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(54) Anti-spin device for cone crusher.

(57) Anti-spin device for a gyrating rock crusher including a stationary spindle (62) and a crusher head (36) driven by an eccentric (20) and running in a stationary crusher bowl (48). A clutch member (70) having a square cross-section fastened to the top of the spindle (62), and a polyurethane body (80) is fastened to the crusher head (36) and having a square opening (81) receiving the clutch member (70). The clutch exerts sufficient resistive torque on the crusher head (36) to prevent it from spinning with the eccentric (20) in the unloaded condition, but allows the head to counter-rotate slowly during crushing operations.

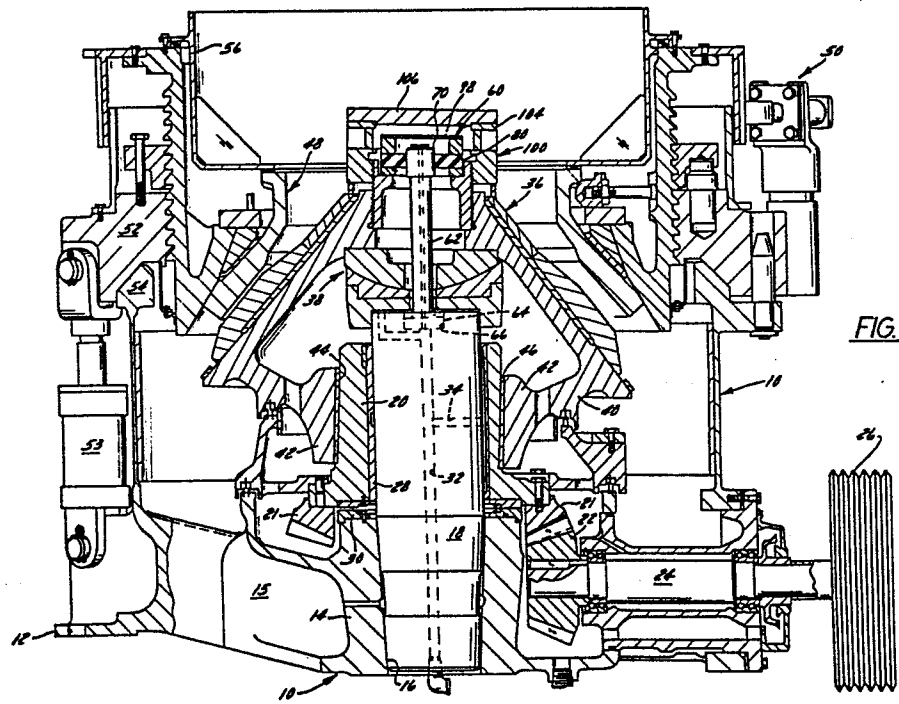


FIG. 1

ANTI-SPIN DEVICE FOR CONE CRUSHER

This invention relates to an anti-spin device for a cone crusher, and more particularly to a nonmechanical type anti-spin device employing deformational and frictional resistance of an elastomer to provide the resistive counter-torque to prevent the crusher head from spinning with the crusher eccentric when the crusher is operated at no load, i.e. with no material being crushed in the crushing cavity.

5 A gyratory cone rock crusher utilizes a cone-shaped crusher head normally driven by an eccentric. The head gyrates within a stationary, conical shaped crusher bowl to provide a rotating alternating converging and diverging cavity conically extending between the bowl and the head in which the feed material is crushed during the convergence and released to fall further down the cavity during the divergence, receiving one or more blows during the passage through the full length of the cavity, dependent on the speed of rotation of the eccentric and other factors. The eccentric is rotated through reduction gearing by the power source such as a large electric motor coupled directly or through a belt drive to the crusher. In general the bowl and head crusher are furnished with wear-resistant liners, referred to as bowl liner (or concave) and mantle, respectively. The crushing cavity is actually the volume between the concave surface of the bowl liner and the convex surface of the mantle.

20 Due to the inherent design of the crusher, the gyrating head has a tendency to rotate in the direction of rotation of the eccentric when the crusher is not under load, a phenomenon known as "head spin". During normal operation when the crusher bowl is filled with rock, the crusher head is prevented from rotating with the eccentric by engagement with the stationary crusher bowl through the rock particles, due to surface friction. Indeed, in some gyrating crushers the gyrating action of the crusher head causes a slow reverse rotation of the crusher head relative to the bowl due to the differential radii at the opposed crushing surfaces. However, when the crusher bowl is

empty, because of some interruption in the flow of rock to the crusher, the only resistive torque that is available to prevent head spin is in the thrust and journal bearings which support the crusher head in the frame. In some crushers employing a large diameter spherical bearing for the crusher head, as in the Symons cone crusher, the resistive countertorque provided by this bearing is sufficient to prevent head spin.

