July 15, 1958 T. J. GUNDLACH 2,843,330

SHAFT PARALLELING AND TIMING DEVICES FOR PAIRED ROLL MACHINES

Filed Feb. 25, 1953

FIG. 1.

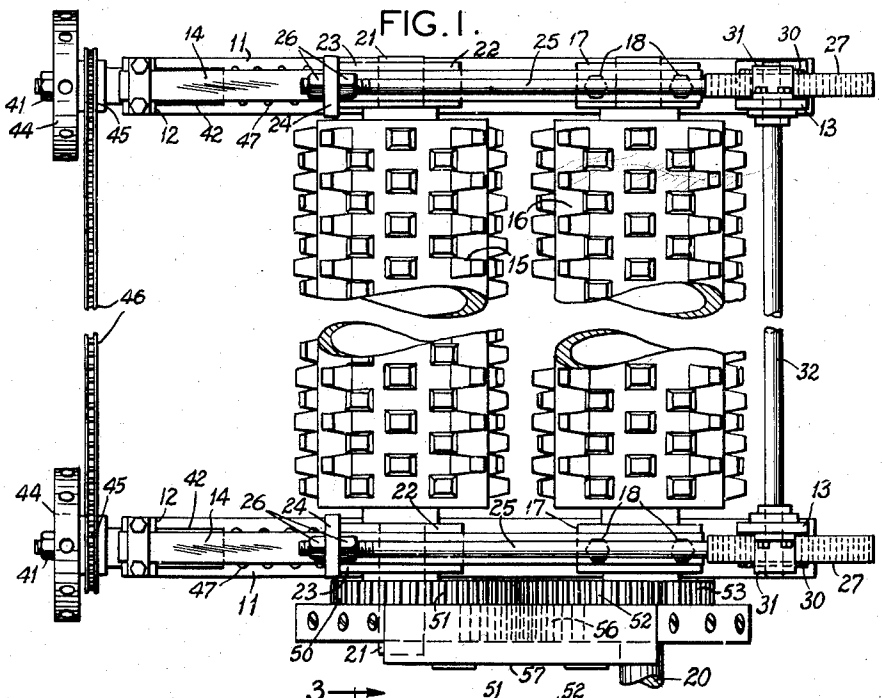


FIG. 2.

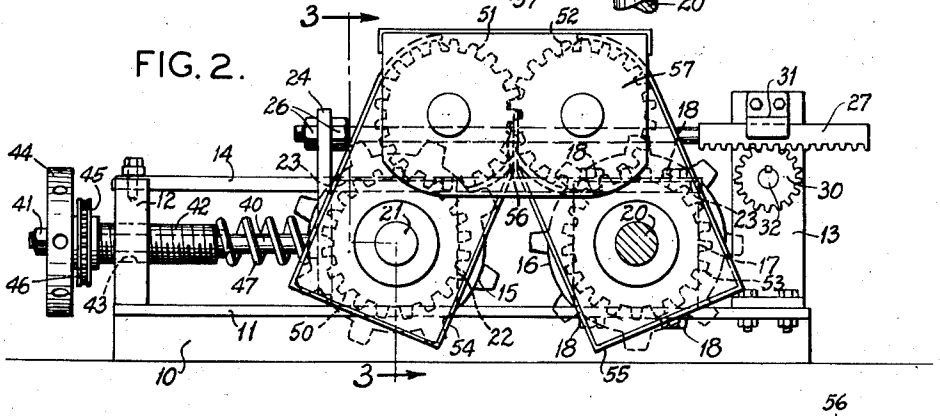
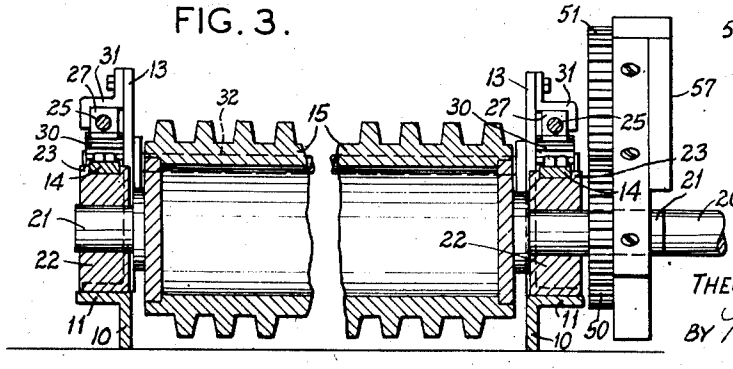


FIG. 3.



