April 10, 1962 R. D. CONWAY ETAL 3,028,957

ELLIPTICAL ROLLER DEVICE WITH CLOSELY SPACED RIBS

Filed Nov. 12, 1957 2 Sheets-Sheet 1

Fig-1

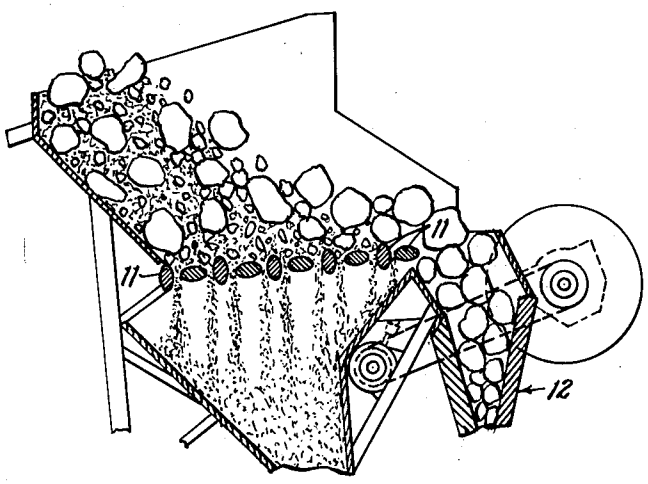



Fig-2

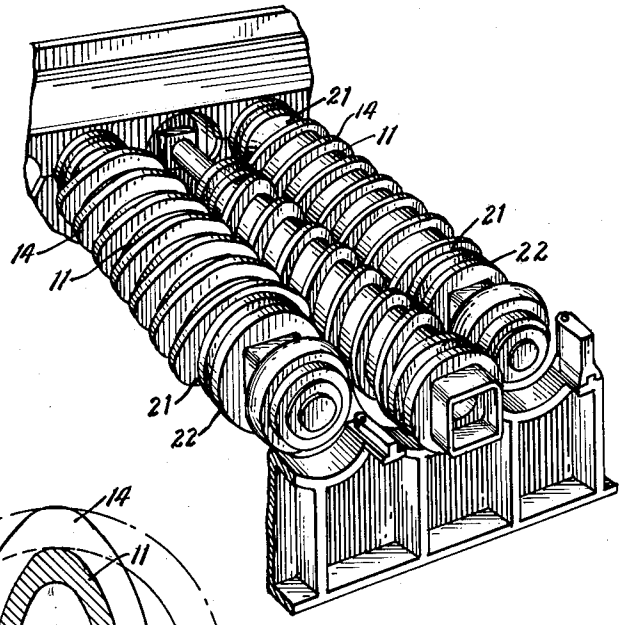
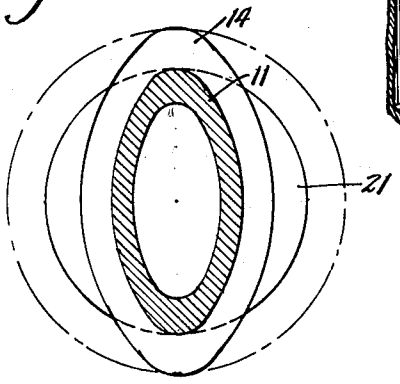



Fig-3




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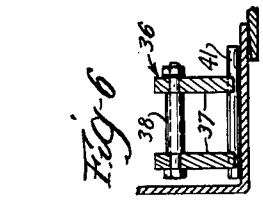



