J. E. KENNEDY.

CRUSHING ROLL MACHINE.

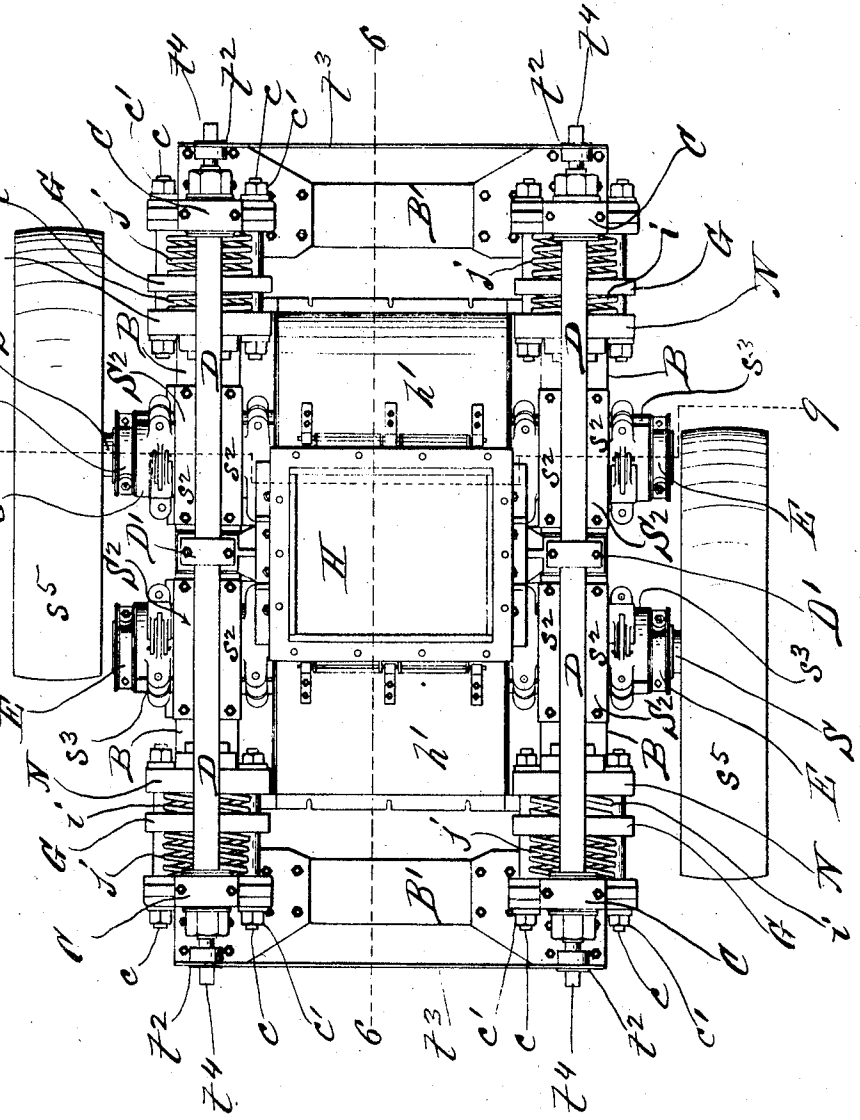
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1,356,291.

Patented Oct. 19, 1920.

8 SHEETS—SHEET 1.

Fig. 1.



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8 SHEETS—SHEET 2.

Fig. 2.

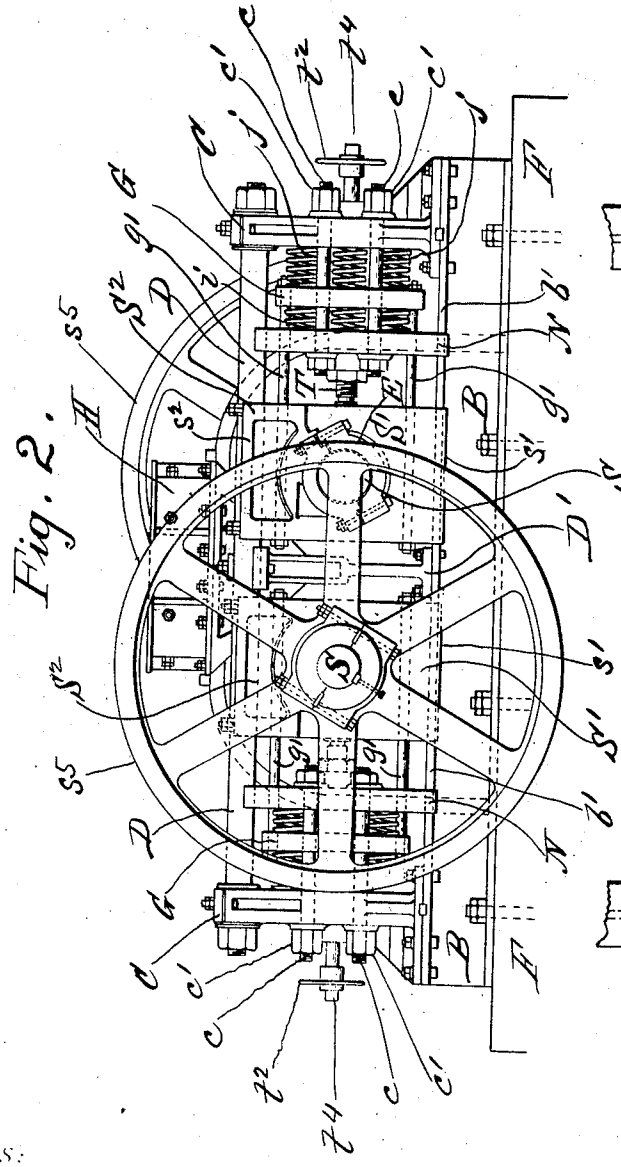
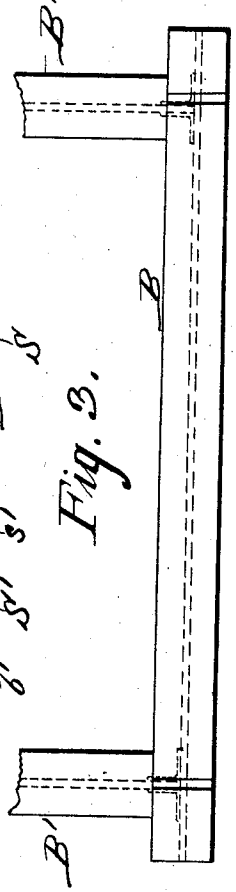


Fig. 3.