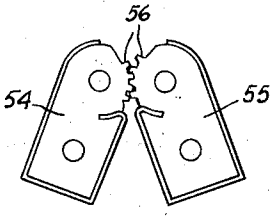


FIG. 4.

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SHAFT PARALLELING AND TIMING DEVICES FOR PAIRED ROLL MACHINES

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Application February 25, 1953, Serial No. 338,867

6 Claims. (Cl. 241—230)

This invention relates to shaft paralleling and timing devices for paired roll machines, and more particularly to an improved arrangement for maintaining parallelism of variably spaced, material-processing rolls or rollers, for example, specially formed rollers of coal or ice crushing equipment. The invention further includes, as one aspect thereof, the combination of an improved roll paralleling means, with roll-timing gearing, such that a pair of coacting, variably-spaced parallel rolls may at all times during their operation be kept both in accurate parallelism and in accurately timed operative relation to each other.

Devices have heretofore been designed in an attempt to maintain true parallelism of a pair of coacting parallel rolls, despite a variable translatory spacing of the rolls, as through lateral movement of at least one of the paired rolls. However as far as is known to this applicant, all such devices are characterized by an extremely high first cost, a requirement of frequent service attention, and particularly in machines embodying rolls of substantial length, are inadequate to prevent under all conditions, a distinct cocking tendency of a displaceable roll. It is accordingly a major and general object of the present invention to overcome each of the shortcomings heretofore prevalently experienced, and to provide a device of simple, durable, mechanical character serving positively to maintain a laterally movable roll of a pair or more of coacting rolls, with its axis in predetermined angular relation, specifically parallel, to the roll or rolls cooperating therewith.

A further important object of the invention is realized in an arrangement, in machines of the general type noted, such that there exists at all times a positively operating mechanical interconnection between opposite, slidably mounted bearings for a shiftable roll coacting with one or more companion rolls, so as to maintain the shiftable roll in true parallelism with the companion elements under all conditions.

A still further and valuable objective is realized in a device of the general type noted, such that each of a plurality of roll-loading springs coacts, with equal roll-biasing effect, entirely over the length of the spring-urged roll, and further such that a plurality of spaced springs for the purpose noted, impart a resultant spring loading substantially uniformly over the length of the spring loaded roll.

An additional object of the invention is realized in improved adjusting and spring loading means serving a shiftable roll constituting one of a set of material processing elements.

Objective combinations realized through the present improvements include a functional combination of the several improvements generally above referred to, with an improved timing gear assembly for parallel rolls of variable spacing such that, while the rolls are permitted to separate and approach each other incident to the exigencies of the load thereon, not only is parallelism of

a shiftable roll maintained at all times, but a predetermined timed relation is maintained between the shiftable roll and one or more companion rolls, irrespective of extent of roll separation.

The foregoing and numerous other objects will more clearly appear from the following detailed description of a currently preferred embodiment of the invention, particularly when considered in connection with the accompanying drawings, in which:

Fig. 1 is a top or plan view of a single-stage crushing device such as used for the sizing of coal or like frangible solid material;

Fig. 2 is a side elevational view of the machine shown by Fig. 1;

Fig. 3 is a transverse, vertical sectional view as taken along staggered planes indicated by line 3—3 of Fig. 2, and

Fig. 4 is a reduced side elevational view of the meshing brackets shown in Fig. 2.

Referring now by characters of reference to the drawing, it should be noted that all of the usual enclosing structure, feed hopper, conveyors and other accessories are, for clarity of illustration, omitted from the present drawing and description, and that much or all of such accessory equipment is or may be of conventional type. Further, in the interest of minimization of present description and illustration, only a single stage crusher is shown, it being understood that the features of the present invention may be employed in either or any stage of a two-stage or multiple-stage material-processing assembly.

