

[54] **APPARATUS FOR CRUSHING AND/OR COMPACTING**

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[51] Int. Cl. **B30b 3/04, B30b 15/14**

[58] Field of Search **100/DIG. 2, 48, 50, 100/161, 176; 241/99, 159, 230, 231**

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[57] **ABSTRACT**

The disclosed machine or apparatus for crushing is of the general type having a plurality of sets or pairs of opposing crushing rollers arranged in series through which the materials for treatment are passed. One roller from each set of rollers is rotatably supported by a frame. The other roller from each set of rollers is rotatably supported by a member movable relative to the frame. The rollers supported by the movable member move with that member relative to the frame supported rollers to provide for relief from shock loading between the opposing rollers. Resilient means resist relative movement between the opposing rollers in the separating or shock relieving direction.

38 Claims, 10 Drawing Figures

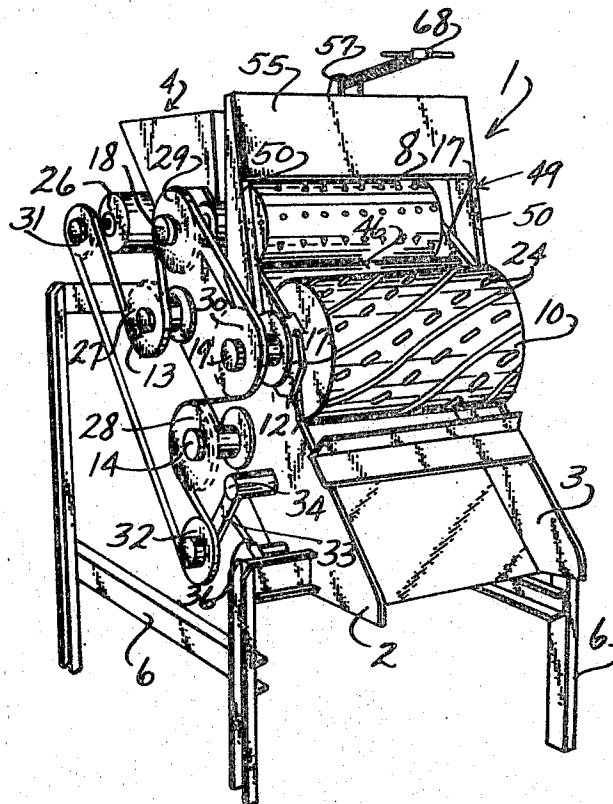


FIG. 1

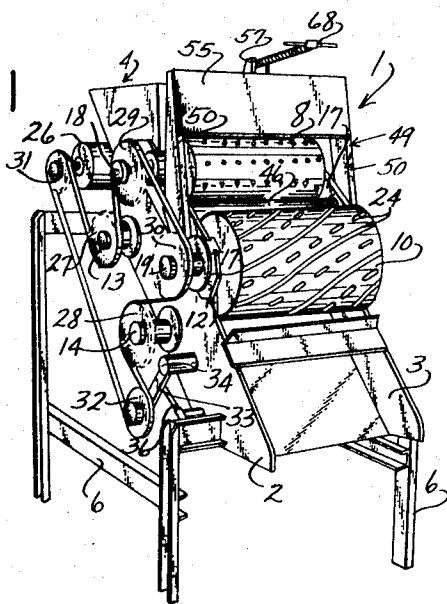
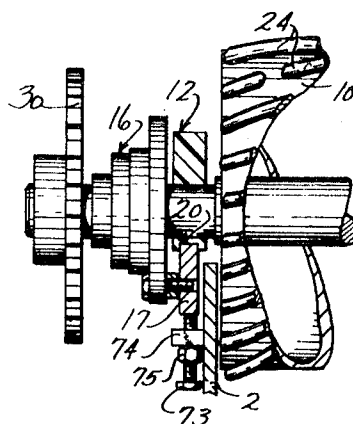


