June 26, 1951 W. C. STEINMETZ 2,558,321

PARALLEL ROLL ADJUSTMENT MECHANISM

Filed Oct. 30, 1948 4 Sheets-Sheet 1

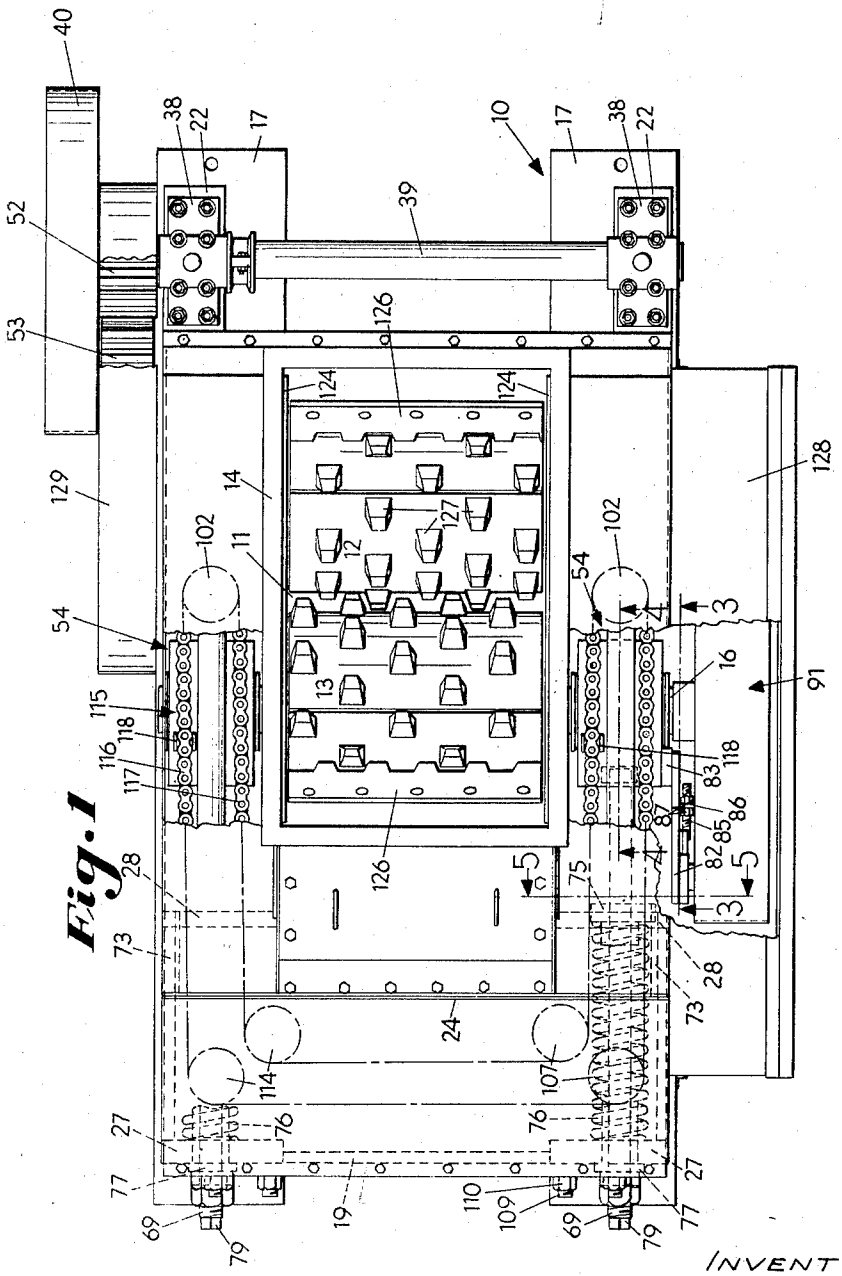


Fig. 1

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PARALLEL ROLL ADJUSTMENT MECHANISM

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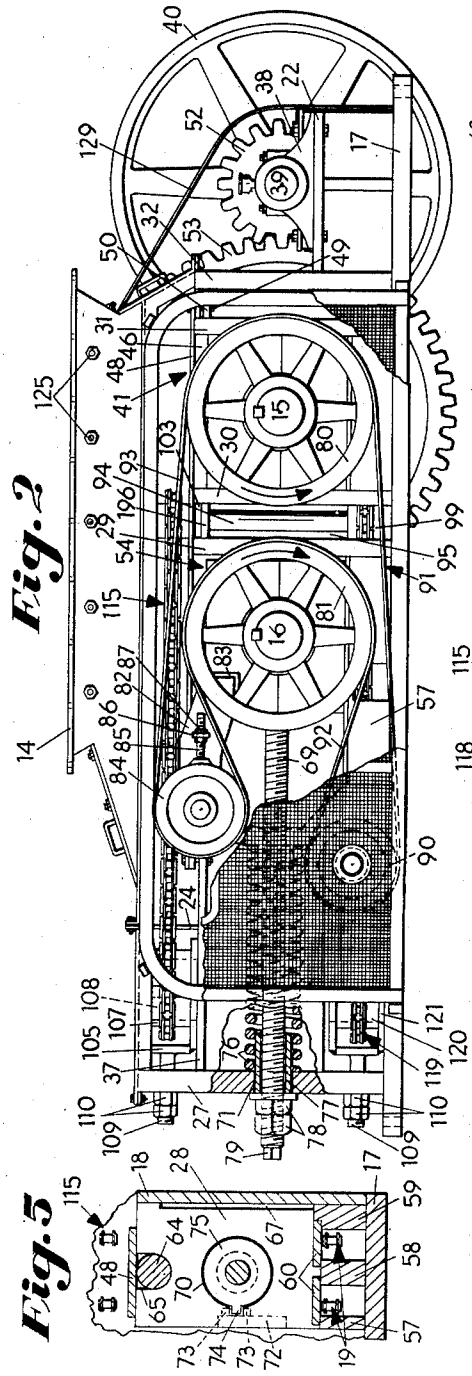