The drawings show, particularly in Fig. 2, a base structure generally indicated at **10**, and including a horizontal flange portion **11**, extended upwardly from the ends of which and secured thereto, are uprights **12** and **13**, bolted as shown, or if desired, welded or otherwise assembled to the base **10—11**.

Shown as mounted horizontally and spaced above but parallel to the flange **11**, is a horizontal frame member **14**, it being noted that at each side of the frame, the two sides being similar, the paired horizontal elements **11** and **14** provide as will appear, a guide for a horizontally shiftable crosshead assembly. The present machine embodies a pair of material-processing rolls indicated respectively at **15** and **16**, between which the material to be processed, for example coal to be sized as by crushing, is introduced downwardly as by a conveyor or hopper (not shown). The rolls **15** and **16** for this field of usage are provided with surface formations, and in certain rolls are characterized by patterns of projections and recesses which coact in the operation of the rolls, to reduce the coal to a given size with a minimum of waste or fines and with a minimum of dusting effects. In many cases such patterns of projections and recesses on the companion rolls are such as to require that the two rolls be kept at all times in accurately timed relation. At the same time, at least one of the rolls is most desirably subject to a translatory displacement away from the companion roll, the displaceable roll being member **15** in the present structure.

Provisions for journalling the companion rolls **15—16** include a pair of bearing blocks **17**, one at each end of the roll **16**, these journal elements being fixed in place as by threaded studs **18** engaging the elements **11** and **14**, as will best appear from Fig. 2, and through which, as will now be obvious, the axis of the rotatable element **16** is fixedly established. The roll **16** is provided with a shaft **20**, which in the present example may serve as a power input shaft, and the roll **15** provided with a shaft **21** driven as later described, through a timing gear train.

The journals serving shaft **21**, one at each end of the roll **15**, are each carried in a slidable or shiftable crosshead member **22**. Each such crosshead is provided with a longitudinal groove at its top bounded by marginal flanges **23** which slidably embrace opposite sides of the guide element **14**. This latter thus constrains the adjacent crosshead to an accurately horizontal path of travel in a straight line under all conditions.

There will now be described a preferred form of shiftable-roll-paralleling device through which the shaft **21** and roll **15**, although yieldably mounted for lateral displacement toward and away from the roll **16**, are constrained to true parallelism with the roll **16** and shaft **20** under all conditions. Projecting vertically of the left hand (Fig. 2) face of the crosshead **22** is a rigid vertical arm **24**, provided with a horizontal aperture through which extends the adjacent end of a rack rod **25**. The rack rod **25** is threaded over a considerable portion of its length, at the left hand (Fig. 2) end which threaded portion carries a pair of adjusting and securing nuts **26**, through which, as will appear, an accurate initial adjustment of the relation of rod **25** and the crosshead **22** may be desirably effected. The opposite or right hand end (Fig. 2) of the rack rod comprises the rack proper, which may be either integral with the rod **25** or separately formed and welded or otherwise attached thereto, the rack proper being indicated at **27**. The rack is shown as overlying and meshing with a cooperating pinion **30**. An inverted Z-shape rack guide **31**, best seen in Fig. 3, slidably overlies the squared portion of the rack **27** above its teeth, and constrains the rack to a true linear movement, acting to keep same in accurate register with the cooperating pinion **30**.

Journalled in or on the spaced pair of uprights **13**, is a cross shaft or jack shaft **32**, there being a pair of the pinions **30**, one carried at each end of the shaft **32** and keyed or otherwise firmly attached to this shaft. A companion rack rod and rack are provided on the opposite side of the assembly, the mounting, guiding and adjustment positions of which are or may be identical on the two sides of the machine. Thus, without at this point exhaustively describing the operation of the device, it will now appear that any shifting movement of roll **15**, hence of crossheads **22**, will result in a slight rotary movement of the shaft **32** with identical movements of both rack rods in the same direction, thus positively assuring parallelism of the roll **15** and its shaft to the roll **16** under all conditions.