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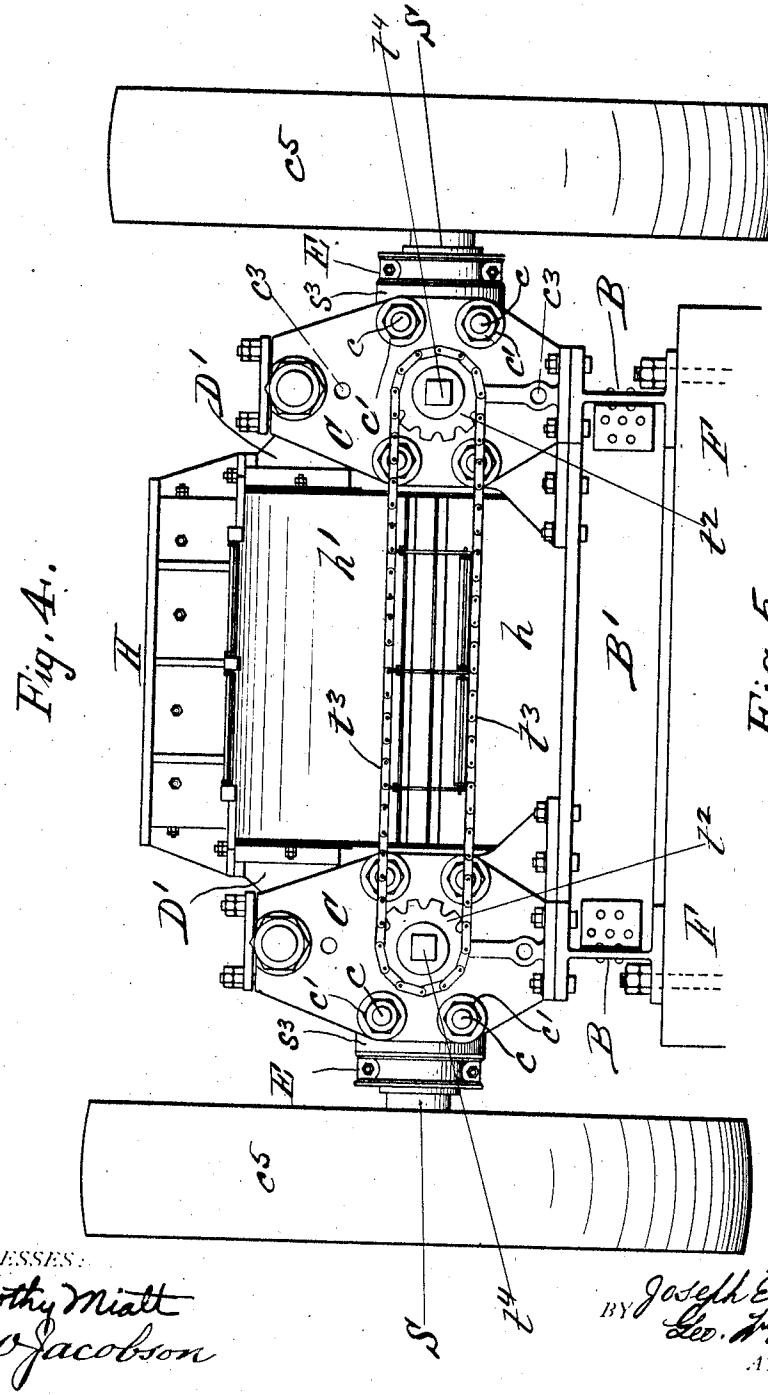


Fig. 4.

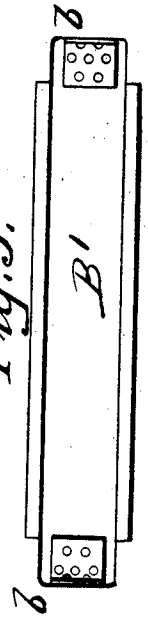


Fig. 5.

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8 SHEETS—SHEET 4.

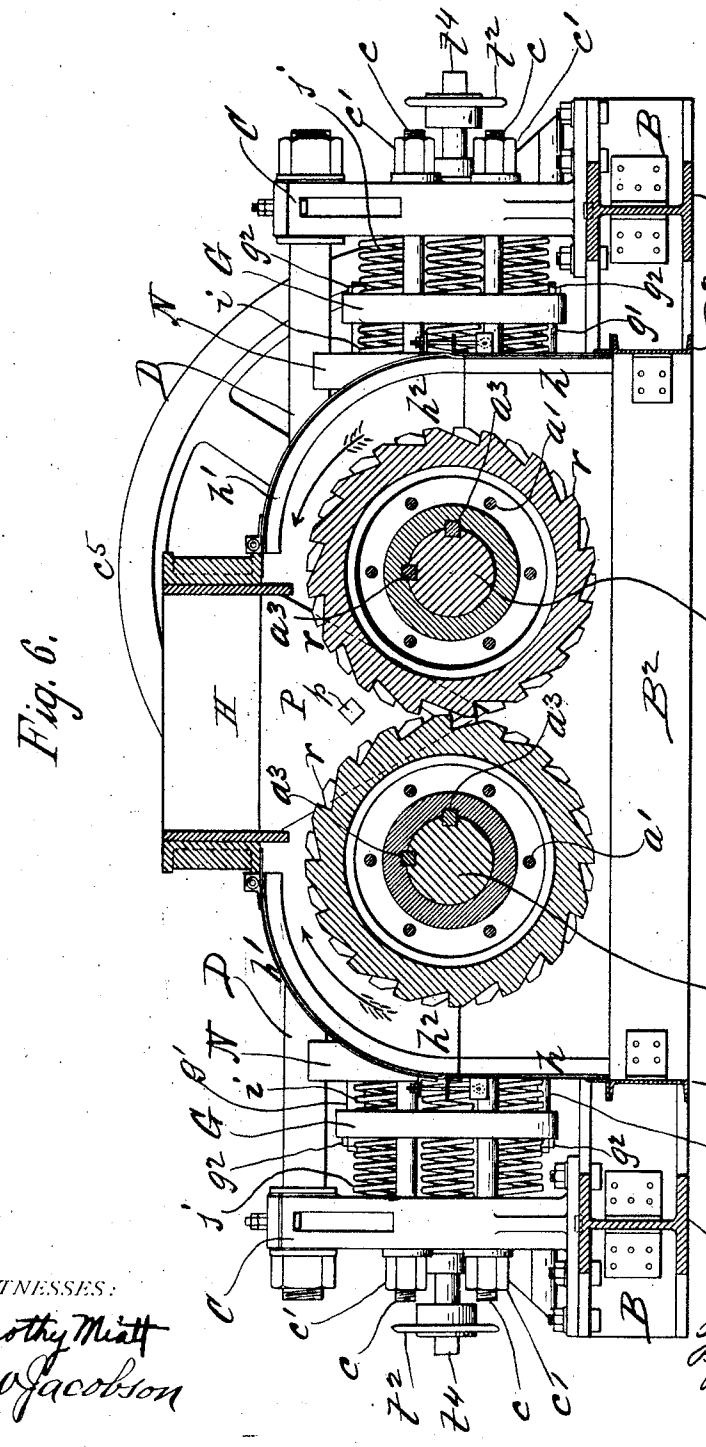


Fig. 6.