Fig. 2

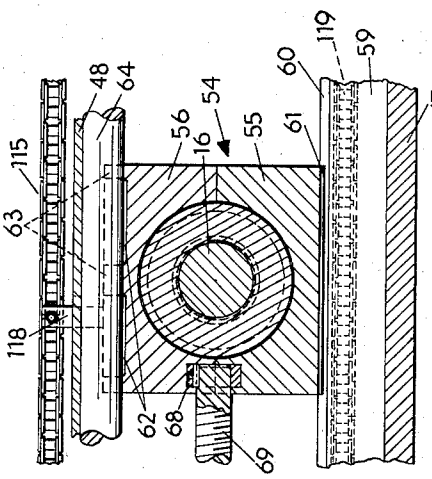


Fig. 4

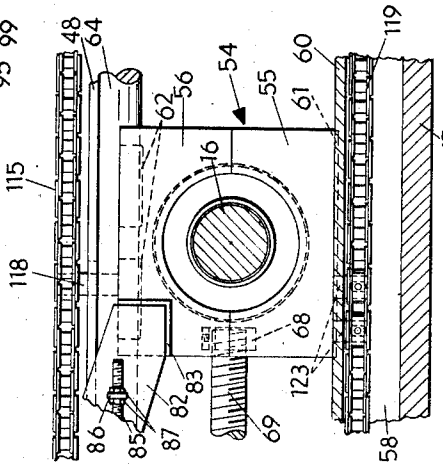


Fig. 3

Fig. 5

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PARALLEL ROLL ADJUSTMENT MECHANISM

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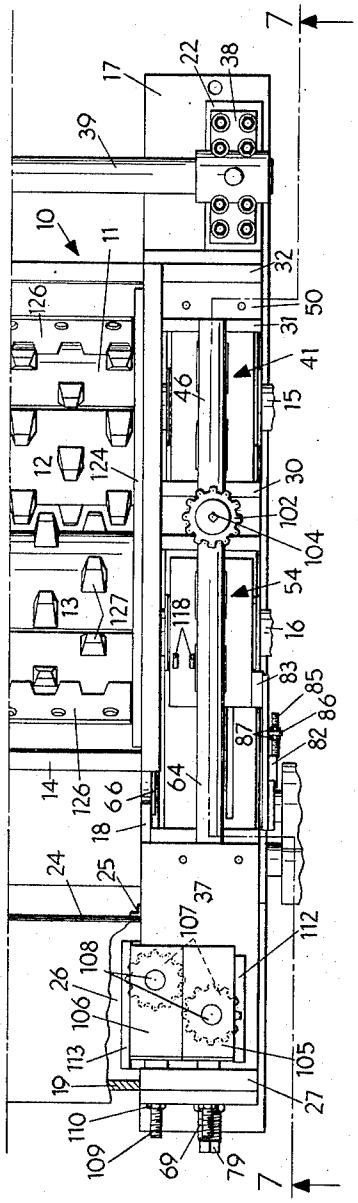


