciding with the axis of pivot 89. The teeth on gear 91 mesh with a toothed rack 93 which slidably engages a rib 94 integral with bed plate 83, and a bearing strip 95 which underlies rack 93. The other end of pivot rod 96 is connected to a double-acting piston 97 in a pneumatic or hydraulic cylinder assembly 98 bolted to bed plate 59. Assembly 98 is adapted to move rack 93 longitudinally and thereby swing rotary flying shears unit 66 in a horizontal plane which is tangent to the bite of the circular knives of unit 66 and contains rod line 35. Assembly 98 includes a cylinder 99 in which piston 97 reciprocates. A second switch pipe 100 is provided to move switch pipe 49 in a horizontal plane parallel to floor 43 and by means of such movement to effect the shearing of a rod traveling along rod line 35 while such rod continues its travel. A further compressed air connection 101 having a piston 102 and piston rod 103 therein. A pedestal 103 supports assembly 85 and in turn is supported on a bed plate 105 to which it is bolted. Bushing brackets 106 guide piston rod 103 which has a reduced section 104, the outer end of which is pivotally connected to the other end of link 102. Appropriate ports and valves (not shown) are provided in switch pipe 100 to move piston rod 103 and thereby switch pipe 100 in a horizontal plane. Other conventional control circuits of a mechanical, pneumatic or hydraulic nature may be employed to effect the necessary synchronized movement of piston rod 66 and thereby of switch pipe 94. Switch pipe 49 is constrained to swing through a prescribed horizontal arc by a lateral guiding bracket 61 affixed to a pedestal 62 supported on the main bed plate 63. Bed plate 59 is rigidly connected to main bed plate 63 by being laterally bolted thereto. The plane of the knives 111
is also so inclined to such a rod being sheared so that the respective rotation of the knives carries the rod into the bite and the allows the portion thereof following the cut to pass through the bite, thus avoiding the necessity of its being cut or sheared again.

Each knife is bolted to a block 112 keyed to a shaft 113. A nut assembly 114 holds each block 112 with its corresponding knife 111 endwise on its shaft 113. Shaft 113 is journaled in an opposed endwise thrust bearing 115 and radial bearing 116a within a rotatable barrel 116. End cap plates 117 and 118 close the hollow interior of barrel 116 to which they are bolted and also protect the bearings 115 and 116. Friction pads 119 and retainer nuts 120 complete the journaling arrangements for each shaft 113. Suitable packing boxes 121 are placed between each shaft 113 for the respective end cap plates 117 and 118. A pulley 122 is keyed to the rear end of each shaft 113 for engagement by a plurality of flexible drive V-belts 123.

The lowermost barrel 116 is cradled in a journaling member 124 bolted to base 83. A casting 125 is mounted in such a fashion that it completes the bearing for lowestmost barrel 116 and supplies the lower half of a bearing for the event that the progress of the rod shown in Figure 9 after the shear unit 66 is passed, is stopped or interrupted. For such an operation, the shears unit 66 would normally be in readiness with the axis along line "A" as shown in Figure 10 and would be pulled back and in the dotted position therefrom shown in the same figure. The time delay relay in the circuit would be adjusted that the desired front-end length of rod would pass the vertical axis through the bite of the knives before a cut is made by means of the automatically controlled extension stroke of piston 55 in assembly 53. Blades 111 would then be rotating toward each other so as to drive the rod or would be reversed.

When pipe 49 would then be in the full line position shown in Figure 10 and the portion of the rod following the cut would pass through guide pipe 49 and guide 80 to the succeeding shearing plane to be sheared. Such rod would normally in the up position shown in Figure 9 for such an operation, the cropped end of the rod would pass out through scrap chute 76. The rod would continue to run through the cusp on the upper side of the bite while unit 66 remained in position "A," as shown in Figure 10, although during such running of the following portion of the rod, assembly 98 may be caused to retract pistons 85 and rod 96 a sufficient distance so that the position where its axis would coincide with line "C," shown in Figure 10 for more rapid response in the event of trouble in the succeeding portion of the rod line.

In the event of difficulties with the operation of the rod line through a succeeding mill or working stand, emergency switches at various stations may be connected in the circuit and jamming of rods moving along rod line 35 prevented by energizing the disengagement valves controlling assemblies 79, 98 and 53 in the chronic order named. Such actuation would first lower gate 75 closing chute 76 and opening guide 72 and 81 which might lead to a reeling coil, another mill line or elsewhere away from the trouble zone. Then, unit 66 would be swung to position "B" and followed immediately by the return of switch pipe 49 to the dotted position shown in Figure 10 by a limit switch 140 by a fixed projection 141 fastened to base 83. Stops 142 adjacent the two ends of quadrant 85 insure against any overrun in either direction of unit 66.

The return of switch pipe 49 to the northermost position severs the rod again so that the portion following the new cut will not be involved in any jam-up caused by the trouble in question. As soon as rods cease to pass along rod line 35, the change in the active electro-magnetic cell 37 causes unit 66 to be returned to position "A" with switch pipe 49 remaining in its dotted position ready for the next front end cropping operation. On the other hand, if there is no difficulty in any succeeding working station affecting the rod line in the proximity of unit 66, switch pipe 49 remains in the full line position shown in Figure 10 until the last of the rods against the bite of unit 66 whence it is then automatically returned to switch pipe 49's dotted line position by assembly 53.