Proceeding now to describe the structure by which provision is made for a precisely coordinated initial setting of both ends of the shaft of roll **15**, and by which a uniform spring loading is imparted at all times to the roll **15** at any given point along the roll, it will be noted that there is extended horizontally and substantially centrally of the rear portion of each crosshead, an adjusting rod **40**. That end of each rod **40** which engages the crosshead may if desired, be headed and pivotally located within the member **22**. Each rod **40** extends to the left (Fig. 2) and is threaded over a substantial portion of its free end to receive an adjusting and assembly nut **41**. The rod **40** extends through a bore in an externally threaded sleeve **42**, the threads of which cooperatively engage companion threads in a suitable bore **43** in the adjacent stationary upright **12**.

Attached to the outermost or left hand end of the threaded sleeve **42** is a capstan head **44**, a hub portion of which carries a sprocket **45**, the two sprockets of the companion heads **44** being engaged by a roller chain or like **46**, it now appearing that the chain and sprocket interconnection between the adjustable head and sleeve assemblies, will compel an equal adjustment of both such assemblies, responsive to adjusting manipulation of either of the heads **44**.

There is disposed between the inner end of each sleeve **42** and the crosshead, or arm **24** thereon, a coil compression spring **47**. That end of the spring adjacent the crosshead may if desired, be welded or otherwise secured thereto, although not usually necessarily attached at this point. Since the rods **40** are free to move outwardly (i. e. to the left, Fig. 2) of the sleeves **42** and heads **44**, it will appear that the springs **47** will coact to oppose yieldably any displacement movement of the roll **15** away from the companion roll **16**. It will further have appeared that an initial setting of roll **15** with respect to roll **16**, for example, to prevent bottoming of the projections of either roll in the recesses of the other, may be made through the nut **41** on the outer end of each rod **40**. This adjustment once made, will not have to be frequently repeated, assuming only crushing of farily uniform material to a uniform size.

The function of the springs **47** will now have become fully apparent when it is considered that, incident to movement of the crossheads **22** responsively, for example, to the advent of an unusually large stone or other object at some point between the rolls, there results a movement of the shiftable roll to the left (Figs. 1 and 2). Since the threaded sleeve **42** remains fixed in position, and since the crosshead together with rod **40**, will move to the left in the figures noted, there will result a compression of springs **47** to the extent needed to permit passage of the foreign object. A considerable latitude of adjustment of spring loading is, now obviously, possible by variation in the position of the externally threaded sleeves **42** in respect to the frame uprights **12**.

Usually in the last stage of a dual or multiple stage crusher is the coal or like material more or less accurately sized, and it is for such purpose that there is most desirably employed a pattern of accurately interfitting projections and recesses on the companion rolls, as above referred to. Such an arrangement is shown, for example, in Letters Patent No. 2,578,540, issued December 11, 1951, to this applicant, the materials portions of that patent being referred to for better understanding of the present requirements.

In the event the nature of the material to be processed is not such as to require any accurately timed relation between the coacting rolls such as **15—16**, any suitable form of interconnecting gearing may be employed between the shafts **20** and **21**. When however, as in the last stage of a coal crusher, a timed relation of the two shafts is desired, there may be employed for this purpose a timing gear train which is of variable-length type, to enable a lateral displacement of roll **15** for example, toward and away from the roll **16** without impairing or destroying the timed relation of the rolls. Such a device is, per se, the subject of a separate copending application for patent by this applicant, bearing Serial No. 334,037 filed January 29, 1953, now Patent No. 2,777,333 dated January 15, 1957, and entitled "Timing Gear-Train Assembly." For purposes of present understanding and of reasonable completeness of present disclosure, it is noted that this timing gear drive consists of four gears or pinions operatively related to constitute a gear train, and indicated in inverse order of drive in Fig. 2, at **50, 51, 52** and **53**. Of these, gear **50** is attached to shaft **21**, and gear **53** fixedly secured to shaft **20**. Gear **50** engages gear **51**, the latter meshing with gear **52** and this in turn with gear **53**. This gear train is supported as an assembly, in the manner shown, solely by the shafts **20** and **21**, and thus may be said to be floatingly mounted or carried by these shafts.