Fig. 6

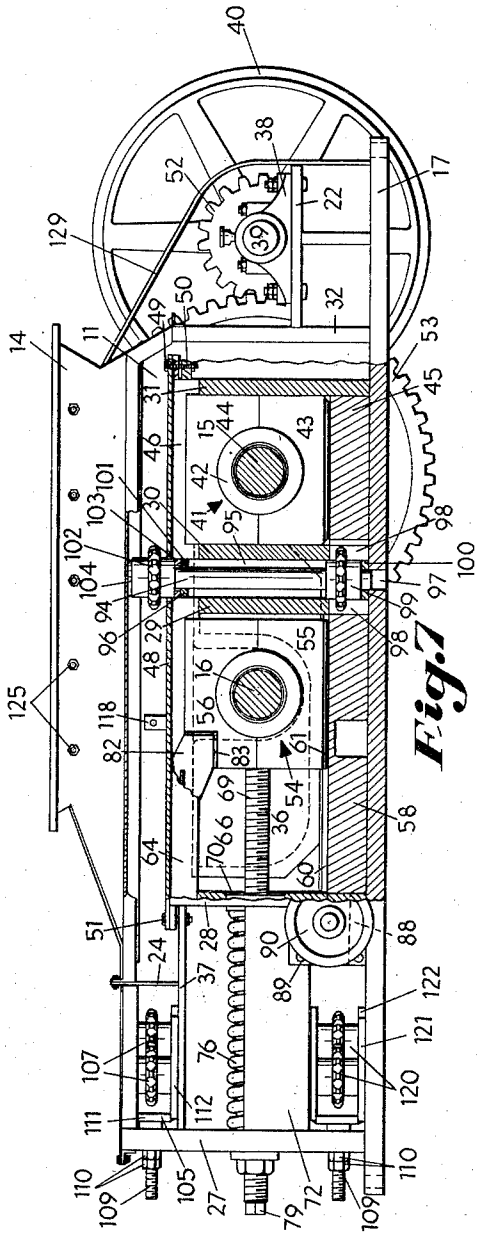


Fig. 7

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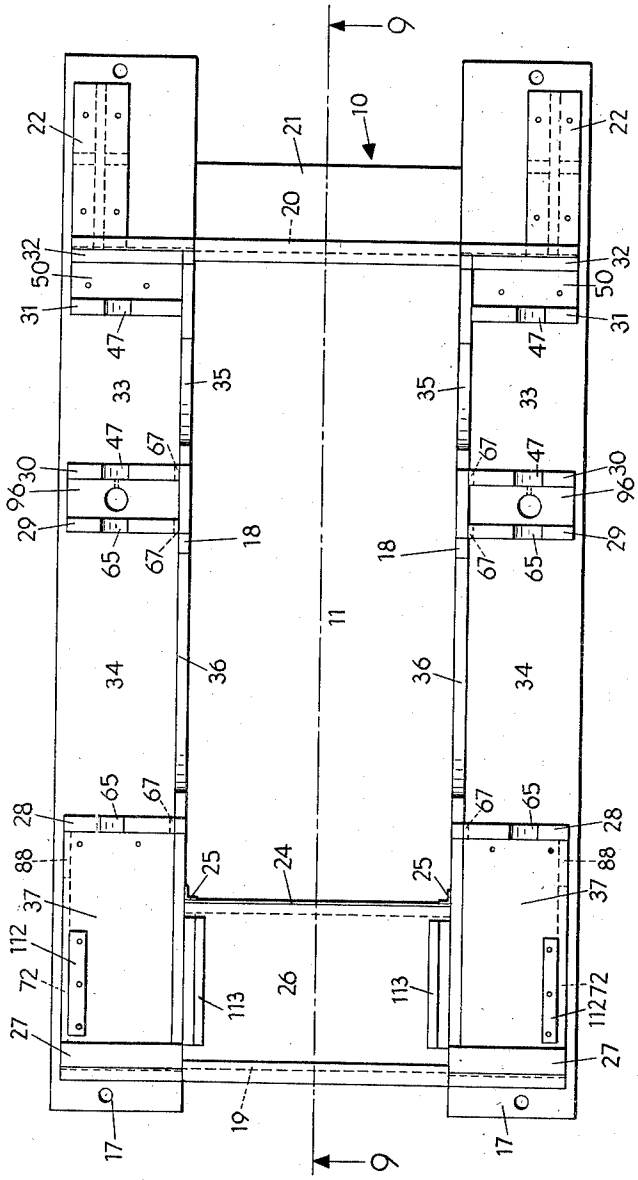


Fig. 8

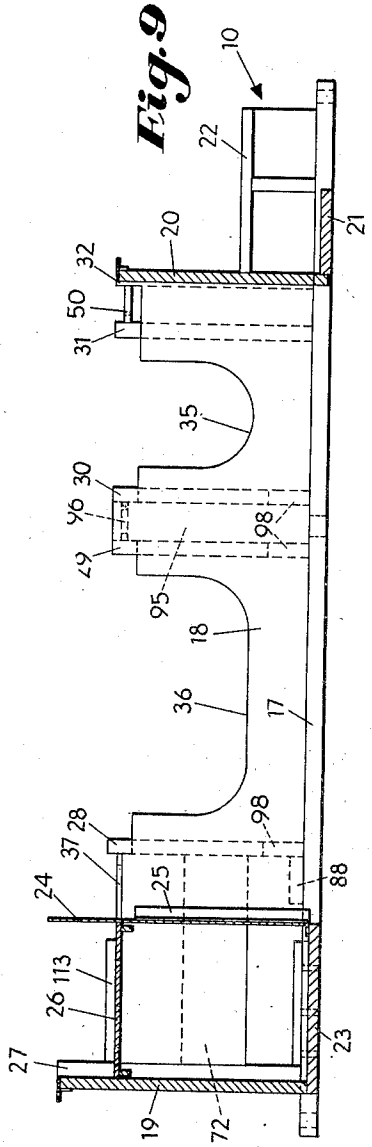


Fig. 9

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2,558,321

UNITED STATES PATENT OFFICE

2,558,321

PARALLEL ROLL ADJUSTMENT MECHANISM

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Application October 30, 1948, Serial No. 57,557

2 Claims. (Cl. 241—230)

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My invention relates to crushers and more particularly to crushers of the type wherein the proximity of a crushing roll, rotor or element is adjustable with respect to a crushing or breaking element co-operating therewith.