Fig-6

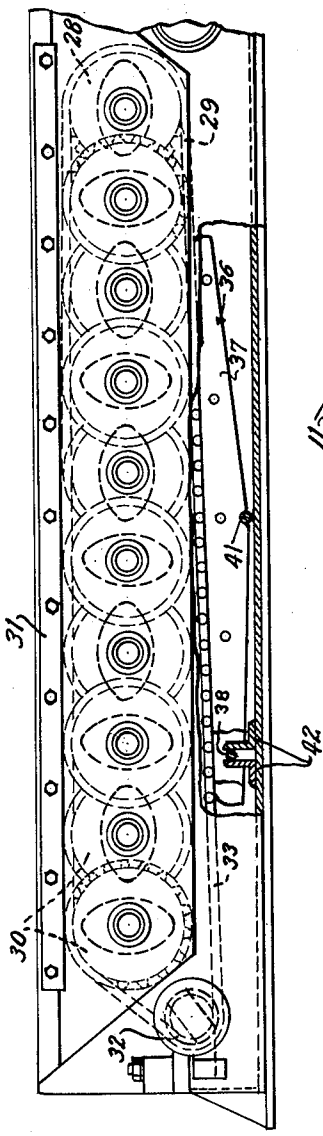



Fig-4

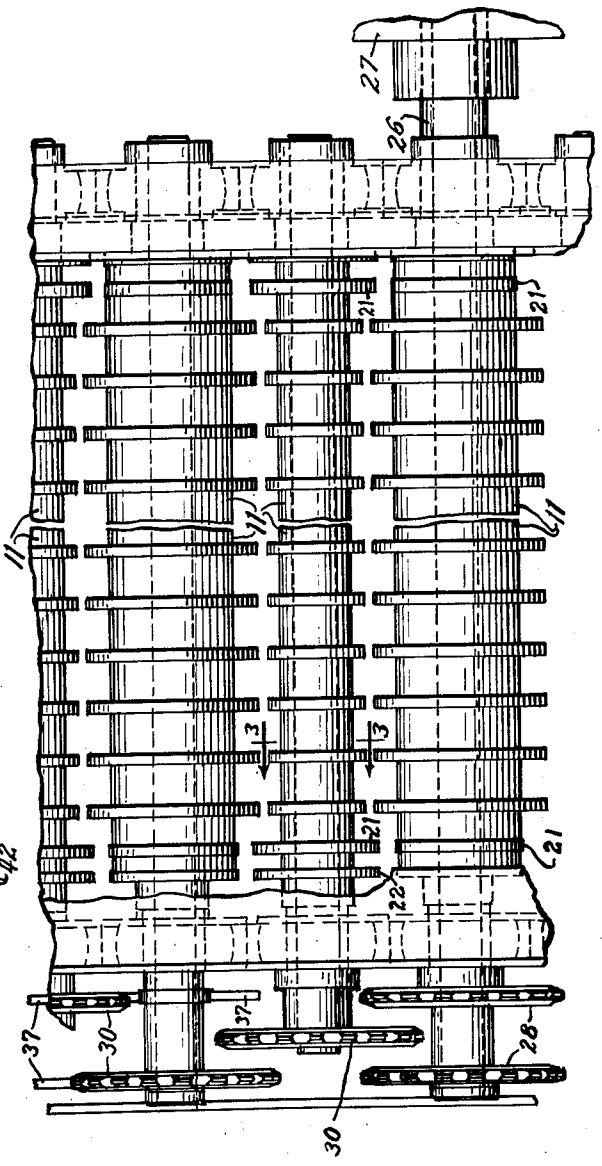



Fig-5

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United States Patent Office 3,028,957 Patented Apr. 10, 1962



3,028,957

# ELLIPTICAL ROLLER DEVICE WITH CLOSELY SPACED RIBS

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Filed Nov. 12, 1957, Ser. No. 695,818
9 Claims. (Cl. 209—106)

Although material separating apparatus of the elliptical roll type described in Erickson Patent 2,743,813 has proved very advantageous, it has given some trouble. The trouble may generally be described as jamming. Jamming occurs when a piece of hard rock of just the right size wedges itself between a pair of elliptical rollers. In spite of the theory that the spacing remains the same between the rollers, and no jamming should occur, it happens. Partly, this is because minor variations are encountered in practice. It is possible for such a wedge shaped piece of rock to fall in place when the space is enlarged and jam the rollers to such an extent that either the rock is crushed or the turning of the rollers stops. If enough turning power is made available, damage to the machinery can conceivably result. Similarly, jamming has occurred between the side of the machine and elliptical roller. With gravel, a round piece just too large to pass between the rolls can be rolled into jamming position by the higher peripheral speed of one roll at its larger radius than of the adjacent roll at its smaller radius.

According to the present invention, the between-roller jamming is substantially eliminated by providing closely spaced ribs along the surface of the rollers. Of course, spacing the ribs closer together than necessary would undesirably retard the flow of smaller sizes through the spaces between the bars. It has been found, however, that spacing the ribs apart a distance just slightly less than the maximum spacing between adjacent rollers substantially eliminates jamming while maintaining a good efficiency of separation of the sizes of material.

The roller-to-wall jamming has been largely eliminated by providing anti-jam rings of circular contour between the eliptical ribs and the wall.

When jamming occurs, it is sometimes desirable to drive the rollers in reverse direction rather than to risk damage to the machine by pushing them in the direction of rotation against which they are jammed. Because all but one of the rollers are chain-driven from that one drive roller, reverse drive causes other trouble if there is slack in the chain. Slack permits the drive roller to turn while the others remain stationary until the slack is taken up. This changes the spacing at that point and new jamming may result. Furthermore, the takeup of the slack is likely to be accompanied by a snap type of application of the load which places an undue strain on the parts. Efforts to avoid this trouble by reducing slack in the chain by a very tight adjustment of the take-up sprocket has placed an extra tension on the chain and extra load on all of the bearing surfaces in the chain, and on some other bearings, which was objectionable. According to the present invention, the idle reach of the chain is supported by a guide way so that slack is substantially eliminated without undue chain tension.