Two principal gear-supporting brackets constitute part of the gear train assembly and are indicated at **54** and **55**. These brackets are movably interconnected close to the zone of their convergence as shown by the drawing, such interconnection being in the present example by meshing gear teeth **56** formed respectively on the brackets **54** and **55**. This arrangement compels, incident to any displacement of the shaft **21** and the displaceable roll in either direction, an equal swing of bracket **55**, as bracket **54** is

varied in its angularity. This arrangement positively precludes any epicyclic movement of either of gears **51** and **52**, with respect to the other, which but for some such provision would destroy the timed relation of the two rolls **15—16**. A third overlapping bracket section indicated at **57** coacts with the brackets **54** and **55** in supporting the gears of the train in proper relation at all times. These brackets, as will be understood, may take the form of gear-case sections, as disclosed in the application hereinabove identified, all material parts of which are incorporated herein by this reference, and to which attention is hereby directed for further details of the timing gear train together with its articulate construction and floating mounting.

It will best appear from Fig. 3 that the rack rods **25** and hence the racks **27**, are located each in a vertical plane, although extending horizontally, which plane intersects the shaft journals including the crossheads. This arrangement makes for completeness of assembly and carries the lines of force through the racks directly in line at all times with the path of movement of the slidable crossheads serving shaft **21**.

Although the operation of the roll-paralleling arrangement when used either alone or in combination with the floating, articulately-mounted gear train, are thought to have been fully apparent from the description of parts, it may be noted for completely that when the machine is put into service it is of course usually desirable to check the angularity of roll **16** to assure a position such that the fixed axis of shaft **20** extends exactly at a right angle across the frame. Assuming the desirability or necessity of maintaining a predetermined operative relation between the rolls **15—16**, the shaft **21** is brought to a predetermined operative spacing with respect to the roll **16**, usually so that the projections on each roll do not bottom in the depressions of the companion roll, and so that the projections and recesses of the rolls are angularly staggered for correct action on the material, for example, coal to be reduced to a particular size. A final precise adjustment along the lines noted may be effected by actuation of the nuts **41** which, upon fixing parallelism of the shafts with correct roll spacing, may be tightened securely on the respective rods **40**. The loading of the springs **47** is usually desirably equalized on the two sides of the machine as may readily be done by actuation of the threaded sleeves **42**, with separate adjustment thereof if required, but with positive interconnection between the two threaded adjustment through chain **46**. Following such initial settings, the machine may be placed in operation.

It is inevitable in the crushing of coal and like solids of natural origin, that foreign materials will occasionally find their way into the crushing zone. Sometimes extremely hard rock, large pieces of metal or other objects are thus encountered which, but for some provision such as described, would likely destroy or impair the effectiveness of the rolls unless the latter are releasably retained in their normal operative positions. In the event a large rock for example, finds its way between the rolls say at either end of the crushing zone, unless a paralleling arrangement be provided, the shafts and bearings would be subject to tremendous cocking stresses. With the present improvements, even though the roll-spreading stresses are applied at either end, or perhaps even centrally of the rolls, the displacement of the movable roll **15** is bound to occur equally at both ends. In such case, the crossheads will move to the left (Fig. 2) against the loading of the springs **47**, the rods **40** moving to the left with the crossheads, the nut **41** on each rod **40** being free of the adjusting head **44**. This same movement will, now obviously, occur in the same manner and to the same extent on both sides of the machine. Such action of the foremost crosshead **22** in moving to the left (Fig. 2) will rotate the adjacent pinion **30** to a certain extent; also the cross shaft **32** will be rocked or rotated to the same extent, and also the corresponding pinion on the opposite side of the machine. Similarly the companion rack **27** and rod **25** will be moved to an extent and in a direction identical with the nearest rack rod shown in this figure. It will now have appeared from the enforcedly equal and unidirectional displacements of the two crossheads that, irrespective of the location of the roll spreading stresses, the rolls are maintained while operative, in exact parallelism under all conditions. Likewise, through the action of the gear train **50—51—52—53**, despite the roll separating effect noted, the relative timing of the rolls remains constant under all conditions.