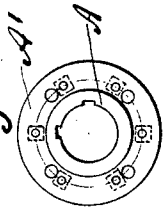


Fig. 8.

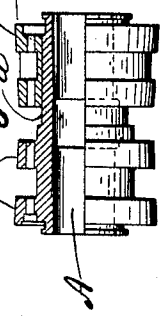


Fig. 7.

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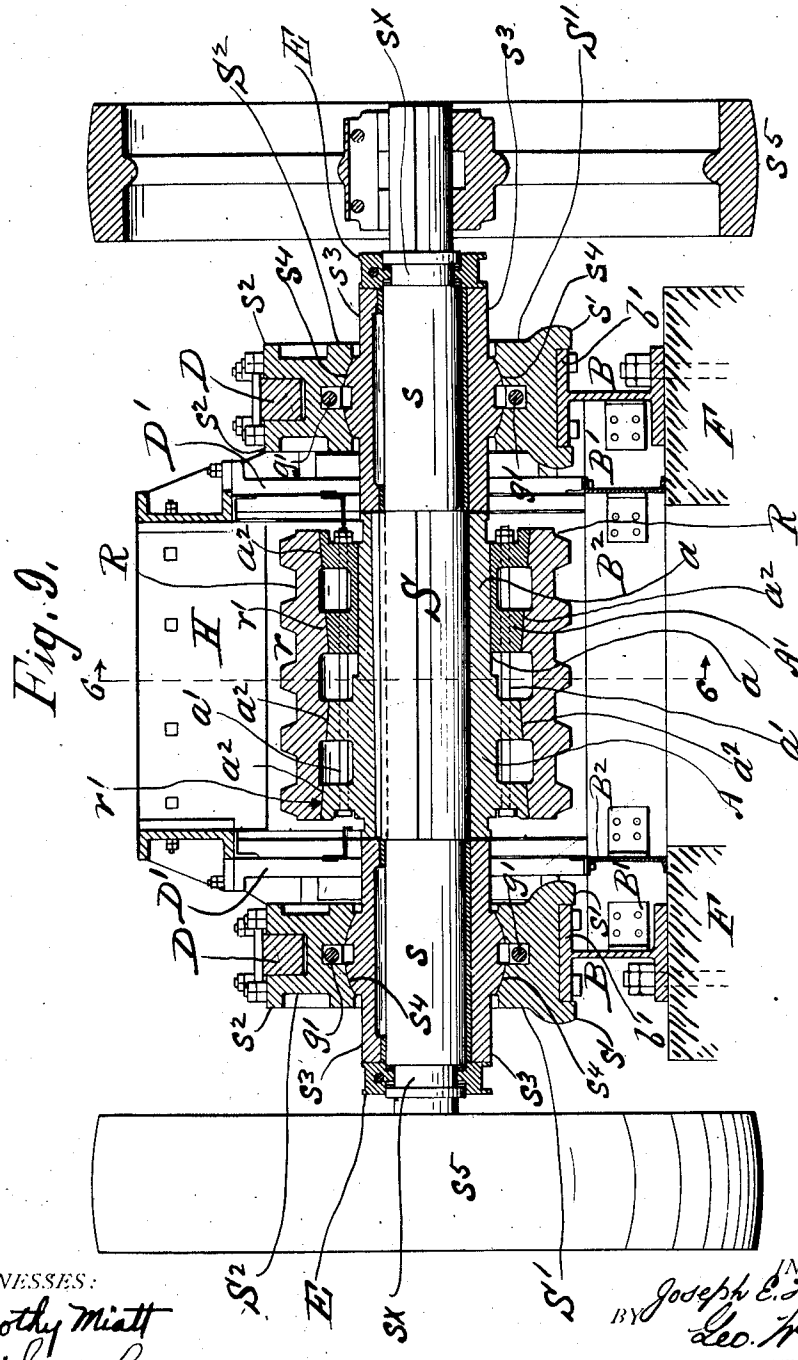
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8 SHEETS—SHEET 5.

Fig. 9.



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8 SHEETS—SHEET 6.

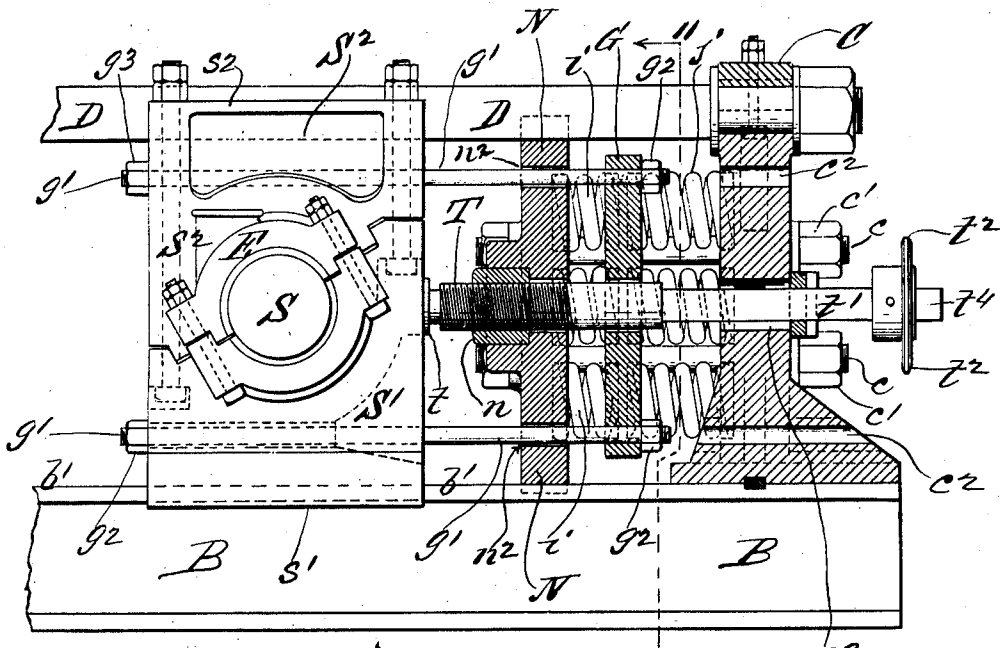


Fig. 10.