An object of my invention is to provide an improved crusher of the above mentioned type.

Another object of my invention is to provide an improved crusher of the above mentioned type wherein mechanism is provided for maintaining the axis of a crushing roll, rotor, or element parallel with respect to a co-operating crushing or breaking element while the proximity of the roll, rotor or element moves or is adjusted with respect to said co-operating crushing element.

Another and more specific object of my invention is to provide an improved crusher including a crushing roll, rotor or element the axis of which is movable in a plane intersecting a co-operating crushing or breaking element and wherein the crushing roll is urged toward said co-operating breaking element for reducing material therebetween with an improved linkage or motion mechanism for positively causing the ends of the crushing roll to travel in said plane through equal distances when the roll moves with respect to said co-operating crushing element particularly while crushing material.

Other objects of my 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 plan of a double roll crusher embodying features of my invention, parts of the crusher being broken away and parts thereof being indicated, for the sake of clarity, in dot-dash lines;

Fig. 2 is a side view in elevation with parts broken away to show structure of the apparatus seen in Fig. 1;

Figs. 3, 4 and 5 are sectional detail views, the sections being taken on lines 3—3, 4—4 and 5—5, respectively, of Fig. 1;

Fig. 6 is a top elevational view of one half of the crusher seen in Figs. 1 and 2 with certain parts removed and certain parts broken away;

Fig. 7 is a sectional, elevational view of one side of the crusher, the section being taken substantially on line 7—7 of Fig. 6, but showing certain parts on said section line in elevation;

Fig. 8 is a view in plan of the main frame of the crusher; and

Fig. 9 is a view in section, the section being taken on line 9—9 of Fig. 8.

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Briefly described, the crusher shown in the drawings embodies the features of my invention and it is a double roll crusher including a main frame 10 that forms a crushing compartment or chamber 11 in which there are two power driven crushing rolls 12 and 13 that co-operate to crush friable material such, for example, as coal, iron ore and the like, that is fed to the crushing rolls 12 and 13 through a feed chute 14. The crushing roll 12 is a fixed crushing roll, that is, its shaft 15 is carried for rotation at each end by bearing assemblies that are removably fixed to the main frame 10 and the crushing roll 13 is bodily movable toward and away from the fixed crushing roll 12 along a plane. The movable crushing roll 13 is carried for rotation adjacent each end of its shaft 16 by bearing assemblies that are slidably mounted to the main frame 10. The proximity of the movable crushing roll 13 with respect to the fixed crushing roll 12 is adjustable by mechanism which is fully described hereinafter. The ends of the movable crushing roll 13 are interconnected through the bearing assemblies which support the ends of its shaft 16 by parallel motion mechanisms that maintain the axis of the movable roll 13 at all times parallel with the axis of the shaft 15 of the fixed roll 12. These parallel motion mechanisms above referred to are also described hereinafter.

The construction of the crusher shown in the drawings will best be understood if features of construction of the main frame 10 are first described. Therefore reference is now made to Figs. 8 and 9 of the drawings wherein the main frame 10 is shown by itself. The main frame 10 is generally symmetrical about a plane taken vertically through its longitudinal center. Along opposite sides it includes laterally spaced base or mounting plates 17. Along the inner edges of each base plate 17 there is welded in a vertical position a side frame plate 18 which plates 18 form the sides of the crushing chamber or compartment 11. The side frame plates 18 terminate short of the ends of the base plates 17 and the sides of the main frame 10 including the base plates 17 and the side frame plates 18 are spaced apart by means of a pair of inside upright end plates 19 and 20 welded to the base plates 17. End plate 20 is also welded to the side frame plates 18 and forms one side of the crushing chamber 11 adjacent the fixed crushing roll 12.