It will have been noted that a definite limit of approaching movement of the two rolls is provided for by the setting of nuts **41** on the rods **40**. Likewise a definite limit of range of displacement of the rolls away from each other, specifically in the present disclosure the displacement of roll **15**, is provided for by the inherent extent of possible flattening of the paired springs **47**.

It is noted as of advantage that the precision parallelism of the displaceable roll to what may be termed the fixed roll **16**, is further assured by the elimination of any effective lost motion through the rack and pinion connection. This is due to the fact that the rack rods **25** hence the racks **27**, are at all times subject to the loading of springs **47** and are thus in positive actuating relation to the pinions **30** under all conditions without noticeable lost motion. It should further be noted as inherent in the paralleling arrangement described, that the effective spring loading imparted to the displaceable roll **15**, is the resultant of the loading of the two springs **47**. Furthermore, by reason of the positive interconnection between the crossheads afforded by the rack and pinion assembly, this loading is virtually equalized entirely over the length of the displaceable roll, at all times.

From the foregoing it will have appeared that the several advantages, objectives and purposes of the present improvements are fully realized by the structure disclosed as an exemplary embodiment. Although the invention has been described by detailed reference to a single currently preferred commercial embodiment, the detail of description should be understood solely in an instructive, rather than in any limiting sense; numerous variants being possible within the fair scope of the claims hereunto appended.

I claim as my invention:

1. In a machine embodying a pair of variably separable rotatable members operable in mutually timed relation, a shaft carrying each of said members, one of said shafts being journalled to rotate on a fixed axis and the other said shaft being subject to lateral displacement toward and away from the fixed shaft, gearing connecting the shafts in timed relation throughout a substantial range of separation of the shafts and rotatable members carried thereby, the gearing including a gear fixed to each shaft and a pair of intermediate gears, a bracket structure for the gearing carried by the roll shafts and formed of articulately connected sections, the bracket structure including a first section mounted on one shaft and carrying one said intermediate gear, a second section mounted on the other shaft and carrying another said intermediate gear, and a third section connecting the said intermediate gears, the first and second sections having interfitted teeth to prevent epicyclic movement of said intermediate gears, and means acting responsively to displacement of either end of the displaceable shaft, to impart an identical displacement to the other end of the last said shaft.

2. In a machine including a pair of parallel, mutually timed variably separable shafts, a timing gear assembly serving as an operative interconnection between said shafts, and embodying a train of gears, one gear of said train being affixed to each of said shafts, and a plurality of intermediate gears, an articulate gear-bracket structure serving to support and maintain the gears in operative relation, the bracket structure being floatingly supported

entirely by the shafts connected through the gear train, the bracket structure including a first section mounted on one shaft and carrying one said intermediate gear, a second section mounted on the other shaft and carrying another said intermediate gear, and a third section connecting the said intermediate gears, the first and second sections having interfitted teeth to prevent epicyclic movement of said intermediate gears, and means for maintenance of the shafts in parallel relation, each with respect to the other, incident to translatory displacement of at least one of said shafts, under shaft-cocking stresses.

3. In a coal crusher, a pair of horizontal rolls between which coal or like material is introduced for sizing, a frame for operatively supporting said rolls, a shaft for each roll, a pair of bearings for one of said shafts affixed to the frame, a crosshead at each end of the other said shaft to render same displaceable with the roll carried thereby, a shaft journal carried by each crosshead, an arm carried by each crosshead, a rack rod extended horizontally of said arm, the arm being provided with a rod aperture, and the rack rod being threaded and provided with nuts on its threaded portion, enabling adjustment of the rack rod with respect to said arm and the associated crosshead, a pair of vertical frame elements, journals on said elements, a cross shaft carried by said journals, a pinion at each end of the cross shaft, each rack rod having a toothed end engaging the adjacent pinion, the rack rods being identically related to the pinions, whereby a shifting movement of either crosshead is identically imparted through the rack rods and pinions thence to the other cross head, thus serving to maintain the displaceable roll in accurate parallelism to its companion roll irrespective of spacing of the rolls, a spring attached to each crosshead, a screw-thread member engaging each spring, a sprocket on each screw member, and a chain interconnecting the sprockets, whereby to compel and facilitate identical adjustments of the crossheads and the loading thereon of the respective springs.