FIG. 7

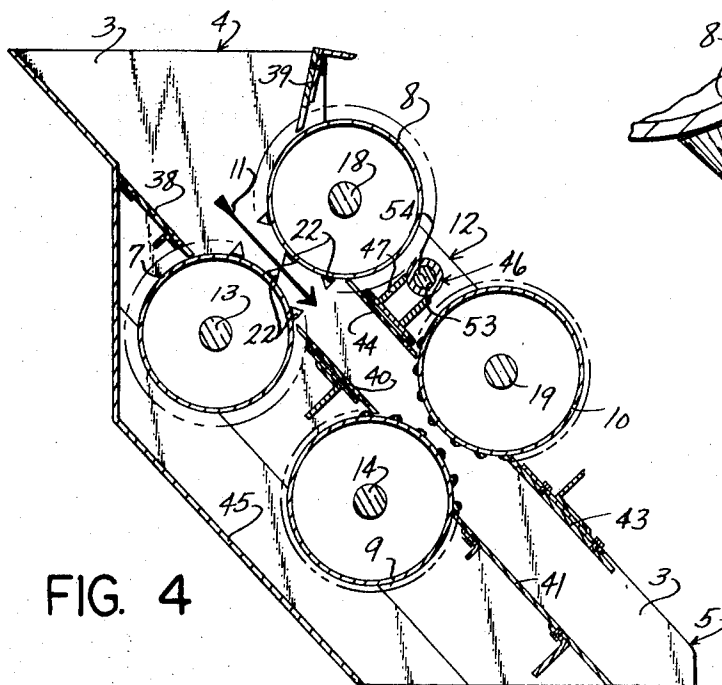


FIG. 4

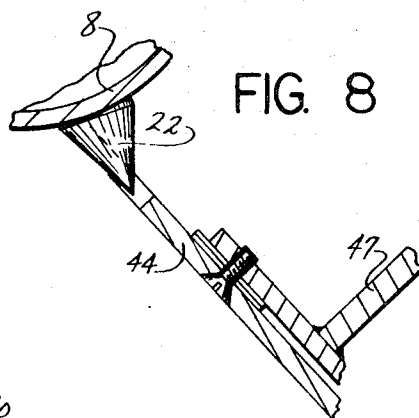
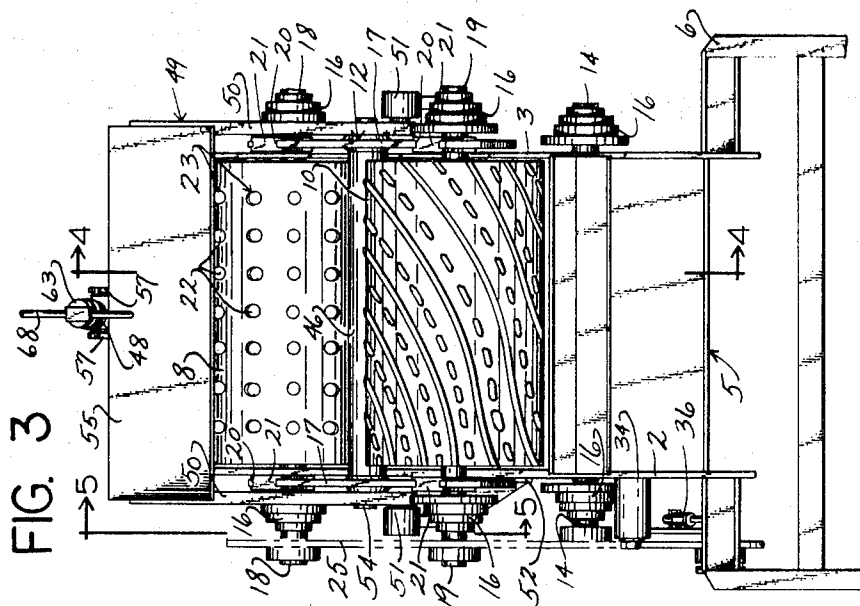
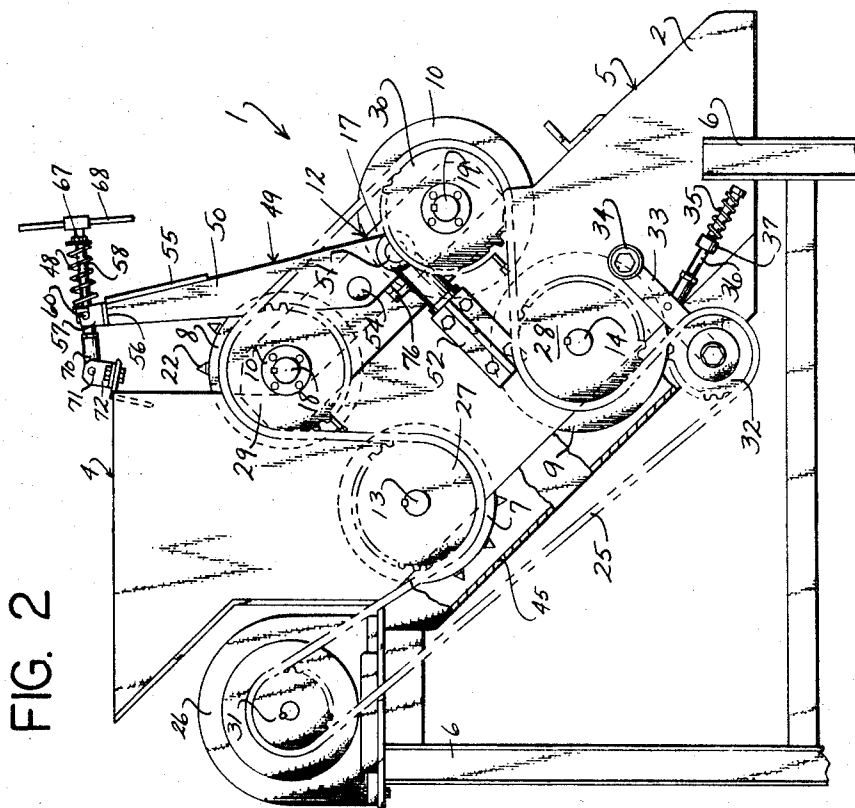


FIG. 8

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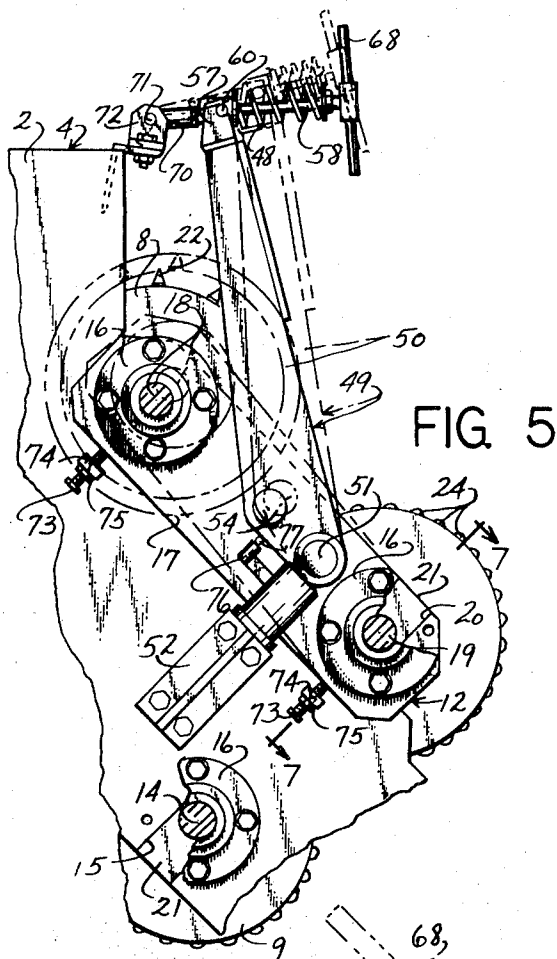