Additional objects and advantages of the invention will be apparent from the following description and from the drawing.

*Designation of Figures*

FIG. 1 is a somewhat diagrammatic view of an elliptical roll device in which the invention of this application may be incorporated, although the scale, of FIG. 1 does not permit illustration of the present invention, and



in fact the elliptical bars are diagrammatically illustrated as if they were solid elliptical bars.

FIG. 2 is a fragmentary perspective view showing three elliptical rollers incorporating features of the present invention.

FIG. 3 is a cross-sectional view taken through the main body portion of one of the rollers and showing the face of one of the elliptical ribs and beyond that the anti-jam ring. The view might be taken for example, on line 3—3 of FIG. 5.

FIG. 4 is a side elevation of an elliptical roller device, showing especially the supporting of the idle reach of the chain.

FIG. 5 is a fragmentary plan view of the structure shown in FIG. 4, the chain being omitted for clarity.

FIG. 6 is a sectional view through the supporting guide for the idle reach of the chain.

Although the following disclosure offered for public dissemination is detailed to ensure adequacy and aid understanding, this is not intended to prejudice that purpose of a patent which is to cover each new inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements. The claims at the end hereof are intended as the chief aid toward this purpose, as it is these that meet the requirement of pointing out the parts, improvements, or combinations in which the inventive concepts are found.

*Background Description*

This invention is an improvement on elliptical roller devices such as that illustrated in FIG. 1. In this figure a plurality of elliptical rolls **11** forming a bed are driven in a clockwise direction, as viewed, and with successive rolls having a 90 degree phase displacement. When sufficient material is heaped on such a device, the fines and smaller pieces pass between the bars while the larger pieces are moved toward the right in FIG. 1 where they pass over the end bar of the bed. In FIG. 1 these larger pieces are dropped into a jaw crusher **12**. Because of the elliptical shape of the rollers, the spacing between them remains fairly uniform. It is not necessary to consider whether or not it would theoretically be possible to so shape the rolls that the spacing between them would remain exactly uniform, because in practice a slight increasing and decreasing of the space has been encountered which causes the jamming heretofore described when pieces of hard rock wedge into the space when it is at its largest.

A machine of this type, perhaps the first such successful machine, is described in Erickson Patent 2,743,813. This patent pointed out the necessity for maintaining a heavy burden on the roller device and avoiding any forward slope sufficient to cause it to clear itself should the supply of material be discontinued. Under these conditions, the burden is agitated enough to let the fines fall through the burden and through the spaces between the bars, while the oversize pieces are moved along the series of bars. This proper functioning has the incidental effect of giving the pieces a maximum time to get in a wedging position between the rollers.

Although the elliptical ribs were shown along the rollers in the Erickson patent, they were considered optional and their purpose was described as preventing large but thin pieces from passing between the rollers. Their spacing along a bar was not close enough to accomplish the purpose of the present invention.

*Spacing of Ribs*

According to the present invention, the elliptical ribs **14** on the elliptical rollers **11** have slightly less clearance between them along one roll than the maximum spacing

between two adjacent rolls **11**. As a result, pieces small enough to pass between the ribs will ordinarily be too small to cause jamming between the rolls. It is necessary to say "ordinarily" because on extremely rare occasions a piece has just the right dimensions in one direction to pass between the ribs, while having just the right dimensions in another direction to jam between the rollers. How much smaller the clearance between ribs should be than the maximum clearance between rollers depends in part on expected use and in part on how much variation there is in the spacing between a pair of rollers. With some rock such as limestone, good results have been attained with a clearance between ribs approximately equal to the nominal clearance between rollers. By nominal clearance is meant the difference between the space between roller axes and the sum of the major and minor radii of a roller body. This nominal clearance is also the actual clearance between the roller bodies if there is no imperfection. Departures more than 1/16" from this are not to be expected. By "roller body" is meant the portion of the roller between the ribs.

For work with gravel, where round pieces are encountered, a clearance between ribs of 1/4" less than the nominal spacing between the roller bodies has been found to give good results. Apparently a round rock within a quarter of an inch of the size which will pass between rollers can be made to jam by a rolling-in action when it is rolled between a downwardly moving surface of one roller and a slower upwardly moving surface of an adjacent roll.