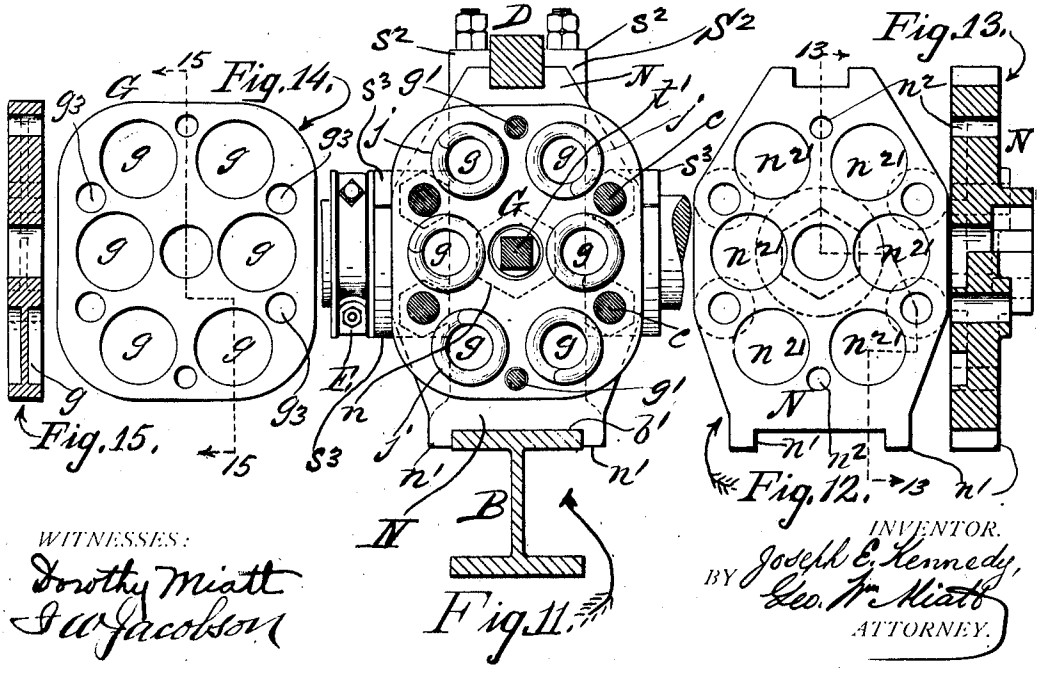


Fig. 14.

Fig. 15.

Fig. 11.

Fig. 13.

Fig. 12.

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8 SHEETS—SHEET 7.

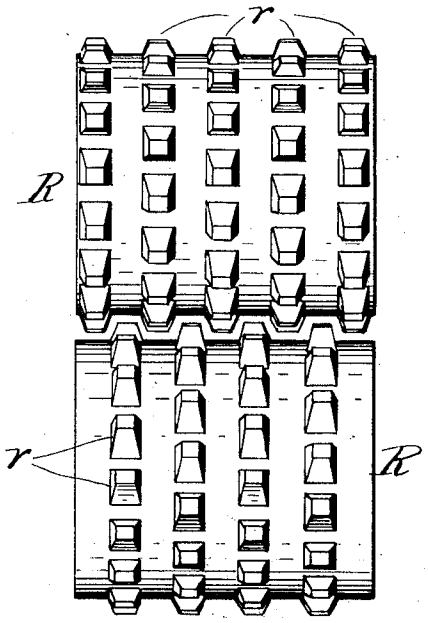


Fig. 16.

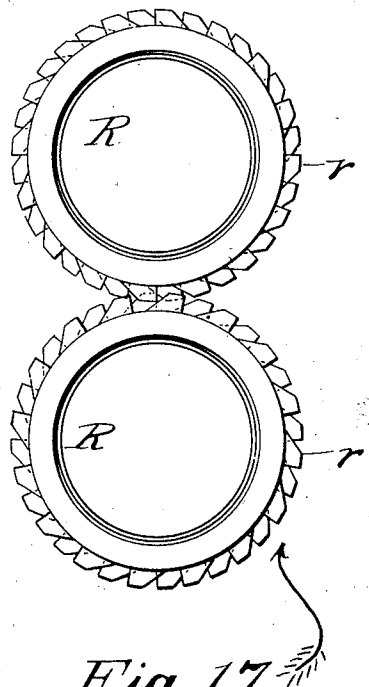


Fig. 17.

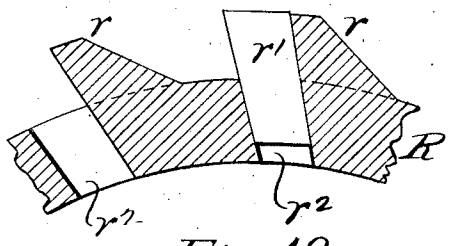


Fig. 18.

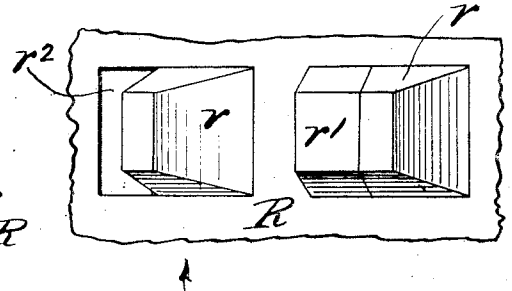


Fig. 19.

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8 SHEETS—SHEET 8.

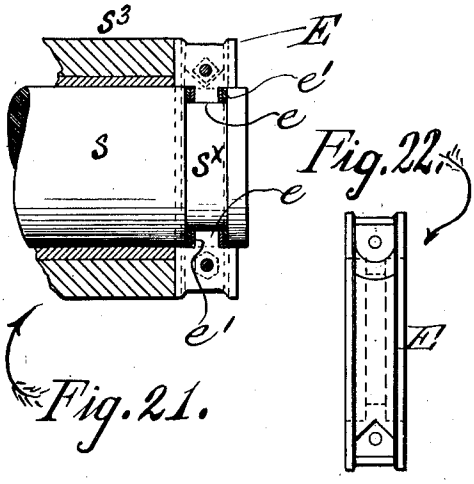


Fig. 21.

Fig. 22.

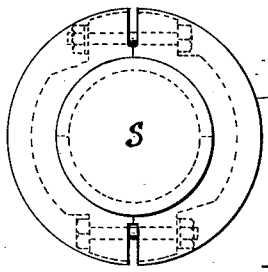
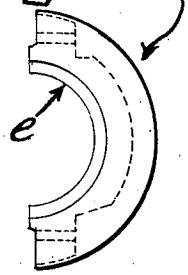
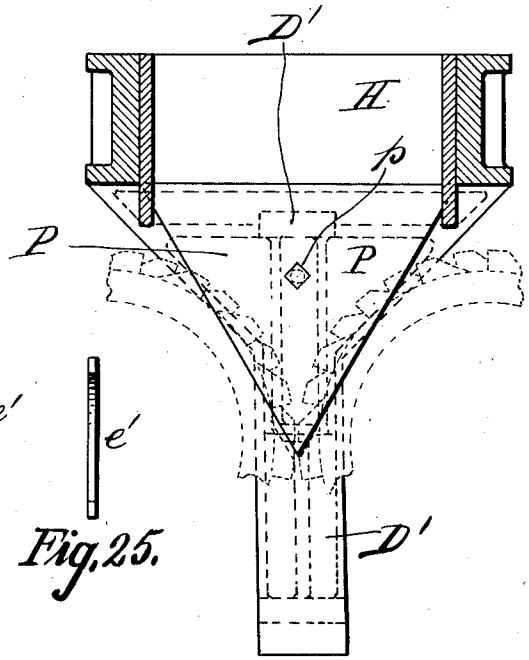


Fig. 20.