FIG. 5

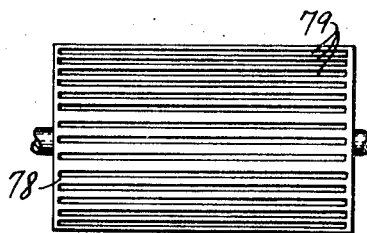


FIG. 9

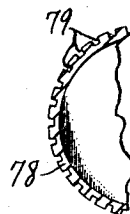


FIG. 10

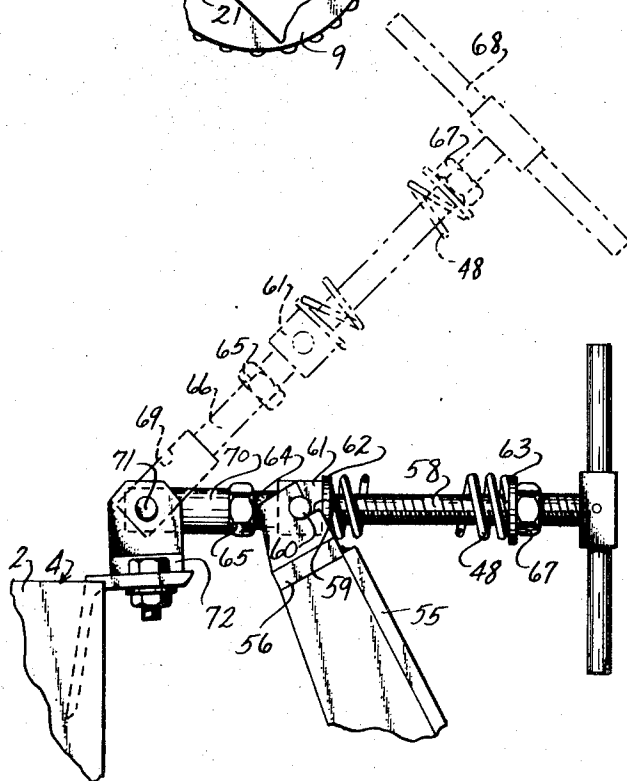


FIG. 6

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APPARATUS FOR CRUSHING AND/OR COMPACTING

BACKGROUND OF THE INVENTION

Machines or apparatus for crushing and/or compacting materials frequently are of a type having one or more sets or pairs of opposing rollers through which the materials are passed. Such machines are generally designed for a given peak load and the components selected to at least accommodate that load. Even when operating within the stated peak load conditions, at least some machines are notoriously hard on the bearings which rotatably support the crushing rollers. As a consequence, the load capability of the machines may be materially reduced over a relatively short period of time from the stated peak load conditions. If the load capability of such a machine is exceeded, jamming generally results to incapacitate the machine. To free or relieve a jam, substantial disassembly of the machines is sometimes necessary giving rise to protracted and costly downtime and sometimes also to an unsightly and burdensome accumulation of the materials awaiting treatment by the machine. It is primarily an object of this invention to provide a machine for crushing and/or compacting materials which is better able to withstand the shock loading encountered in the operation of such machines and wherein possible jams are relatively easily and quickly relieved and without the need for major dismantling of the machine.

SUMMARY OF THE INVENTION

The invention relates to that type of crushing and/or compacting machine or apparatus wherein a plurality of sets or pairs of opposing crushing rollers are arranged in series. Broadly according to the invention, a frame rotatably supports one roller from each set of rollers. The other roller from each set of rollers is rotatably supported by a member movable relative to the frame and the frame supported rollers. The rollers supported by the movable member move with that member relative to the frame supported rollers to provide for relief from shock loading between the sets of opposing rollers. Relative movement between the opposing rollers to relieve shock loading therebetween is resisted by resilient means.

DESCRIPTION OF THE DRAWING FIGURES

The drawings furnished herewith illustrate the best mode presently contemplated for carrying out the invention and described hereinafter.

In the drawings:

FIG. 1 is a perspective view of the crushing and/or compacting machine of this invention;

FIG. 2 is an enlarged side elevational view of the crushing machine;

FIG. 3 is an enlarged end elevational view of the crushing machine;

FIG. 4 is a sectional view taken generally on line 4—4 of FIG. 3;

FIG. 5 is an enlarged sectional view with parts broken away taken generally on line 5—5 of FIG. 3 and in phantom lines shows generally how the apparatus reacts to relieve a shock loading;

FIG. 6 is an enlarged detail view of the roller release mechanism and in phantom lines shows generally how the lever of the roller support assembly can be released to clear the rollers in the event of jamming;

FIG. 7 is an enlarged sectional view taken generally on line 7—7 of FIG. 5;

FIG. 8 is an enlarged sectional detail view of one of the stripper plates for clearing debris from the corresponding roller and which forms a portion of the chute generally enclosing the flow path through the machine;

FIG. 9 is a side elevation showing another form of roller which could be used in the machine of this invention; and

FIG. 10 is a partial end elevation of the roller depicted in FIG. 9.

DESCRIPTION OF THE INVENTION

The crushing machine or apparatus 1 of this invention as shown in the drawings and described hereinafter was specifically designed for crushing frangible and/or compacting metallic receptacles with the principal aim being to reduce the volume that bottles and cans might otherwise occupy. The invention, however, is believed to have application to crushing machines generally and could be designed for crushing materials other than bottles and cans.

Referring to the drawings, the crushing machine 1 includes the opposed, transversely spaced frame side plates 2 and 3 which form a portion of the hopper 4 at the upper end thereof, into which the materials for treatment are fed, and the chute 5 at the lower end thereof wherein the materials are crushed and then delivered for suitable disposition. The apparatus 1 is mounted on a suitable support frame 6.