In comparing the spacing of the ribs with the spacing between the roll bodies, it is necessary that the comparison be with the spacing between the most closely spaced rollers. Erickson Patent 2,743,813 contemplated having the rollers at the receiving end of the series more closely spaced than those near the delivery end. The mere fact that at the delivery end the rollers might be spaced further apart than the spacing between the ribs would not prevent the jamming nearer the receiving end where the roller bodies were more closely spaced than the same rib spacing. Therefore, it may be said that the spacing of the ribs on the rollers which are most closely spaced should be not more than approximately the nominal spacing between the roller bodies, and preferably (at least for gravel) as small as at least one-quarter inch smaller than the nominal spacing between the roller bodies of these rollers.

The spacing between ribs contemplated is that between the outer faces of the ribs, assuming a gradual taper extends to a flat rib face. If the corners are rounded, the spacing just inwardly of the rounded corner should be considered.

As illustrated in FIGURE 5, the ribs of adjacent rollers should be in alignment with one another so that there will be maximum freedom of passage of small particles between the rollers, consistent with the foregoing discussion.

*Anti-Jam Ring*

To prevent jamming between elliptical rollers and the side plates by which the material is held on the bed, it is preferred to provide anti-jam rings **21** between the side plates and the ribs **14**. As seen in FIG. 3, the anti-jam rings **21** are circular, and have a diameter not less than the long diameter of the roller body **11**. As a matter of fact, they would more perfectly guard against the jamming in question if they were as large in diameter as the larger diameter of the ribs **14**. As seen from FIG. 5, however, this would be impossible with the spacing of the rollers **11** as shown. The illustrated diameter has given good results. There is provided, as heretofore, an end ring **22** in the plane of the side plate. The anti-jam ring **21** need not be isolated as shown. It could be formed by extending the end ring **22** to project from the side plate to the position of ring **21**. The illustrated form is preferred, partly to avoid a casting difficulty, and partly for increased capacity to pass small pieces of material.

*Chain Support*

It has been found convenient to drive the rollers **11** through the roller at the discharge end of the bed. As seen in FIG. 5, this roller is provided with a drive hub **26** which is driven by a drive device **27** which may comprise a speed reducer, and preferably is limited to a torque which will not break the equipment when jamming occurs. Hub **26** drives the roller **11** aligned with it and through it drives double sprocket **28**. Chain **29** passes around double sprocket **28**, and is driven by it. With the illustrated arrangement of sprockets **30**, one of which is aligned with and drives each of the other rolls **11**, the chain **29** is a triple chain, so as to engage the three lines of driven sprockets. Its normal active reach extends over the sprockets and is held down on the sprockets **30** by a guide **31**. An eccentrically mounted sprocket (or double or triple sprocket) **32** may be adjusted to take up slack in the chain **29**.

It will be observed from FIG. 4 that the chain **29** has a long reach **33** extending from double sprocket **28** to double or triple take-up sprocket **32**. This reach is normally the idle or return reach. When it is necessary to reverse the drive of rollers **11**, sprocket **28** and its roller, when turned counter clockwise as viewed in FIG. 4, will take up any slack in reach **33** before full force can be exerted on the sprockets **30**. Any appreciable amount of slack to be taken up would be objectionable for the reasons discussed.

Although the features of the present invention already described greatly reduce the number of instances in which jamming necessitates reversing the drive of the rollers, the necessity is not completely eliminated. However, the most objectionable aspects of that reversal are overcome according to the present invention by supporting the normally idle reach **33** along most of the intermediate portion of its length. As seen best in FIG. 4, this is accomplished by providing a support guide **36** with its top surface approximately located to prevent any droop in idle reach **33** of the chain. It is convenient to have the support guide **36** easily removable, and this has been accomplished by the structure shown.

The support guide **36** comprises essentially two plates **37** rigidly secured in properly spaced relationship by spacer bolts **38**. The support guide **36** may be supported by a single fulcrum bar **41** and may be restrained from longitudinal movement by brackets **42** engaging one of the spacer bolts **38** in a manner permitting vertical movement of the spacer bolt and hence rocking of the support guide **36**.

Preferably a bath of oil extends to the bottoms of sprockets **30** or at least high enough to submerge the lowest portion of chain **33**, so that the chain and sprockets and guides **31** and **36** will be lubricated.

The jamming trouble which has occasionally been quite inconvenient in prior use of elliptical roll material separating devices is greatly reduced and rendered relatively unobjectionable by the combination, according to the present invention, of the close spacing of the elliptical ribs, the provision of anti-jam rings between these ribs and the side plates, and provision of a guide support for the idle reach of the chain so that reversing, on the rare occasions necessary, will be harmless.