4. In a coal crusher, a pair of horizontal, coacting, crushing and sizing rolls between which coal or like material is introduced for sizing, a frame for operatively supporting said rolls, a shaft for each roll, a pair of bearings for one of said shafts affixed to the frame, a crosshead at each end of the other said shaft to render same displaceable with the roll carried thereby, a shaft journal carried by each crosshead, an upstanding arm carried by each crosshead, a rack rod extended horizontally of said arm, the arm being provided with a rod aperture, and the rack rod being threaded on both sides of said aperture and provided with nuts on its threaded portion, enabling a precise adjustment of the position of the rack rod with respect to said arm and the associated crosshead, a pair of vertical frame elements, journals on said elements, a cross shaft carried by said journals, a pinion at each end of the cross shaft, each rack rod having a toothed end engaging the adjacent pinion, a fixed guide through which the toothed end of each rack rod operates incident to movement of the rod, the rack rods being identically related to the pinions, whereby a shifting movement of either crosshead is identically imparted through the rack rods and pinions thence to the other crosshead, thus serving to maintain the displaceable roll in accurate parallelism to its companion roll irrespective of spacing of the rolls, a spring attached to each crosshead, a screw-thread member engaging each spring, a sprocket on each screw thread member, a chain interconnecting the sprockets, whereby to compel and facilitate identical adjustments of the crossheads and the loading thereon of the respective springs, a gear train operatively interconnecting the two roll shafts in accurately timed relation under all conditions of roll spacing, the gear train assembly including a gear carried by each roll shaft, a pair or more of gears operatively intervening those carried by the roll shafts, and a sectional gear bracket, by which the intermediate gears of the gear train are supported, said brackets being floatingly carried by the roll shafts, and means operatively interconnecting the end sections of the gear bracket in a manner to prevent epicyclic movement of intermediate gears of the train in a manner to maintain the rolls in accurately timed relation under all conditions of roll separation.

5. In a crusher or like machine, a pair of rolls between which material is introduced, a frame for operatively supporting said rolls, a shaft for each roll, a pair of fixed bearings for one of said shafts, a crosshead at each end of the other said shaft to render same displaceable, an arm carried by each crosshead, a rack rod carried by said arm, a threaded connection on said rod to enable adjustment of the rack rod with respect to said arm and associated crosshead, a cross shaft carried by said frame, a pinion at each end of the cross shaft, each rack rod having a toothed portion engaging the adjacent pinion, the rack rods being identically related to the pinions, whereby a shifting movement of either crosshead is identically imparted through the rack rods and pinions thence to the other crosshead, thus serving to maintain the displaceable roll in accurate parallelism to its companion roll irrespective of spacing of the rolls, a spring connected to each crosshead, a screw-thread member engaging each spring, a sprocket on each screw member, a chain interconnecting the sprockets, whereby to compel and facilitate identical adjustments of the crossheads and the loading thereon of the respective springs.

6. In a crusher or like machine, a pair of rolls between which material is introduced, a frame supporting said rolls, a shaft for each roll, a pair of fixed bearings for one of said shafts, a cross head at each end of the other said shaft to render same displaceable, an arm carried by each crosshead, a rack rod carried by said arm, a threaded connection on said rack rod to enable adjustment of the rack rod with respect to said arm and associated crosshead, a cross shaft carried by said frame, a pinion at each end of the cross shaft, a rack on each rack rod and engaging the adjacent pinion, a spring connected to each crosshead, a screw-thread member engaging each spring, a sprocket on each screw member, and a chain interconnecting the sprockets.

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