The materials to be crushed are directed by gravity from the hopper 4 between a first set or pair of opposed crushing rollers 7 and 8 and a second set or pair of opposed crushing rollers 9 and 10 following which the crushed materials exit from the apparatus 1 via the chute 5. The chute 5 along with the crushing rollers generally enclose the inclined flow path for the materials through the machine as generally indicated by the arrows as at 11.

As generally shown in the drawings, the first set or pair of crushing rollers 7 and 8 are disposed on an inclined plane which is generally normal to the flow path 11, and the second set or pair of rollers 9 and 10 generally parallels the first set of rollers and is arranged in series therewith. As further shown, the four crushing rollers 7, 8, 9 and 10 are disposed in a generally rectangular pattern wherein the rollers 7 and 9 generally parallel the crushing or flow path 11 and the chute 5, as do also the corresponding opposing rollers 8 and 10 during normal operation. The opposing rollers 7 and 8 of the first set are generally identical in size and construction each to the other, and are somewhat smaller in diameter than the second set of opposing rollers 9 and 10 which, as shown are also generally identical in size and construction each to the other. Since the several crushing rollers are disposed in a generally rectangular pattern and opposing rollers 7 and 8 are smaller in diameter than rollers 9 and 10, it follows that the first set of rollers are spaced apart radially a somewhat greater distance at their periphery than are the second set of rollers. All of the rollers are of generally equal length and generally span the transverse distance between the frame side plates 2 and 3. While the rollers 7 and 9 are rotatably supported in fixed relation by the opposed side plates 2 and 3, the corresponding opposing rollers 8 and 10 are carried by a movable bogie unit assembly 12 which is resiliently or yieldably supported as herein-

after described to provide relief for the opposing rollers under shock loading.

The crushing rollers 7 and 9 fixed relative to the frame side plates 2 and 3 are respectively carried by the transversely extending shafts 13 and 14. As generally shown in FIG. 5, the respective shafts 13 and 14 are disposed in corresponding transversely aligned recesses 15 which extend generally normal to the flow path 11 and open downwardly in the side plates 2 and 3. The shafts 13 and 14 are journaled in corresponding transversely spaced and aligned flanged bearing units 16 secured as by bolts to the outside of the frame side plates 2 and 3 adjacent to the corresponding recess 15.

The opposed crushing rollers 8 and 10 are carried by the transversely spaced and aligned bogie plates 17 disposed outwardly from the corresponding frame side plates 2 and 3 and forming a part of the bogie unit assembly 12. The rollers 8 and 10 are keyed or otherwise secured on corresponding transversely extending shafts 18 and 19 which are spaced above the frame side plates 2 and 3 and are respectively disposed in corresponding transversely aligned recesses 20 in the opposed plates 17. The recesses 20 for the respective shafts 18 and 9 are generally disposed adjacent to the opposite ends of the plates 17 with the recesses extending generally normal to the flow path 11 and opening in an upward direction to receive the shafts. Like shafts 13 and 14 for rollers 7 and 9 respectively, the shafts 18 and 19 for the rollers 8 and 10 respectively are journaled in transversely spaced and aligned bearing units 16 secured to the outside of the respective plates 17 adjacent to the corresponding recesses 20 as shown in FIG. 7.

A plastic sealing member 21 surrounds the respective shafts 13, 14, 18 and 19 and is inserted in the several recesses 15 and 20 to shield and protect the corresponding shaft portions and adjacent bearing units 16.

Externally the opposed crushing rollers 7 and 8 are provided with a plurality of radially projecting teeth or spikes 22 adapted to impale the cans passing through the rollers, while the arrangement and number of spikes 22 may vary, it is hoped that each can passing through the rollers 7 and 8 will be engaged by at least one spike and to this end the illustrated embodiment shows the spikes arranged in circumferentially spaced, transversely extending rows 23 with the spikes in the respective rows being also circumferentially aligned. The spikes 22 generally aid in pulling material from the hopper 4 into the crushing or flow path 11 and also serve to puncture any sealed cans delivered to the crushing apparatus 1 to relieve any fluid pressure therein and further serves to weaken or lower the strength of the cans in compression. The diameter of the opposing rollers 7 and 8 inclusive of the spikes 22 may generally approximate the diameter of rollers 9 and 10. The rollers 9 and 10 may have a roughened outer surface as provided by radially projecting, spirally disposed weld heads 24, as shown, to aid in pulling the material through the rollers and along the flow path 11.

The several shafts 13, 14, 18 and 19 carrying the respective rollers 7, 8, 9 and 10 are all driven through a common drive chain 25 by the motor 26 mounted on the support frame 6. On one side of the crushing machine 1 the respective shafts 13, 14, 18 and 19 project outwardly beyond the respective bearing units 16 and carry the corresponding drive gears 27, 28, 29 and 30. The gears 27, 28, 29 and 30 may be generally identical

in size so as to impart generally the same speed to the corresponding rollers 7, 8, 9 and 10, and are disposed in a common plane with the drive sprocket 31 carried on the shaft of the motor 26. In the order of its engagement, the drive chain 25 winds clockwise about the gear 29 on shaft 9, then counterclockwise about the gear 30 on shaft 10, counterclockwise about the gear 28 on shaft 8 and then clockwise about the gear 27 on shaft 7 as viewed in FIG. 2. The drive chain 25 is driven in a counterclockwise direction by motor 26 as viewed in FIG. 2 to impart the desired rotation to the rollers 7, 8, 9 and 10 to advance and crush materials fed into the hopper 4.

The desired tautness for drive chain 25 is maintained by the spring-loaded idler gear 32 carried by the arm 33 pivoted at 34 to the frame side plate 2. The idler gear 32 is disposed inside the run of drive chain 25 and is biased outwardly by the compression spring 35 which acts through the link 36 pivotally connected to the arm 33. The link 36 is universally supported from the frame side plate 2 by the bearing collar 37 which also serves as an abutment for the spring 35.