The closely spaced elliptical ribs have an added advantage of improving the movement along the bed of pieces too large to pass between the rollers.

The greatest importance of the guide support for the chain, in the combination mentioned above, is in avoiding back-lash between the rollers in the event of reversal. Other driving means free from such back-lash would also serve the purpose of the combination. The chain drive

and its guide support are preferred partly because of adaptability to existing machine designs.

We claim:

1. Apparatus for separating loose material by size including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, the bed being so disposed that it will not clear itself of pieces too small to pass between the rollers, and means including side walls along the sides of the bed and diverging upwardly from the bed for maintaining on the receiving end of the bed a sufficient burden of material so that pieces too large to pass between the rollers will be discharged at the discharge end of the bed; characterized by the following: said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is as small as the nominal spacing between the bodies of said most closely spaced rollers; said rollers being provided with circular rings of a diameter at least approximately equal to the maximum transverse dimension of the roller body and located between the side wall and the elliptical ribs.

2. Apparatus for separating loose material by size including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, the bed being so disposed that it will not clear itself of pieces too small to pass between the rollers, and means including side walls along the sides of the bed and diverging upwardly from the bed for maintaining on the receiving end of the bed a sufficient burden of material so that pieces too large to pass between the rollers will be discharged at the discharge end of the bed; characterized by the following: said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is approximately as small as one quarter inch smaller than the nominal spacing between the bodies of said most closely spaced rollers; said rollers being provided with circular rings of a diameter at least approximately equal to the maximum transverse dimension of the roller body and located between the side wall and the elliptical ribs; and said rolls being driven by means substantially free of backlash between the rollers when the drive is reversed.

3. Apparatus for separating loose material by sizes including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, the bed being so disposed that it will not clear itself of pieces too small to pass between the rollers, and means for maintaining on the receiving end of the bed a sufficient burden of material so that pieces too large to pass between the rollers will be discharged at the discharge end of the bed, said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is as small as the nominal spacing between the bodies of said most closely spaced rollers.

4. Apparatus for separating loose material by sizes including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is as small as the nominal spacing between the bodies of said most closely spaced rollers.

5. Apparatus for separating loose material by sizes including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is approximately as small as one quarter inch smaller than the nominal spacing between the bodies of said most closely spaced rollers.

6. Apparatus for separating loose material by size including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, said rollers having elliptical ribs extending beyond their bodies; characterized by having said rollers provided with circular rings of a diameter at least equal to the maximum transverse dimension of the roller body located between the side wall and the elliptical ribs.

7. Apparatus for separating loose material by size including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, the bed being so disposed that it will not clear itself of pieces too small to pass between the rollers, and means including side walls along the sides of the bed and diverging upwardly from the bed for maintaining on the receiving end of the bed a sufficient burden of material so that pieces too large to pass between the rollers will be discharged at the discharge end of the bed; characterized by the following: said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers most closely spaced together of any in the bed being such that the clearance between said ribs on said rollers is as small as the nominal spacing between the bodies of said most clearly spaced rollers; and said rollers being driven by means including a drive chain free from long unsupported reaches of chain and substantially free from slack whereby the drive is substantially free of backlash between the rollers when the drive is reversed.

8. Apparatus for separating loose material by sizes including a bed of rollers generally elliptical in cross-section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed, said rollers having elliptical ribs extending beyond their bodies with the spacing of the ribs along the rollers being such that the clearance between said ribs on said rollers is as small as the nominal spacing between the bodies of the rollers having the closest possible spacing between the rollers permitted by the apparatus.

9. Apparatus for separating loose material by size including a bed of rollers generally elliptical in cross section and with adjacent rollers displaced approximately 90 degrees in phase, means for driving the rollers with their tops moving toward the discharge end of the bed; characterized by the following: each of said rollers having sprocket means axially aligned therewith and mounted to rotate therewith, endless chain means doubled around a drive sprocket means associated with a roller at the discharge end of the bed, means other than the chain means for driving said end roller, and the drive sprocket means and through the drive sprocket means driving the chain mean, the upper run of said chain means engaging the upper sides of the sprocket means on the remaining rollers to drive said remaining rollers, means for supporting the lower run of the chain means at a plurality of points spread along its length to hold it in a substantially straight

line independently of tension thereon, and chain tightening means for removing slack from the chain without applying great tension to it whereby during forward drive the drive sprocket means is subjected to chain tension substantially only by the upper run of the chain, and upon reversing there is substantially no phase displacement between the end roller and the remaining rollers.



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