By a different arrangement of the control circuit which will be readily evident to those skilled in the circuit control art, unit 66 and the combination thereof may be employed to effect the severance of rods passing along rod line 35 by the action of a predetermined number of sections each of a predetermined length for ease of subsequent rolling or other purpose. In these cases, a shearing cut can be made on the rod each time the unit is in position "A" by moving switch pipe 49 from its dotted to its full line position as shown in Figure 10. Then when the next cut is to be made, unit 66 may be swung to its position "B" and switch pipe 49 then brought from its full line position to its dotted position by the action of the shearing rod. These shearing are effected without any change in the normal distance between the shafts 113 and are quickly, easily and automatically possible in combination with whatever other control circuit may be employed.

Although I have illustrated and described a preferred embodiment of this invention, it will be understood that changes may be made therein within the spirit of this invention and the scope of the appended claims.

1. In a rotary flying shear mechanism for rod rolling mills or the like, in combination, a pair of spaced parallel shafts in fixed relation to each other, circular shearing knives respectively affixed to said shafts in rod shearing relation to each other, a sliding base supporting said shafts and adapted to provide a sliding plane defined by the axes of said shafts, said sliding base being pivotally connected to a bed plate about an axis in a plane of movement of said knives and passing through the axes of said shafts, means for rocking said sliding base about said pivot, a switch pipe in front of said circular knives closely surrounding said rod line, a pair of guide pipes behind said circular knives in the plane of movement of said switch pipe adapted to provide the respective severed portions of a rod passing along said rod line, a diverter gate in one of said guide pipes, and means interconnected by a pair of guide pipes behind said circular knives in the plane of movement of said switch pipe adapted to operate said diverter gate when said first-mentioned means move said sliding base from one shearing position of said knives to the other shearing position of said knives about said pivot.

2. In a rotary flying shear mechanism for rod rolling mills or the like, in combination, a pair of spaced parallel shafts in fixed relation to each other, circular shearing knives respectively affixed to said shafts in rod shearing
relation to each other, eccentric means for adjusting said knives to maintain the same shearing plane therebetween, a sliding base supporting said shafts and adapted to slide in a plane normal to the plane defined by the axes of said shafts, said sliding base being pivotally connected to a bed plate about an axis lying in the shearing plane of said knives and passing through the axes of said shafts, means for rocking said sliding base about said pivot, a switch pipe in front of said circular knives closely surrounding said rod line, a pair of guide pipes behind said circular knives in the plane of movement of said switch pipe adapted to receive the respective severed portions of a rod passing along said rod line, a diverter gate in one of said guide pipes, and means interconnected with said first-mentioned means to operate said diverter gate when said first-mentioned means move said sliding base from one shearing position of said knives to the other shearing position of said knives about said pivot.

3. A shearing apparatus comprising means to guide a longitudinally-traveling bar in a generally horizontal normal path of travel, a cutting mechanism located somewhat beyond the guide means in the direction of travel of the bar and at one side of the said path, a guideway located beside the cutting mechanism and generally aligned with the said guide means so as to receive a bar traveling along the said path after it passes the cutting mechanism, means to move the guide means laterally of the said path and thereby to shift the bar laterally into the cutting mechanism to cause severance of the bar, a second guide located laterally of the guideway, and selectively operable means to direct a bar piece formed by such a severance into either the said guideway or the said second guide.

4. A shearing apparatus comprising means to guide a longitudinally traveling bar in a generally horizontal normal path of travel, a cutting mechanism located somewhat beyond the guide means in the direction of travel of the bar and laterally of said path, a guideway located beyond the cutting mechanism in the direction of travel of the bar and generally aligned with the guide means in position to receive a bar traveling along the said path, means to move the guide means laterally and thereby to shift the bar laterally into the cutting mechanism to cause severance of the bar, a receptacle located laterally of the guideway, and a switch mechanism located immediately beyond the cutting mechanism in the direction of the travel of the bar and operable selectively to direct the front end of the rear bar piece formed by such a severance into either the said guideway or the said receptacle.

5. A shearing apparatus as set forth in claim 4 in which the guideway includes an outer upstanding side wall having an opening therethrough immediately beyond the cutting disks in the direction of travel of the bar, and the switch mechanism includes a blade normally closing the opening, the rear end of the blade being movable inwardly adjacent the cutting disks to deflect a front end formed by severance of the bar laterally of the normal path of the bar through the opening and into the receptacle.

6. A shearing apparatus as set forth in claim 3 in which said second guide is a receptacle and the end formed by severance of the bar may be directed by the said selectively operable means into either the said guideway or the said receptacle.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor(s)</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,701,016</td>
<td>Yoder</td>
<td>Aug. 31, 1937</td>
</tr>
<tr>
<td>1,944,718</td>
<td>Rafter</td>
<td>Jan. 23, 1934</td>
</tr>
<tr>
<td>2,170,255</td>
<td>Sheperdson</td>
<td>Aug. 22, 1939</td>
</tr>
<tr>
<td>2,187,211</td>
<td>McKinley et al.</td>
<td>Jan. 16, 1940</td>
</tr>
<tr>
<td>2,307,452</td>
<td>Cohen</td>
<td>Jan. 5, 1943</td>
</tr>
<tr>
<td>2,363,079</td>
<td>O'Malley</td>
<td>Nov. 21, 1944</td>
</tr>
<tr>
<td>2,548,459</td>
<td>Wood</td>
<td>Apr. 10, 1951</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Country</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>518,628</td>
<td>Germany</td>
<td>Aug. 7, 1931</td>
</tr>
</tbody>
</table>