Internally the hopper 4 is provided with suitable guide plates 38 and 39 which extend transversely between the frame side plates 2 and 3 to guide the materials within the hopper 4 into the vicinity of the flow path 11. The edge of guide plate 38 adjacent to roller 7 as well as the edge of guide plate 39 adjacent to roller 8 may be serrated to provide for a relatively small clearance with respect to the peripheral surfaces of the rollers and to accommodate the projecting spikes 22 on the rollers.

The chute 5 is formed by a series of disconnected stripper plate elements which are spaced longitudinally and generally parallel the flow path and serve to guide and generally confine the crushed materials and also to strip materials from the several rollers. The chute 5 includes the stripper plate 40 disposed intermediate the rollers 7 and 9 and spaced somewhat beneath the upper common tangent line for the rollers. Plate 40 extends transversely between and is secured to the frame side plates 2 and 3 for support. The edge of plate 40 adjacent to roller 7 is serrated to provide for relatively small clearance with respect to the peripheral surface of roller 7 and to accommodate the radial spikes 22 projecting from the surface of the roller. A relatively small clearance separates the opposite edge of plate 40 from the weld beads 24 on roller 9. The chute 5 continues on the opposite side of roller 9 with the stripper plate 41 which extends transversely between and is secured to the frame side plates 2 and 3. The plate 41 forms the underside of the mouth 42 of chute 5 from which the crushed materials issue.

The upper side of mouth 42 is formed by the stripper plate 43 which extends from the roller 10 generally parallel to plate 41. The plate 43 is spaced somewhat above the lower common tangent line for rollers 8 and 10 and extends transversely between and is secured to the frame side plates 2 and 3.

The stripper plate 44 intermediate the rollers 8 and 10 generally parallels the opposed plate 40 of chute 5. As generally shown in FIG. 3, the edge of plate 44 adjacent to roller 8 is serrated to provide for relatively small clearance with respect to the surface of the roller and to accommodate the projecting spikes 22. The opposite edge of plate 44 has relatively small clearance relative to the roller 10. Chute plate 44 extends transversely

generally from frame side plate 2 to side plate 3, but remains out of contact with the respective side plates. Plate 44 is secured to the bogie unit assembly 12 in a manner to be described hereinafter and is thus movable with the assembly 12 along with the rollers 8 and 10 so that its stripper relation to the respective rollers 8 and 10 is generally fixed.

If the receptacles to be crushed in the crushing apparatus 1 contain liquid, the general area of the apparatus could become rather messy. To generally alleviate such a condition, a collecting trough 45 may be suspended or be otherwise secured between frame side plates 2 and 3 beneath the rollers 7 and 9. Such a trough 45 would also be expected to intercept any small particles able to pass through the clearances between the respective rollers and adjacent stripper plates in the hopper 4 and forming the chute 5. Additional casing elements, not shown, may cover other portions of the apparatus 1 as desired to further alleviate a possible mess, enhance the appearance of the apparatus, and promote safety.

The opposed bogie plates 17 of the unit assembly 12 are joined together by a transversely extending tubular connecting member 46 which is secured to the respective plates 17 midway between the axes of shafts 18 and 19 and in spaced relation above a common plane through the shaft axes. Connecting member 46 along with the mounting arrangement of shafts 18 and 19 for rollers 8 and 10 provide for movement of the respective bogie plates 17 generally in unison to accommodate any shock loading imposed on the crushing rollers. The stripper plate 44 between the rollers 8 and 10 is supported from the connecting member 46 by a plurality of transversely spaced bracket projections 47.

Shock loading imposed on the crushing rollers is resisted by the compression spring 48 acting through the inverted U-shaped lever member 49. The respective legs 50 of the U-shaped lever 49 are disposed outwardly of the bogie plates 17 and the lower free ends of legs 50 are pivotally supported on the transversely aligned pivot at 51 provided for by the brackets 52 projecting outwardly and upwardly from the respective frame side plates 2 and 3.

The respective legs 50 of lever member 49 are pivotally connected to the bogie unit assembly 12. The bore 53 in the tubular connecting member 46 opens outwardly through the respective bogie plates 17 and the shaft 54 extends therethrough with the respective ends thereof pivotally engaging the corresponding legs 50 of the lever 49. As shown in FIG. 5, the shaft 54 connecting the bogie unit assembly 12 to the lever 49 is spaced from the pivot at 51 mounting the lever to the frame side plates 2 and 3, and for the particular adjustment shown for the bogie plates 17, the shaft 54 and the pivot at 51 are generally disposed in a common plane spaced above and generally paralleling the common plane through the axes of the roller shafts 18 and 19.

The central connecting leg 55 of the inverted U-shaped lever member 49 carries a U-shaped bracket 56 generally centrally thereof with the legs 57 of the bracket extending upwardly on opposite sides of the threaded rod 58 mounting the compression spring 48. The spaced legs 57 of bracket 56 are provided with corresponding transversely aligned recesses 59 adapted to engage with the transversely extending projections 60 on the collar block 61 movable on the rod 58.

The threaded rod 58 carries the compression spring 48 in a pretensioned condition between a pair of spaced washer abutments 62 and 63. Adjacent to the mounting end of rod 58 the washer abutment 62 is positioned by the sleeve 64, which is integral with and carries the collar block 61, and the nut 65. While the position of the nut 65 and sleeve 64 on the rod 58 will be further described hereinafter, the assembled relation of the nut 65 onto the rod 58 provides for a threaded mounting end portion 66 beyond the nut. The washer abutment 63 at the opposite or free end of rod 58 is positioned by the adjustment nut 67 which is drawn up against washer abutment 63 to place the spring 48 under the desired tension. Beyond the adjustment nut 67, the free end of rod 58 is provided with a cross-bar handle 68.

The mounting end portion 66 of rod 58 is threadably engaged within the threaded bore 69 of the block 70. The block 70 in turn is pivotally supported on a transverse axis at 71 by the bracket assembly 72 mounted on the hopper 4.