Fig. 23.





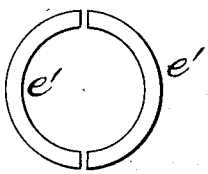


Fig. 24.

Fig. 25.

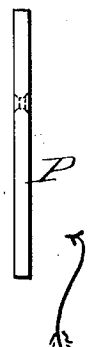


Fig. 27.

Fig. 26.

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UNITED STATES PATENT OFFICE.

JOSEPH E. KENNEDY, OF NEW YORK, N. Y.

CRUSHING-ROLL MACHINE.

1,356,291. Specification of Letters Patent. Patented Oct. 19, 1920.

Application filed February 15, 1917. Serial No. 148,789.

To all whom it may concern:

Be it known that I, JOSEPH E. KENNEDY, a citizen of the United States, and a resident of the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Crushing-Roll Machines, of which the following is a specification.

My improvements relate to roll mills for crushing rock, ore, coal and other crude material, and are designed to increase the capacity and efficiency of such machines. That is to say, for a given size of machine, coarser material may be reduced,—the machine being able to adapt itself to the varying requirements of use upon practically all grades of raw material.

The invention consists in the specific construction and arrangement of parts described and claimed,—distinctive features concerning the form and arrangement of the sluggers; the means for adjusting the sluggers on one roll with relation to those on the other; the roll and tension mechanism and means for adjustment thereof; and other details of construction, all as hereinafter fully set forth.

In the accompanying drawings,

Figure 1, is a plan of my improved mill;

Fig. 2, is a side elevation thereof;

Fig. 3, is a top view of one side of the roll base frame;

Fig. 4, is an end elevation of the mill on a larger scale;

Fig. 5, is an elevation of an end girder of the base frame;

Fig. 6, a vertical longitudinal section on plane of line 6—6, Figs. 1, and 9;

Fig. 7, is a sectional elevation in detail, on a reduced scale, of one of the roll cores, showing both fixed and movable hearts;

Fig. 8, is an end elevation of the parts shown in Fig. 7;

Fig. 9, is a transverse section taken upon plane of line 9—9, Fig. 1;

Fig. 10, a sectional elevation showing a bearing box mount and the adjacent spring cage, etc.;

Fig. 11, a transverse section taken upon plane of line 11—11, Fig. 10;

Fig. 12, a rear elevation of one of the spring pressure nut plates;

Fig. 13, a section taken upon plane of line 13—13, Fig. 12;

Fig. 14, an elevation of one of the intermediate spring cage plates;

Fig. 15, a section taken upon plane of line 15—15, Fig. 14;

Fig. 16, is a peripheral elevation of two opposed slugger roll tires, showing the intervening and staggered arrangement of the sluggers;

Fig. 17, an elevation of opposed slugger roll tires taken at right angles to Fig. 16;

Fig. 18, is a sectional detail illustrating the use of renewable front or wear plates on the sluggers;

Fig. 19, is a top view of the parts shown in Fig. 18;

Fig. 20, is a side elevation of one of the adjustable shaft collars;

Fig. 21, is a central sectional elevation thereof and of adjacent parts;

Fig. 22, is an edge elevation of one of the adjustable shaft collars;

Fig. 23, is a side elevation of one of the sections thereof;

Fig. 24, is a detail elevation of one of the split washers;

Fig. 25, an edge view thereof;

Fig. 26, a detail view showing one of the triangular hopper end face plates; and one of the central posts of the frame;

Fig. 27, an edge view of one of the triangular face plates.

F, represents the foundation to which the roll-base frame is secured, said roll-base frame consisting primarily of the longitudinal side girders B, and the transverse end girders B′,—said girders being made of rolled steel and being I-shaped in cross section, and the end girders B′, being shaped at their ends *b*, *b*, (Fig. 5) to fit into the side girders B, as shown more particularly in Figs. 4, and 5, and being rigidly secured thereto as indicated.

On the junctional ends of the side girders B, and end girders B′, are positioned and rigidly secured tension spring cage standards C, C, the upper portions of the two on each side of the apparatus being in each case rigidly connected by means of a tension bar D, medially supported upon and rigidly secured to a center post D′, in turn rigidly secured to its side girder B. Thus the rigid main frame work of the structure consists essentially of the base girders B, B′, the end corner cage standards C, C, the medial posts D′, and the reinforcing tension bars D. The hopper H, is supported upon and between the medial posts D, and an inner base frame B^2, formed of channel irons rig-

idly secured together and resting on the foundation F, as seen in Figs. 6, and 9. The roll casing h, h, is also supported upon the inner base frame B^2, and is formed with the usual hinged sections h', h', to afford access to the roll chamber h^2.

Each roll shaft S, S, is mounted upon and between bearing pedestals S', S', which rest slidably upon the upper faces of the side girders B, B, the bearings of said shafts being held to their seats in said pedestals S', S', by means of bearing caps S^2, S^2, the upper portions of which straddle the under sides of the tension bars D, D, as shown more particularly in Fig. 9, in which the bifurcated upper extremities s^2, s^2, of the bearing caps S^2, S^2, are shown, as well as the flanges s', s', of the pedestals S', S', which overlap the upper edges of the side girders B, B. In this manner the journal blocks (S',—S^2,) are sustained laterally while free to be adjusted longitudinally upon and as related to said side girders B, and other parts of the apparatus. Each journal s, s, of each roll shaft S, is seated directly in a split bearing box s^3, formed with a spheroidal peripheral portion s^4, fitting in corresponding concavities in the pedestal S', and cap S^2, as shown in Fig. 9, thus rendering the mount of the ball and socket type so as to afford accuracy of alinement and eliminate binding frictional resistance and wear as much as possible.

Beyond each journal section s, s, one roll shaft S, (or both if desired) is formed with an annular groove s^x, in which fit the semi-circular tongues e, e, (see Fig. 21) of the two sections of a split collar E, which latter abuts against the outer end of the bearing box s^3, as shown more particularly in Figs. 1, 4, 9, 10, 11, 20, and 21. The annular groove s^x, in the shaft is wider than the collar tongues e, e, the difference being compensated for by split shim rings, e', e', so that by placing more or less of these semi-circular shims on one side or the other of the tongues e, e, the collar E, may be positioned on the shaft to attain accurate adjustment of the latter with relation to the alinement of the sluggers r, on the roll tire R, as compared with those on the opposed roll tire R. That is to say the shaft may be variably positioned as related to its longitudinal axis by varying the arrangement of the split ring shims in the grooves s^x, and while this margin of variation is comparatively slight it is sufficient for the purpose of insuring a uniformity of product by accurately centralizing the annular rows of sluggers r, between those on the opposed roll.