Extending between the base plates 17 and welded to the lower edge of the end plate 20 is a plate 21 which co-operates with the base plates 17 to

form the base of the main frame 10. The main frame 10 includes a pair of bearing supporting platforms 22 welded to the hereinafter described partition plate 32 and the base plates 17. Extending between and welded to base plates 17 and to the lowermost edge of the end plate 19 is a bottom end plate 23 (see Fig. 9). The end of the crushing compartment or chamber 11 opposite the end plate 20 is formed by a removable inside end plate 24 that extends between the side frame plates 18 and is secured thereto by means of angle members 25. Angle members 25 are preferably welded to the side frame plates 18 and the inside end plate 24 is bolted to angle members 25 by bolts, not shown. Spaced above the bottom end plate 23 and between the end plate 19 and inside end plate 24 there is a top end plate 26. As previously described, each base plate 17 is welded along its inner edge to one of the side frame plates 18. There is a series of partition plates 27, 28, 29, 30, 31 and 32, which extend outwardly from the side frame plates 18 and upwardly from the base plates 17 and are welded both to the base plates 17 and side frame plates 18. Partition plates 27 are also welded to end plate 19. These partition plates 27 through 32 are spaced to provide a plurality of compartments including bearing compartments 33 in which the bearings for the shaft 15 of the fixed crushing roll 12 are received by the main frame and bearing compartments 34 in which the bearings for the shaft 16 of the movable crushing roll 13 are received. The side frame plates 18 are cut out opposite the bearing compartments 33 and 34 at 35 and 36, respectively, to provide openings therein through which the shafts 15 and 16 extend into the bearing compartments 33 and 34. Extending between each partition 27 and 28 in the plane of the top end plate 26 is a bed plate 37.

Referring now to Figs. 1, 2, 6 and 7 of the drawings, each of the bearing supporting platforms 22 carries a bearing 38 which in turn carries a cross shaft 39 which carries at one end a pulley wheel 40 adapted to be driven by a belt driven from a source of power such as an electric motor, not shown. The fixed crushing roll 12 is carried with its axis extending transversely of the crushing compartment or chamber 11 by bearing assemblies 41 that fit within the bearing compartments 33 and receive the ends of the shaft 15 that extend through the cut-out portions 35 in each side frame plate 18.

Referring particularly to Fig. 7, each bearing assembly 41 includes a self-aligning anti-friction bearing 42 that is received by a pair of complementary supporting blocks 43 and 44. Block 43 which supports the anti-friction bearing 42 rests upon bed members 45 welded to the base plates 17 and to the partition plates 30 and 31. Bearing blocks 43 and 44 are of such dimensions that they abut at their sides the partition members 30 and 31 and the blocks 44 are channeled or grooved lengthwise along their tops to receive bearing block hold-down bars 46 the ends of each of which are received in notches 47 in the partition plates 30 and 31. The bearing block hold-down bar 46 for each of the bearings 41 is held in the lengthwise groove in bearing block 44 and in the notches 47 by a top plate 48 which is bolted at one end by bolts 49 into a spacer plate 50 between and adjacent the tops of the partitions 31 and 32. The opposite end of the top plate 48 is secured by bolts 51 that extend through the bed plates 37.

Referring now to Fig. 1 of the drawings, the shaft 39 between the pulley wheel 40 and the adjacent bearing 38 carries a pinion gear 52 which meshes with a large gear 53 carried upon one end of shaft 15 of the fixed crushing roll 12 which end of shaft 15 extends through its supporting bearing assembly 41 beyond the base plate 17 to receive the large gear 53. Thus it will be seen that when shaft 39 is driven by the pulley 40, pinion gear 52 will in turn drive the large gear 53 and the fixed crushing roll 12.

The bodily movable crushing roll 13 like the fixed crushing roll 12 is carried transversely of and within the crushing compartment or chamber 11 to co-operate with the fixed crushing roll 12 for crushing material fed therebetween as the crushing rolls 12 and 13 rotate. The ends of shaft 16 of the movable crushing roll 13 are carried by bearing assemblies 54 the construction of which is similar in most respects to the construction of bearing assemblies 41 for the shaft 15. Bearing assemblies 54 like the bearing assemblies 41 include bottom blocks 55 and top blocks 56.

In the bottom of each bearing compartment 34 and extending between the partition plates 28 and 29 there are three spaced supporting bars 57, 58 and 59 (see Figs. 3, 4 and 5) which support a pair of spaced bearing strips 60 upon which the bottom blocks 55 of bearings 54 rest and slide. Each bottom block 55 includes a gib or tongue 61 that extends downwardly into the way formed by and between the spaced bearing strips 60. The top block 56 of each bearing 54 is channeled lengthwise along its top surface and is relieved, as indicated at 62 in Figs. 3 and 4, to provide concave semi-circular bearing surfaces 63. Each bearing assembly 54 is held down by a bearing hold-down bar 64 which extends in the concave semi-circular bearing surfaces 63 and the ends of each bar 64 are received in notches 65 formed in the partition plates 28 and 29. Hold-down bars 64 are secured to the main frame 10 by the top plate 48 previously mentioned in connection with the hold-down bar 46. It will thus be seen that the bodily movable crushing roll 13 can move in a plane since its shaft supporting bearing assemblies 54 are slidably carried at their bottoms for guided motion upon the bearing strips 60 by the tongues 61 and the top blocks 56 thereof may slide along the hold-down bars 64.