The minimum crushing thickness for the machine 1 is dependent on the separation provided for between the two sets of opposing rollers 7, 8 and 9, 10. The amount of separation to be maintained between the opposing rollers is established by a plurality of leveling adjustments screws 73 which support the bogie plate unit assembly 12. With reference to FIGS. 5 and 7, the position of the respective bogie plates 17 is set by the pair of longitudinally spaced adjustment screws 73 which engage the bottom edge of plates 17 adjacent to the respective ends thereof. The respective screws 73 extend threadably through the bracket projections 74 from the corresponding frame side plates 2 and 3 and are locked in their position of adjustment by the lock nuts 75 drawn up tight against the corresponding bracket projections.

When the adjustment for the amount of separation between the opposing rollers 7, 8 and 9, 10 is made with the leveling screws 73, the lever 49, by virtue of its pivotal connection at 54 to the bogie plates 17, assumes a corresponding position. In the position of lever 49 corresponding to the position of adjustment for leveling screws 73, the projections 60 of collar 61 are brought into engagement with the corresponding recesses 59 of lever 49 to establish the position of sleeve 64 and nut 65 on the rod 58. From the adjusted position of sleeve 64 and nut 65, the remaining elements on rod 58 are set as previously described.

Should the crushing machine 1 become jammed or approach a jamming condition, provision is made to automatically shut off the motor 26 to stop the drive mechanism for the crushing rollers 7, 8 and 9, 10 so that the machine can be cleared. The automatic shutoff of motor 26 for an overload condition is effected by a micro-switch 76 disposed in the electrical circuit of motor 26. The switch 76 may be mounted on one of the frame brackets 52 and includes an extendible sensing element 77 which remains in contact with the lower edge of the corresponding leg 50 of lever 49. The sensing element 77 is extendible to a given limit as the lever 49 pivots at 51 relative to the frame brackets 52. When the load conditions imposed on either set of crushing rollers 7, 8 and 9, 10 causes the lever 49 to pivot at 51 beyond the limit of the extendible sensing element 77, the switch 76 is actuated to open the electrical circuit of motor 26 to stop the drive mechanism for the rollers.

After the machine 1 is cleared of the materials giving rise to the overload condition as sensed by the switch 76 and as further described hereinafter, the machine may be returned to operation.

During operation of the crushing machine 1, the weight of rollers 8 and 10 and associated elements including the bogie unit assembly 12 and lever member 49 are generally adequate to effect crushing of bottles and/or cans to a desired particle size and/or thickness as provided for by the desired leveling adjustment of the bogie plates 17 by the screws 73. When the weight of rollers 8 and 10 and associated elements are adequate to effect crushing to the desired particle size and/or thickness, then the bogie unit assembly 12 and lever member 49 remain generally unmoved and the biasing pressure of spring 48 remains unused.

When shock loading is encountered between either set of opposing crushing rollers 7, 8 and 9, 10, relief is provided as the corresponding rollers are caused to move apart or further separate to accommodate such loading. As either set of rollers is caused to move apart or separate further to accommodate shock loading, the corresponding ends of the respective bogie plates 17 are caused to be lifted which in turn raises the pivot shaft 46 connecting the plates 17 to the lever 49. With the raising of the pivot shaft 46 in response to a shock load, the lever member 49 is forced to move angularly about its fixed pivot at 51 to compress the spring 48 on rod 58. Thus, the biasing pressure of spring 48 acts through the lever 49 and the bogie plate unit assembly 12 to resist or oppose the shock loading encountered between either set of the opposing rollers 7, 8 and 9, 10. During movements of the bogie unit assembly 12 relative to the frame side plates 2 and 3 to afford relief from shock loading, the lever member 49 serves as a guide to maintain the transverse relationship of the assembly 12 relative to the plates 2 and 3.

With particular reference to FIG. 5, the relative position of the elements to relieve a shock load between the crushing rollers 7 and 8 is illustrated in phantom lines. As there shown, the movement of roller 8 relative to roller 7 to provide shock relief has lifted the corresponding end of the respective bogie plates 17 which generally pivot on the adjustment screws 73 at the opposite end of plates 17. The lifting of the end of the transversely spaced plates 17 has in turn raised the shaft 46 pivotally connecting the plates 17 and lever 49 to cause lever 49 to pivot about its fixed pivot at 51 to compress the spring 48 as shown, with the rod 58 pivoting at 71 to accommodate the arcuate path of the lever after the shock load has passed through the opposing rollers 7 and 8, the lever 49 and bogie plate unit assembly 12 along with the roller 8 return to the position established by the leveling adjustment screws 73.

In the event the crushing machine 1 becomes jammed or approaches a jammed condition as sensed by the micro-switch 76 which has shut off the drive mechanism, the condition must be cleared to render the machine again operable. The required clearing of the machine 1 is a relatively simple matter and is in part generally illustrated in FIG. 6 wherein the lever 49 is generally shown in its normal position in solid lines with the sleeve 64 in abutting relation to the nut 65. In the jammed or near jammed condition the lever 49 is caused to be moved to the right from the solid line position shown in FIG. 6 with the sleeve 64 spaced from the nut 65 and the spring 48 in a compressed condition.

For clearing a jammed or near jammed condition which has shut off the drive mechanism, the rod 58 is unthreaded from the pivotal block 70. As the unthreading of rod 58 relative to block 70 progresses, the compressed spring 48 is restored to its initial pretensioned condition as rod 58 is moved axially relative to the sleeve 64 and the lever bracket 56. After the rod 58 is withdrawn from the block 70 a distance sufficient to restore the initial pretensioned condition to spring 48 and the nut 65 has reengaged the end of the sleeve 64, the rod 58 carries the sleeve 64 and integral collar 61 with it with further unthreading to disengage the collar projections 60 from the recesses 59 in the lever bracket 56. After the collar projections 60 have cleared the recesses 59, the rod 58 and block 70 may be pivoted clear at 71 from lever 49 as generally shown in phantom lines in FIG. 6. It will be observed that even when the rod 58 is disengaged from the lever 49, the pretensioned condition of spring 48 remains unaffected.