Keyed to each shaft S, medially between its journals s, s, is a roll core or fixed "heart" A, on the cylindrical portion a, of which is mounted the supplementary core section or movable "heart" A', the two core sections or hearts A, A', being united by means of coupling bolts a', a'. Two spline keys a^3, a^3, are used in splining the main roll core or heart A, to the shaft S, said keys being slightly wedge tapered and opposed in inclination so as to wedge said core section A, rigidly in position on the shaft. Each core section A, A', is formed with conoidal peripheral bearing surfaces a^2, a^2, convergent toward the center, and on these is supported the slugger shell or tire R, formed internally with corresponding concavo-conoidal bearing surfaces r', r', so that by means of the bolts a', a', the tire R, may be securely wedged to and upon the core members or hearts A, A', and hence rigidly secured to turn with the shaft S, on one extremity of which is mounted the usual drive-fly wheel s^5, by which the roll is actuated. The main core or heart A, is secured to the shaft S, by two wedge keys a^3, a^3, with their convergencies extending in opposite directions, so as to securely lock said main core A, rigidly in position.

The above description applies of course to each of the roll shafts and adjuncts, the same being duplicated in each case with the exception of the arrangement of the sluggers r, r, protuberant from the peripheries of the roll tires R, R. In the first place, in this respect, the sluggers on one tire are opposed in direction to those on the companion tire, the inclined tangential portions on one tire extending from right to left and on the other from left to right,—it being understood that the shafts are rotated in opposite directions (as indicated by the arrows in Fig. 6) so that the operative slugger faces of the opposed rolls travel toward each other centrally and downwardly to grip, like interlocking teeth, the material fed between them from the central hopper H, above. Furthermore, as will be seen more particularly by reference to Figs. 16, and 17, the annular rows of sluggers on one tire not only intervene between the annular rows of sluggers on the opposed roll, but those on each tire are staggered, or break joints individually, as related to those of the next adjoining rows on the same tire, so that a line drawn longitudinally across the peripheral surface of either roll will intersect a plurality of sluggers. By this arrangement of sluggers a maximum of contactual surface is attained without any continuous transverse space as related to the line of motion, and hence the gripping or biting function of the rolls is augmented, with the result that the material under treatment is more effectually reduced, and this is accomplished with the least possible danger of clogging and undue strain.

An incidental feature of my invention in

this connection consists in making the sluggers r, r, with renewable wear-face sections r', as shown in Figs, 18, and 19, in which case a recess or socket r^2, is formed in front of each slugger abutment r,—the face sections r', being slightly tapered or wedge shaped so that their shank portions may be driven into place in the said sockets r^2; or they may be otherwise secured in position by any suitable mechanical expedient, as may be found most desirable in view of the material to be treated. This provision for substitution and replacement of the part of each slugger which is subjected to the greatest degree of abrasive wear adds materially to the life and utility of the crusher rolls, and saves loss of time and labor which would otherwise be involved in the dismantling of the apparatus for substitution of new shells or tires R, for old.

The journal blocks (pedestals S′, and caps S²) rest by gravity upon the rail ways b', b', constituted by the upper flanges of the longitudinal girders B, of the base frame, being held against lateral displacement as before stated by the pedestal flanges s', which straddle said rails and by the bifurcated upper extremities s^2, of the bearing caps S², which straddle the under sides of the tension bars D. The normal positions of the journal blocks (S′,—S²,) and hence of the shafts S, S, and rolls R, R, are prescribed by temper screws T, T, the inner end t, of each of which forms an abutment against which the outer side of one of the pedestals S′, rests. Each temper screw T, is seated in a nut bearing n, embedded in one of the spring pressure nut-plates N, N, which rest upon the ways b', b', straddling the same by means of flanges n', n', the upper portions of said nut-plates N, N, being formed to straddle the under side of a tension bar D, as shown in Figs. 10, and 11, so that said nut-plates N, N, while capable of movement along the rails b', b', are held against lateral movement thereon.

An intermediate spring cage plate G, is interposed between each nut-plate N, and each tension spring cage standard C, said plate G, being formed on each side with depressions or seats g, (Figs. 14, and 15,) for compression springs which are interposed between it and the opposed faces of the nut-plate N, and of the standard C, both of which are formed with coincident depressions or spring seats, as indicated in dotted lines in Fig. 10. Thus compression springs i, i, are interposed between each of said intermediate spring cage plates G, G, and seats n^{21}, in the nut-plates N, N, while in like manner and alinement compression springs j, j, are interposed between each of said intermediate plates G, and each of said standards C.

Each intermediate spring cage plates G, is connected with and supported by one of the journal boxes S′,—S², by means of coupling rods g', g', which extend through holes n^2, n^2, formed to accommodate them in the intervening nut-plate N, as shown particularly in Fig. 10, the ends of said coupling rods g', g', being threaded to receive adjusting nuts g^2, g^2, by means of which the normal distance between journal box S′,—S², and intermediate spring cage plate G, may be prescribed and regulated.

In a similar manner the nut-plates N, are coupled to the standards C, by means of buffer rods c, c, passing through openings g^3, (Fig. 14) formed for them in the intermediate spring plates G, and having their ends threaded for engagement with nuts c', c', by means of which the normal distance between the nut-plates N, and the standards C, is governed. Incidentally it may be mentioned that the openings c^2, c^2, through the standards C, C, are provided to facilitate the insertion into position of the coupling rods g', g', during the assembling of the parts; and the openings c^3, in said standards C, C, are for the accommodation of the shanks t', t', of the temper screws T, T.

Upon each temper screw shank near its outer extremity is rigidly secured a sprocket wheel t^2; and the two temper screws at each end of the apparatus are connected to turn in unison by a sprocket chain t^3. The extreme ends t^4, of the temper screw shanks t', are of square or other angular form in cross section to facilitate manipulation by means of a wrench lever or equivalent mechanical expedient. The coupling together of the pair of temper screws at each end of the apparatus in this manner insures uniform and accurate adjustment and alinement of the journal boxes (S′,—S²,) on each side girder B, and hence a perfect mount for each roller shaft S.