Positioned between each side frame plate 18 and bearing assembly 54 of the movable shaft 16 is a cover or closure plate 66 (best seen in Figs. 6 and 7) which plates have holes snugly receiving shaft 16 to move therewith as the movable crushing roll 13 moves bodily. Plates 66 close the cut-out portions 36 in the side frame plates 18. The closure plates 66 bear against the outside surfaces of the side frame plates 18 and the opposite ends thereof slide through notches 67 formed in the partition plates 28, 29 and 30. (See Figs. 5 and 8.)

The normal proximity of the movable crushing roll 13 with respect to the fixed crushing roll 12 may be adjusted by means of adjusting mechanism now to be described. Each of the bearing blocks 55 and 56 of bearing assemblies 54 is machined so that when the bearing assembly 54 is assembled the blocks fit about a collar 68 (see particularly Fig. 4) that is secured to the end of an adjusting screw 69 whereby the screw 69 and collar 68 may rotate within the co-operating blocks 55 and 56 to adjust the bearing assembly 54 longitudinally between the bearing strips 60 and hold-down bar 64 and consequently

adjust the movable crushing roll 13 with respect to the fixed crushing roll 12. Adjusting screw 69 extends through an opening 70 in partition plate 28 and an opening 71 in the partition plate 27. Extending between and welded to the outside edge of each partition 27 and 28 is a guide plate 72 (Fig. 5) which carries a pair of spaced bars 73 that form a track or way therebetween that receives a tongue 74 of a circular adjusting nut 75 threaded on the adjusting screw 69. A heavy compression spring 76 abuts the adjusting nut 75 and the partition 27 and urges the screw and consequently the movable crushing roll 13 toward the fixed crushing roll 12. The outside end of the adjusting screw 69 is carried within a collared bushing 77 that is received in the opening 71 in the partition plate 27 and the end of the shaft carries a pair of lock nuts 78 and is squared at 79 to receive a wrench.

From the foregoing description of the screw 69 and its co-operating mechanism it will be seen that when the screw 69 is rotated by means of a wrench attached to its squared end portion 79 the adjusting nut 75 may be moved along the screw 69 to increase or decrease the tension of spring 76. It will also be seen that the lock or jam nuts 78 may be set at a position on the screw 69 to adjust the position of minimum clearance between the movable crushing roll 13 and the fixed crushing roll 12.

As previously set forth, the fixed crushing roll 12 is driven from the shaft 39 through the gears 52 and 53 and the bodily movable crushing roll 13 is driven from the fixed crushing roll 12 by a belt and pulley mechanism, best seen in Fig. 2. The driven shaft 15 of the fixed crushing roll 12 carries a pulley 80 which rotates counterclockwise, that is, in the direction indicated by the arrow and the shaft 16 of the bodily movable roll 13 carries a pulley 81. Pulleys 80 and 81 are herein shown as being of equal diameter. However, if desired, the diameter of either pulley 80 or 81 may be changed with respect to the other to drive the crushing rolls at different rates of speed relative to one another. The upper block 56 of bearing assembly 54 adjacent the pulley 81 has a bracket 82 welded thereto through a spacer 83. At one end bracket 82 carries an idler pulley 84. Idler pulley 84 is adjustably mounted on the bracket 82 and its position of adjustment with respect thereto is determined by means of an adjusting screw 85 that extends through an outstanding lug 86 on the bracket 82 and is clamped thereto by means of a pair of nuts 87. It will be seen that as the movable crushing roll 13 moves bodily with respect to the crushing roll 12 the bearing assemblies 54 and idler pulleys 84 will move with it.

Base plate 17 of the main frame 10 is provided with a bar 88 (see Fig. 7) that carries a pulley mounting assembly 89 secured at its bottom to the bar 88 and at its top to the guide plate 72 thereabove. Pulley 90 is mounted on a fixed axis relative to the main frame 10 by the supporting assembly 39. A belt 91 is looped or reeved about the pulley 80 over the fixed idler pulley 90, the pulley 81 of the movable crushing roll 13, and the movable idler pulley 84 carried by the bearing assembly 54. By reference to Fig. 2 it will be seen that the pulley 81 of the bodily movable crushing roll 13 will rotate in a clockwise direction, as indicated by the arrow, which is opposite to the direction of rotation of the pulley 80 of the fixed crushing roll 12 and since the pulleys 80 and 81 are of the same diameter, the crushing rolls 12 and 13 will rotate at equal rates of speed. It will also be seen that since the idler pulley 84 and the pulley 81 move bodily as the movable roll 13 moves with respect to the fixed crushing roll 12, the required length of the belt 91 at all times remains constant since, as the idler pulley 84 and pulley 81 move to the left for example, the length of the portion 92 of belt 91 will be decreased and that the length of the belt portion 93 between the idler roll 84 and the pulley 80 will be increased an amount equal to that which the belt portion 92 is decreased. Thus belt 91 will at all times drive the pulley 81 from the driving pulley 80.