After the rod 58 is disengaged from the lever 49 as shown in phantom lines in FIG. 6, the lever can be moved manually about its fixed pivot at 51 to lift the shaft 46 and the bogie plate unit assembly 12 so that any jam or near jam between either set of crushing rollers 7, 8 and 9, 10 can be cleared. After a jammed or near jammed condition is cleared and the rollers 8 and 10 are restored to their normal position by manipulation of lever 49 to reseat the respective bogie plates 17 on the adjustment screws 73, the rod 58 is threadedly reengaged with the pivotal block 70 and the collar projections 60 are simultaneously reengaged into the bracket recesses 59 of lever 49 to render the machine 1 ready to resume operation.

The radially projecting weld beads 24 on the crushing rollers 9 and 10 require a certain amount of separation between the rollers and therefore place some limitation on the particle size and/or thickness attainable there-through. If somewhat greater crushing ability is desired or needed, either or both of the rollers 9 and 10 may be replaced with the roller 78, as generally shown in FIGS. 9 and 10, having a generally similar diameter as rollers 9 and 10, but wherein the desired roughened surface for aiding in pulling materials through the rollers is provided by a plurality of circumferentially spaced inwardly projecting grooves 79. With either or both rollers 9 and 10 replaced with roller 78; the leveling adjustment of the respective bogie plates 17 as set by screws 73 can provide for a lesser separation between the opposing crushing rollers and correspondingly greater crushing ability.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

We claim:

1. In a crushing apparatus wherein crushing is effected between a plurality of sets of opposing rollers arranged in series, a frame rotatably supporting one roller from each set of rollers, a member movable relative to the frame and the frame supported rollers and rotatably supporting the other roller from each set of rollers, said other rollers being movable with the movable member relative to the frame supported rollers to provide for relief from shock loading between the sets of opposing rollers.

2. The invention as set forth in claim 1 including means for supporting the movable member in a given

position relative to the frame, and means for guiding the movable member relative to the frame when said member is caused to move in response to shock loading.

3. The invention as set forth in claim 1 wherein relative movement between the opposing rollers in the shock relieving direction is resisted by resilient means.

4. In a crushing machine wherein crushing is effected between two sets of opposing rollers arranged in series and forming a materials flow path through the machine, a frame rotatably supporting one roller from each set of rollers on one side of the materials flow path, a member movable relative to the frame and the frame supported rollers and rotatably supporting the other roller from each set of rollers on the opposite side of the materials flow path, said rollers carried by the movable member being movable with said member relative to the frame supported rollers to provide for relief from shock loading between the sets of opposing rollers.

5. The invention as set forth in claim 4 including means for supporting the movable member in a given position relative to the frame, and means for guiding the movable member relative to the frame when said member is caused to move in response to shock loading.

6. The invention as set forth in claim 5 wherein the guide means for the movable member is pivotally connected to the movable member intermediate the rollers carried thereby.

7. The invention as set forth in claim 6 wherein the guide means for the movable member comprises lever means pivotally mounted onto the frame.

8. The invention as set forth in claim 5 wherein the guide means for the movable member comprises lever means having pivotal connection to the movable member generally midway between the rollers supported by said member and being pivotally mounted onto the frame in spaced relation from the movable member connections, said pivotal connection between the lever means and the movable member being movable with said member in response to shock loading between either set of opposing rollers to pivot the lever means in a given direction relative to the frame.

9. The invention as set forth in claim 8 wherein movement of the lever means in said given direction in response to shock loading between either set of opposing rollers is resisted by resilient means.

10. The invention as set forth in claim 9 wherein the resilient means is disposed to act upon the end of the lever means opposite from its mounting to the frame.

11. The invention as set forth in claim 4 wherein the two sets of opposing rollers are driven by a single drive arrangement.

12. The invention as set forth in claim 11 wherein the drive arrangement comprises a chain drive and the drive chain of the arrangement is maintained in a taut condition by a spring-biased idler adapted to accommodate relative movement between the opposing rollers.

13. In a crushing machine wherein crushing is effected between two sets of opposing rollers arranged in series and forming a materials flow path through the machine, a frame rotatably supporting one roller from each set of rollers on one side of the materials flow path, a member movable relative to the frame and the frame supported rollers and rotatably supporting the other roller from each set of rollers on the opposite side

of the materials flow path, means for supporting the movable member and its rollers in a given position relative to the frame, said rollers carried by the movable member being movable with said member relative to frame supported rollers to provide for relief from shock loading between the sets of opposing rollers, means for guiding the movable member and its rollers relative to the frame when said member is caused to move in response to shock loading, and means for resisting the movements of the movable member and its rollers in response to shock loading.

14. The invention as set forth in claim 13 wherein the crushing machine is designed for crushing cans and bottles and the first set of opposing rollers is provided with a plurality of radially projecting spikes to puncture the cans and assist in pulling the bottles and cans through said first set of opposing rollers.

15. The invention as set forth in claim 13 wherein the second set of opposing rollers is provided with a roughened surface to assist in pulling the pieces of glass and partially flattened cans through said second set of opposing rollers.

16. The invention as set forth in claim 15 wherein the roughened surface on the second set of opposing rollers is formed by circumferentially spaced, transversely extending weld beads.

17. The invention as set forth in claim 15 wherein the roughened surface on the second set of opposing rollers is formed by circumferentially spaced, transversely extending grooves.

18. The invention as set forth in claim 13 wherein stripper plates are disposed on opposite sides of each roller to remove any materials sticking to the corresponding roller.

19. The invention as set forth in claim 18 wherein the stripper plate disposed between the rollers supported by the movable member is secured to said member and carried thereby.