The normal or rest positions of the bearing blocks (S′,—S²,) being prescribed as above indicated by means of the temper screws T, T, so as to attain the desired normal distance between the peripheries of the roll tires R, R, any excessive resistance engendered by the presence of abnormally large lumps in the material fed to the rolls will be taken up and compensated for by the springs i, i, j, j, which will allow the nut-plates N, N, to yield temporarily, but will return them to normal as soon as the excess of resistance is passed,—the intermediate spring plates G, by their connection with the bearing blocks (S′—S²,) maintaining the proper relationship of parts under all conditions of operation by insuring the contact of the inner ends t, of the temper screws T, with the bearing

pedestals S'. Thus the apparatus is effectually safeguarded and reinforced against undue shock and strain, and smoothness of operation attained. And the facility with which the peripheral relations of the rolls may be changed with accuracy by means of the sprocket and chain-connected temper screws T, T, is an important factor in the practical operation of the apparatus, in that differences or variations of grade of material may be quickly met and provided for.

The reversible cheek plates P, at the ends of the rolls are of triangular shape as shown in Fig. 26, each being secured on the adjoining center posts D', by a bolt p, the head of which is countersunk in the plate P. More than one bolt may be used if preferred,—the essential feature being that of so supporting each cheek plate P, on its center post D', that its apices may be successively utilized at the area of greatest attritive wear between the rolls.

By the relative arrangement of roll-sluggers herein set forth I am enabled to use rolls of smaller diameter for a given capacity because the sluggers take hold better and more uniformly, and the disintegration of comparatively large pieces of material is assured by the fact that the peripheral areas of the rolls afford no intervening pockets or spaces through which material may pass or be carried without being subjected to grinding by opposed sluggers. And in this connection the provision for the adjustment of the shafts on their longitudinal axes for the purpose of attaining accurate alinement of the rows of sluggers on one roll with relation to those on the other is important,—as well as the fact that the sluggers on each roll are staggered or break joints with each other, laterally considered, so that there is no continuous straight space across the face of either roll,—the material fed to the rolls being scattered and broken by and between the sluggers without any chance of escape through the rolls in unreduced condition. Furthermore this arrangement of sluggers is adapted to the feeding through of clays and sticky ores, a result not heretofore attained in a satisfactory manner.

The formation of the base frame of I-shaped rolled steel girders is an advantageous feature of construction of the apparatus considered as a whole, affording adequate support for the corner cage standards C, as well as for the journal boxes (S', S^2,) and nut-plates N, also constituting suitable track-ways for said boxes and plates. And the tension bars D, supported medially by the central posts D', and connecting and reinforcing the cage standards C, aid materially in equalizing and distributing the strain to which the parts are subjected during crushing operations, supplementing and rendering effective the action of the shock-absorbent spring cages.

By the provision of sluggers with replaceable wearing faces I obviate the cost of time and labor involved in the substitution of roll tires, as well as the initial cost of new tires, so that the life and utility of the apparatus is increased and the cost of maintenance reduced. This result also is contributed to by the triangular cheek plates supported on the center posts in such manner that their end portions may be successively utilized to bear the brunt of wear at the ends of the crushing rolls.

What I claim as my invention and desire to secure by Letters Patent is,

1. In crushing roll mechanism of the character designated, in combination, two opposed cylindrical crushing rolls formed of one piece tires of uniform diameter throughout, each tire formed with peripheral sluggers of uniform size and shape integral with the tire, the sluggers on one tire being tangentially inclined in a direction opposite to the inclination of those on the other tire, and being arranged in annular rows spaced apart, the rows of sluggers on one tire intervening in position as related to those on the other tire, and the sluggers of each row on each tire being staggered longitudinally of the roll as related to those in each adjacent row, so that the sluggers in alternate rows are in alinement with each other and with the spaces between the sluggers in intervening rows, for the purpose described.

2. In crushing roll mechanism of the character designated, the combination with a one piece cylindrical roll tire formed with protuberant slugger abutments and with sockets in front of said abutments, of wear-face sections fitting and driven in part into said sockets, for the purpose described.

3. In crushing roll mechanism of the character designated, the combination with a one piece cylindrical roll tire formed with protuberant slugger abutments and with sockets in front of said abutments, of wear-face sections fitting and driven in part into said sockets, said wear-face sections being made wedge shaped, for the purpose set forth.

4. In crushing roll mechanism of the character designated, a roll shaft formed with annular grooves adjacent to the outer ends of its journal sections, split collars adapted to bear against the outer ends of the journal boxes and formed with annular tongues fitting in said shaft grooves, but of less width than said grooves, split shim rings fitting between the said collar tongues and the sides of the shaft grooves, and a crushing roll mounted on said shaft and formed with annular peripheral rows of protuberant sluggers, in combination with an opposed crush-

ing roll also formed with annular peripheral rows of sluggers, the rows on one roll intervening as related to those on the other, and being laterally positioned with relation to each other by means of the aforesaid split collars and shim rings, for the purpose set forth.

5. In crushing roll mechanism of the character designated, in combination, roll shafts formed with annular grooves adjacent to the outer extremities of their journal sections, split collars adapted to bear against the outer ends of the shaft journal boxes, and formed with annular tongues fitting in said shaft grooves but of less width than said grooves, split shim rings fitting between the said collar tongues and the sides of said shaft grooves, and a crushing roll mounted on each of said shafts and formed with peripheral annular rows of protuberant sluggers, the rows of sluggers on one roll intervening as related to the rows of sluggers on the other roll and being positioned laterally with relation thereto by means of the aforesaid split collars and shim rings, for the purpose set forth.

6. In crushing roll mechanism of the character designated, the combination of opposed crushing rolls formed with annular rows of peripherally protuberant sluggers, the rows on one roll intervening as related to those on the other, and means for adjusting one of the shafts longitudinally to effect the lateral positioning of the rows of sluggers on its roll with relation to the rows of sluggers on the opposed roll.

7. In crushing roll mechanism of the character designated, the combination of opposed crushing rolls formed with peripherally protuberant sluggers, the sluggers on one roll intervening in position as related to those on the other roll, and means for adjusting one roll on its longitudinal axis to regulate and prescribe the relation of its sluggers to those on the opposed roll, for the purpose described.

8. In crushing roll mechanism of the character designated, the combination of opposed crushing rolls formed with peripherally protuberant sluggers, the sluggers on one roll intervening in position as related to those on the other roll, and means for adjusting the rolls on their longitudinal axes to regulate and prescribe the relation of the sluggers on each roll with relation to those on the other, for the purpose described.

9. In crushing roll mechanism of the character designated, a roll shaft formed with an annular groove adjacent to the outer end of one of its journal sections, and a split collar adapted to bear against the outer end of the box for said journal, and formed with an annular tongue fitting in said shaft groove but of less width than said groove, split shim rings fitting between the said collar tongue and the sides of the shaft groove, and a crushing roll mounted on said shaft and formed with protuberant peripheral sluggers, in combination with an opposed crushing roll also formed with peripherally protuberant sluggers, the sluggers on one roll intervening as related to those on the other, and the adjustment of said split collar on the shaft by means of the split shimes regulating the position laterally of the sluggers on one roll with relation to those on the other, for the purpose set forth.