From the foregoing description it will be seen that the distance or clearance between the crushing rolls 12 and 13 may be determined by adjusting the lock or jam nuts 78 and that the bodily movable crushing roll 13 is urged toward the position of minimum clearance with respect to the fixed crushing roll 12 by the springs 76. Thus, should a large non-crushable piece of material such, for example, as a piece of iron, enter between the rolls 12 and 13 the movable crushing roll 13 can move away from the fixed crushing roll 12 to permit the non-crushable object to pass between the rolls 12 and 13 by compressing the springs 76 thereby preventing damage to the crusher.

An important feature of my invention resides in the parallel motion mechanism now to be described that maintains the axis of the movable crushing roll at all times parallel with respect to the axis of the fixed crushing roll 12. The parallel motion mechanism includes a pair of shafts 94 (see Fig. 7) one of which is carried in each of two compartments 95 formed between partition plates 29 and 30 at opposite sides of the main frame 10 (see Fig. 8). Each shaft 94 extends through an opening formed in a shaft support and abutment plate 96 positioned between the partitions 29 and 30 and adjacent the tops thereof. It may be mentioned that the adjacent ends of hold-down bars 46 and 64 abut the plates 96; that the ends of the hold-down bars 46 opposite the shaft support and abutment plates 96 abut the spacer plates 50; and that the ends of the shafts 64 opposite the shaft support and abutment plates 96 abut the ends of the bed plates 37. The lowermost end of each shaft 94 extends into an opening 97 in each base plate 17 and partitions 29 and 30 are cut out as at 98 to receive a sprocket wheel 99 spaced upwardly from the base plate 17 by a collar 100. Shafts 94 extend through openings in the top plates 48 and are held against vertical movement relative to the main frame 10 by set screws 101 in the shaft support and abutment plates 96. A second sprocket wheel 102 is carried by each shaft 94 at its upper end which sprockets 102 are spaced with respect to the plates 96 and 48 by bearing collars 103 and are secured thereon against upward movement by a screw and washer 104. Sprocket wheels 99 and 102 are free to rotate upon the shaft 94.

Referring now to that part of the parallel motion mechanism indicated in the lower left hand corner of Fig. 1 and shown in detail at the left side of Fig. 6 and in the upper left hand corner of Fig. 7 of the drawings, there is a pair of yoke members 105, 106 each of which carries between its side members a sprocket wheel 107 mounted upon a shaft 108 that extends between the upper and lower members or tines of the yokes. Each yoke 105 and 106 is provided with an adjusting screw 109 that extends through

openings in the partition plates 27. Adjusting screws 109 carry locking adjusting nuts 110. Yokes 105 and 106 are identical except that the shaft 108 of yoke 105 is positioned closer to the tine connecting portion 111 of the yoke 105 than is the shaft 108 of yoke 106. The reason for this difference in location of the shafts 108 of yokes 105 and 106 is to permit clearance of the strands of a looped chain hereinafter described.

As seen in Fig. 6, yoke members 105 and 106 lie side by side and abut one another and the yokes as a pair rest upon the bed plate 37. Bed plate 37 is provided with a guide bar 112 which abuts one side of the yoke member 105 and top end plate 26 is provided with a guide bar 113 that abuts one side of the yoke member 106. Thus it will be seen that by adjusting the nuts 110 on the screws 109 of either of the yoke members 105 and 106 the position of their respective sprockets 107 may be changed with respect to the sprocket 102 on shaft 94.

As seen in the upper left hand corner of Fig. 1, the parallel motion mechanism includes a second pair of sprockets 114 carried by yokes and mounting structure, not shown, but which is identical in construction to that described for yokes 105, 106. The parallel motion mechanism includes an endless chain 115 so reeved about sprockets 102, 107 and 114, as to form a double stranded U-shaped loop the ends of the legs of which U-shaped loop are formed by the sprockets 102.

With reference to Fig. 1, it will be seen that the U-shaped looped chain 115 includes an outside strand or run 116 and an inside strand or run 117 and that if the outside strand 116 is moved in one direction the inside strand 117 will be moved an equal amount in the opposite direction. The ends of shaft 16 of the bodily movable crusher roll 13 are connected to the endless chain 115 through brackets 118 carried by bearing assemblies 54. However, they are not connected to the same strand thereof. By reference to Fig. 1 it will be seen that the bearing assembly 54 seen at the top of the drawing is connected by its bracket 118 to the outside strand 116 of the chain 115 and that the bracket 118 of the lower bearing assembly 54 is connected to the inside strand 117. Thus it will be seen that should a non-crushable object be presented to the crushing rolls 12 and 13 the bodily movable crushing roll 13, since it is resiliently urged toward the fixed crushing roll 12, will move away from the roll 12. In so doing, of course, it will move the bearing assembly 54 which is connected to the outside strand 116. This, of course, will move the outside strand 116 to the left and, of course, move the inside strand 117 above said bearing assembly 54 to the right an equal amount. On the opposite side of the crusher, of course, the direction of travel of the strands of chain 115 will be reversed, that is, the outer strand 116 will be traveling to the right and the inner strand 117 will be traveling to the left and since the bearing assembly 54 on the opposite side of the crusher is connected to the inside strand 117 both of the bearing assemblies 54 and consequently each end of the bodily movable crusher roll 13 will move in a plane away from the fixed crushing roll 12 through the same distance. The yokes 105 and 106 are adjustable by means of the screws 109 and nuts 110 to provide for adjustment of the endless chain 115.