20. The invention as set forth in claim 18 wherein the frame of the machine includes transversely spaced side plates, and the crushing rollers and stripper plates extend generally between said frame side plates, said side plates, crushing rollers and stripper plates forming a generally enclosed materials flow path through the machine.

21. The invention as set forth in claim 13 wherein the frame of the machine includes transversely spaced side plates, said side plates at least in part forming a hopper at the upper end of the machine for receiving the materials to be crushed and a chute at the lower end of the machine for delivery of the crushed materials.

22. The invention as set forth in claim 13 wherein the movable member comprises a pair of transversely spaced and aligned plates and the respective rollers supported by said member are rotatably mounted between said plates and adjacent to the respective ends of the plates, and wherein the guide means for said movable member is pivotally connected to the respective plates generally midway between the respective rollers.

23. The invention as set forth in claim 22 wherein the transversely spaced plates of the movable member are connected by a transversely extending tubular member generally midway between the rollers to form a unit assembly, said tubular member having a bore which opens outwardly through the plates, and a shaft disposed in the bore of said tubular member and extend-

ing outwardly beyond the respective plates to form the pivotal connection with the guide means.

24. The invention as set forth in claim 23 wherein the support means for the movable member comprises a plurality of leveling adjustment screws which extend through projections from the frame and engage the lower edge of the respective movable member plates.

25. The invention as set forth in claim 23 wherein the support means for the movable member comprises a pair of leveling adjustment screws for each of the movable member plates, said screws for each movable member plate extending through corresponding projections from the frame and engaging the lower edge of the plate adjacent to the respective ends thereof.

26. The invention as set forth in claim 13 wherein the guide means for the movable member comprises means having pivotal connection to the movable member generally midway between the rollers supported by said member and being pivotally mounted onto the frame in spaced relation from the movable member connection.

27. The invention as set forth in claim 13 wherein the guide means for the movable member comprises lever means having one end thereof pivotally mounted onto the frame and having pivotal connection to the movable member generally midway between the rollers supported by said member, said pivotal connection between the lever means and movable member being spaced from the pivotal mounting for the lever means and being caused to move with the movable member in response to shock loading between the opposing rollers to effect pivotal movement of the lever means on its mounting to the frame.

28. The invention as set forth in claim 27 wherein the opposing rollers are driven by an electric motor and movements of the lever means are sensed by a switch mounted onto the frame and disposed in the electrical circuit of the motor, said switch being normally closed in its mounted circumstance and adapted to open to stop the motor when the pivotal movement of the lever means exceeds a given amount.

29. The invention as set forth in claim 27 wherein the means for resisting the movements of the movable member and its rollers in response to shock loading comprises a spring, said spring being disposed to act on the end of the lever means remote from its mounting onto the frame.

30. The invention as set forth in claim 29 wherein a rod is pivotally connected to the frame, and a slidable collar is disposed on the rod and is engageable by the end of the lever means remote from its mounting on the frame, said collar having a given position relative to the rod corresponding to the position of the movable member relative to the frame as provided by the movable member support means, said collar being slidable relative to the rod in a given direction from said given position when the lever means are caused to pivot by the movable member in response to shock loading between the opposing rollers, and said spring is a compression spring mounted on the rod adjacent to said collar and is adapted to resist the movements of the collar, lever means and movable member in response to shock loading.

31. The invention as set forth in claim 27 wherein the lever means comprises an inverted U-shaped lever member having transversely spaced legs, the legs of said U-shaped lever member being disposed on opposite sides of the machine and being pivotally mounted

onto the corresponding side of the frame in transversely aligned relation and each of said legs being pivotally connected to the corresponding side of the movable member in transversely aligned relation generally midway between the rollers supported by said movable member.

32. The invention as set forth in claim 31 wherein the means for resisting the movements of the movable member and its rollers in response to shock loading comprises a spring, said spring being disposed to act generally centrally on the connecting leg of the inverted U-shaped lever member.

33. The invention as set forth in claim 32 wherein a rod is pivotally connected to the frame, and a slidable collar is disposed on the rod and is engageable by projecting means carried generally centrally of the connecting leg of the lever member, said collar having a given position relative to the rod corresponding to the position of the movable member relative to the frame as provided by the movable member support means, said collar being slidable relative to the rod in a given direction from said given position when the lever member is caused to pivot by the movable member in response to shock loading between the opposing rollers, and said spring is a compression spring mounted on the rod adjacent to said collar and is adapted to resist the movements of the collar, lever member and movable member in response to shock loading.

34. The invention as set forth in claim 33 wherein a movable abutment is disposed on the rod to seat the end of the compression spring opposite from said collar, said abutment being movable on the rod to pretension the spring to provide the resistance desired to oppose shock loading between the opposing rollers.

35. The invention as set forth in claim 33 wherein the compression spring and slidable collar are disposed between a pair of movable abutments, said abutment adjacent to the collar being disposed on the rod to provide abutting relation for the collar in said given position corresponding to the position of the movable member relative to the frame as provided by the movable member support means, and said abutment adjacent to the spring being movable on the rod to pretension the spring to provide the resistance desired to oppose shock loading encountered by the opposing rollers.

36. The invention as set forth in claim 35 wherein the rod mounting the compression spring and slidable collar is removably connected to a block pivotally mounted on the frame, said rod being removable from said block to effect a disengagement between said collar and lever member without affecting the pretension condition of the spring.

37. The invention as set forth in claim 36 wherein the end of the rod adjacent to the collar abutment is threaded and is removably received within a threaded bore in the pivotally mounted block, said rod being at least partially from the bore of said block to disengage the collar from the lever member and thereafter said rod together with the collar and pretensioned spring being pivotable with the block to clear the lever member.

38. The invention as set forth in claim 36 wherein following a disengagement between said collar and lever member the lever member can be actuated on its pivotal mounting on the frame to lift the movable member relative to the frame and thereby effect further separation between the opposing rollers as may be required to clear a jamming condition between the opposing rollers.