10. In crushing roll mechanism of the character designated, the combination with the opposed crushing rolls and hopper, of reversible end cheek pieces each of triangular form detachably secured each to a central post of the frame work, and said central posts rigidly secured to the longitudinal base girders and to longitudinal tension bars rigidly secured to the end cage standards, whereby the apices of said triangular cheek pieces may be successively utilized at the area of greatest attritive wear between the rolls.

11. In crushing roll mechanism of the character designated, the combination with the hopper and opposed crushing rolls, of a central frame-post, and a reversible triangular end cheek plate detachably secured to said central frame-post, whereby the apices of said triangular cheek pieces may be successivly utilized at the area of greatest attritive wear between the rolls.

12. In crushing roll mechanism of the character designated, in combination, a crusher roll shaft and appurtenances, a main or "fixed" core heart keyed thereto and formed on one side of its transverse center with centrally convergent peripheral conoidal tire bearing surfaces and on the other side of its transverse center with a cylindrical portion, a supplementary or movable core heart contactually mounted on said cylindrical portion of the main core and formed with centrally convergent peripheral conoidal tire bearing surfaces, a centrally convergent tire formed with concave conoidal bearing surfaces contacting with the aforesaid conoidal bearing surfaces on the core hearts or sections, and means for clamping the supplementary core heart to the main core heart to wedge the tire securely in position.

13. In crushing roll mechanism of the character designated, in combination, a crusher roll shaft and appurtenances, a main or "fixed" core heart keyed thereto and formed on one side of its transverse center with centrally convergent peripheral conoidal tire bearing surfaces and on the other side of its transverse center with a cylindrical portion, a supplementary or movable core heart contactually mounted on said cylindrical portion of the main core and

formed with centrally convergent peripheral conoidal tire bearing surfaces, a tire formed with centrally convergent concave conoidal bearing surfaces contacting with the aforesaid conoidal bearing surfaces on the core hearts or sections, and screw bolts securing the supplementary core heart adjustably upon and to the main core heart, to wedge the tire securely in position.

14. In crushing roll mechanism of the character designated, a main frame comprising a base frame composed of longitudinal side girders and transverse end girders of I-shaped rolled steel, end corner posts and medial posts rigidly secured to the base frame, longitudinal tension bars, one on each side, rigidly attached to the corner posts and to the medial post on that side, together with slidable crusher roll pedestal-bearings mounted upon and straddling the longitudinal girders, and also straddling the under sides of said longitudinal tension rods, whereby the approximate perfect alinement of said slidable crusher roll bearings is maintained, thereby reducing frictional resistance to a minimum and insuring an equable pressure between the crushing rolls.

15. In crushing roll mechanism of the character designated, a main frame comprising a base frame composed of longitudinal side girders and transverse end girders of I-shaped rolled steel, end corner posts rigidly secured to the base frame, and longitudinal tension bars, one on each side, rigidly attached to said corner posts together with slidable crusher roll pedestal-bearings mounted upon and straddling the longitudinal girders, and also straddling the under sides of the said longitudinal tension rods, for the purpose set forth.

16. In crushing roll mechanism of the character designated, a main frame comprising a base frame composed of longitudinal side girders and transverse end girders of I-shaped rolled steel, end corner posts rigidly secured to the base frame, and longitudinal tension bars, one on each side, rigidly attached to said corner posts together with slidable crusher roll pedestal-bearings mounted upon and straddling the longitudinal girders, and also straddling the under sides of the said longitudinal tension rods, and spring buffer mechanism supported upon the longitudinal girders and end posts and bearing against said pedestal bearings, whereby approximate perfect alinement of said slidable crusher roll bearings is maintained, thereby reducing frictional resistance to a minimum and insuring an equable pressure between the crushing rolls.

17. In crushing roll mechanism of the character designated, in combination, roll shafts mounted upon and between movable bearing boxes, said bearing boxes slidably mounted on the frame, temper screws mounted upon yieldable nut plates, spring cage plates connected with said bearing boxes, springs interposed between said nut plates and said spring cage plates and between said cage plates and standards on the frame, together with the latter, for the purpose described.

18. In crushing roll mechanism of the character designated, in combination, roll shafts mounted upon and between movable bearing boxes, said bearing boxes slidably mounted on the frame, temper screws mounted upon yieldable nut plates, spring cage plates connected with said bearing boxes, springs interposed between said nut plates and said spring cage plates and between said cage plates and standards on the frame, a sprocket wheel on each of said temper screws, and sprocket chains connecting the sprocket wheels at each end of the apparatus, for the purpose described.

19. In crushing roll mechanism of the character designated, in combination, roll shafts mounted upon and between movable bearing boxes, said bearing boxes yieldably mounted on the frame, temper screws mounted on yieldable nut plates, said nut plates connected with the corner standards of the frame by buffer rods, spring bearing plates intermediate between said frame end standards and said nut plates, and springs interposed between said nut plates and said intermediate spring plates and between the latter and said frame end standards, for the purpose described.

20. In crushing roll mechanism of the character designated, in combination roll shafts mounted upon and between movable bearing boxes, said bearing boxes yieldably mounted on the frame, temper screws mounted on yieldable nut plates, said nut plates connected with the corner standards of the frame by buffer rods, spring bearing plates intermediate between said frame end standards and said nut plates, coupling rods connecting said intermediate spring plate with said movable bearing boxes, and springs interposed between said nut plates and said intermediate spring plates and between the latter and said frame end standards, for the purpose set forth.

21. In crushing roll mechanism of the character designated, in combination, roll shafts mounted upon and between movable bearing boxes, said bearing boxes yieldably mounted on the longitudinal girders of the base frame, temper screws mounted upon nut plates yieldably supported on said longitudinal girders of the frame, buffer rods connecting said nut plates with the end standards of the frame, spring bearing plates intermediate between said frame end standards and said nut plates and connected with said bearing boxes, and springs inter-

posed between said nut plates and said intermediate spring plates and between the latter and said frame end standards, for the purpose described.

22. In crushing roll mechanism of the character designated, in combination a base frame formed of girders of I-shaped rolled steel, end corner standards rigidly secured to said base frame, tension bars rigidly attached to and connecting the end standards on each side of the base frame, roll shafts mounted upon and between movable bearing boxes, said bearing boxes yieldably mounted on the longitudinal girders of the base frame and straddling the same, and also straddling the under sides of said tension bars, temper screws mounted upon nut plates yieldably supported and straddling said longitudinal girders of the base, and also straddling the under sides of said tension bars, buffer rods connecting said nut plates with said end standards, spring bearing plates intermediate between said frame end standards and said nut plates, and springs interposed between said nut plates and said intermediate spring plates and between the latter and said frame end standards, for the purpose described.

JOSEPH E. KENNEDY.

Witnesses:
GEO. WM. MIATT,
DOROTHY MIATT.