There is a second parallel motion mechanism substantially identical with the previously described parallel motion mechanism situated within and adjacent the top of the main frame 10. This second parallel motion mechanism, however, is connected to the bottom blocks 55 of the bearing assemblies 54 whereas the previously described parallel motion mechanism is connected to the top block 56 of each of said bearing assemblies 54. An endless chain 119 of the second parallel motion mechanism is looped about the sprockets 99 which are directly below sprockets 102 and carried by shafts 94. From the sprockets 99 the strands of the chain 119 extend rearwardly between the supporting bars 57, 58 and 59 in each bearing compartment 34 to sprockets 120 carried by yoke members 121, 122 which are identical to the yoke members 105 and 106, respectively. It is to be understood, of course, that the chain 119 extends between sprockets 120 situated at the opposite sides of the main frame 10 to complete a U-shaped loop. Because of the relatively limited space in which the strands of chain 119 operate adjacent the bottom blocks 55 the bottom blocks 55 are connected to the chain 119 by a pair of arms 123 (see Fig. 3) which extend through appropriate slots (not shown) in the bearing strips 60 and alongside the chain 119 to which they are bolted. It is to be noted that when the top block 56 of one bearing assembly 54 is attached by means of its bracket 118 to the inside strand 117 of chain 116 the bottom block 55 of the assembly will be attached to the outside strand of chain 119, and vice versa, for the purpose of neutralizing twisting moments on the bearing assemblies 54 when the bodily movable crushing roll 13 is caused to move suddenly away from the fixed crushing roll 12.

It may be mentioned that the feed chute 14 preferably includes a pair of side plates 124 (Fig. 1) arcuately formed at their lowermost edges so as to extend downwardly between the crushing rolls 12 and 13 and these side plates 124 are removably secured within the feed chute 14 by a plurality of bolts 125. Feed chute 14 also includes a pair of plates 126 that extend thereacross and downwardly toward the rolls 12 and 13 and which are notched along their bottom edges to permit the lugs or teeth 127 of the rolls 12 and 13 to pass therethrough.

The driving mechanism including the pulley wheels 80, 81, 84 and 90 is covered by a removable cover 128 and gears 52 and 53 are covered by a cover 129.

From the foregoing description it will be readily apparent that I have provided an improved crusher in which a bodily movable crushing element is resiliently urged toward a co-operating crushing element and that the bodily movable crushing element, when required to do so, can move with respect to its fixed co-operating element in a plane while at all times remaining on an axis that remains either parallel or in a definite angular relationship with respect to the co-operating crushing element, that is, the ends of the crushing roll move in a plane through substantially equal distances because the ends of the bodily movable crushing roll are interconnected by a parallel motion mechanism.

It will also be seen that the axis of the bodily movable crushing roll which is the axis of its driving pulley 81 remains at all times in the same angular relationship with the axis of the driving pulley 80 of the fixed crushing roll 12, and therefore there will be no tendency for the driving belt 93 to run off of the wheels 80, 81, 84,

or 90, when the bodily movable crushing roll 13 moves with respect to the fixed crushing element 12.

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 wishes therefore not to 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 Patent of the United States is:

1. A roll crusher including a crushing roll, crushing means co-operating with said crushing roll for crushing material therebetween, bearing means supporting each end of said crushing roll for bodily movement of the crushing roll to and from the co-operating crushing means, and parallel motion mechanism interconnecting the ends of said crushing roll said parallel motion mechanism including spaced wheels and an endless flexible means trained over said spaced wheels and forming a loop having oppositely moving portions, at opposite sides of said roll and extending parallel to the plane of reciprocation thereof, means connecting one of said portions of said endless looped flexible means with one end of said crushing roll and the other said portion of said endless looped flexible means with the other end of said crushing roll whereby said roll will move to and from said co-operating crushing means with its ends moving through substantially equal distances in the same direction.

2. A roll crusher including a main frame, a crusher roll having a shaft extending transversely of said main frame, bearing means for each end of said shaft reciprocatably carried by said main frame, means co-operating with said roll for crushing material therebetween, means

urging said crushing roll to a position adjacent said co-operating crushing means, and parallel motion mechanism interconnecting said bearings, said parallel motion mechanism including spaced wheels carried by said main frame and a pair of endless flexible means lying in planes at opposite sides of said bearings and extending parallel to the plane of reciprocation thereof, each endless flexible means being trained over a plurality of said spaced wheels and each forming a loop having oppositely movable portions lying side by side, means connecting those portions of each of said flexible means adjacent each of said bearings traveling in the same direction thereto whereby said roll can move only to and from said co-operating crushing means with its ends traveling through substantially equal distances in the same direction.

WALTER C. STEINMETZ.

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