10 In crushers supported by antifriction type thrust bearings, however, the bearing may not provide sufficient countertorque to prevent the head from rotating under the frictional torque exerted by the eccentric and therefore it is necessary to provide a supplemental device known as
15 an "anti-spin device" to retard or prevent head-spin while, at the same time, allowing the slow reverse rotation to occur under normal crushing load. Similarly, in crushers in which the crushing head is supported on a relatively small diameter spherical thrust bearing, the bearing may
20 not provide sufficient countertorque, due to the small radius at which the effective frictional resistance acts, to prevent head spin. The device is equally applicable in such cases.

Spinning of the crusher head is highly undesirable
25 for several reasons:

1) the high centrifugal force that it induces in the bearing system detrimentally affects the life of the bearing through changes in the loading pattern.

2) The large diameter of the bearings and the high
30 relative rotational velocity of the crusher head can produce centrifugal forces on the bearing lubricant sufficient to actually starve the bearing so that it runs dry or without sufficient lubrication and thereby damage the bearing due to heating or even cause it to seize up altogether,
35 necessitating expensive repairs.

3) Rocks falling into the crushing chamber of a cone crusher when the crushing head is spinning at high speed can be thrown clear of the crusher and present a safety

hazard to operating personnel and equipment in the vicinity.

4) The liner and mantle for the crushing bowl and the
5 crusher head are designed for a low relative speed crushing
action. The excessive abrasive action of the rock becoming
wedged in the converging gap between the crushing head
spinning and gyrating at high relative speeds relative to
the stationary bowl when the rock falls into the crushing
10 chamber can cause expensive shortening of the useful life
of the head liner and bowl liner through excessive frictional wear.

5) Rocks striking the spinning head of the crusher
can damage the equipment by exerting a surface shear on
15 the liners which tends to loosen the bond between the liners
and the bowl and crushing head, respectively, causing them
to become loose and suffer early failure.

There are a host of devices designed to prevent the
head from spinning with the eccentric during unloaded or
20 free running operation. They include one way clutches,
automatically applied friction clutches and hydraulic drive
or retarding devices of various kind. These devices are
generally effective when they are operating properly, but
they are afflicted with problems of complexity, cost, durability,
25 serviceability, and extensive down time of the machine while service is being performed.

One way clutches, which are the most frequently used
device, absolutely bar the rotation of the head under no
load conditions and allow relatively free rotation in the
30 reverse direction. When bearing distress occurs due to wear,
oil starvation, contamination or metal fatigue, the urging
of the head under the resultant frictional torque, even at no
load, may be sufficient to overcome the torque capability of
the clutch, causing severe damage to the
35 clutch components and, very often as a secondary result,
failure of important components of the main structure of the
crusher and other external damage. In addition, it is frequently
necessary to provide a coupling between the

crusher head and the clutch to accommodate the lateral translations of the head and prevent damage to the clutch. These couplings are expensive and are themselves subject to premature failure if improperly installed or operated.

The other devices mentioned suffer from similar shortcomings caused by failure or malfunction of the actuating mechanisms or controls which selectively apply the required action dependent on whether there is load or not within the crusher. All of the mechanical arrangements are susceptible to impact, shock and vibration damage incident to the operation of the cone crusher.

The problems created by vibration have not previously been recognized in the art. The crushing operation inherently involves considerable vibration as rocks fall into the crusher and shatter in the crushing chamber. To some extent this vibration is damped by the other rocks in the crusher and is accommodated by the rugged construction of the crusher. Nevertheless, to the extent that the vibration is transmitted through the crusher to the more sensitive drive and control mechanisms and to the other structure vulnerable to shock and fatigue failure, vibration will militate for a shorter service period.

Thus, the crusher art has long been in need of an anti-spin device that is inexpensive, simple in construction, extremely durable and reliable and easily serviced, with minimal machine down time, by service personnel of minimal training, utilizing only the crusher instruction manual.

Accordingly, it is an object of this invention to provide an anti-spin device for a cone crusher which is inexpensive, durable and reliable. It is another object of this invention to provide an anti-spin device which is quickly and easily replaced with minimal machine disassembly and minimal machine down time. It is yet another object of the invention to provide an anti-spin device for a cone crusher that does not require a separate coupling between it and the crusher head. It is a further object of this in-

vention to provide an anti-spin device for a cone crusher that tends to damp vibration. It is yet a further object of this invention to provide an anti-spin device, the malfunction of which will not result in directly or indirectly related damage to the internal components. It is an important object of this invention to provide an improved anti-spin device not subject to the drawbacks and disadvantages of prior art anti-spin devices.

These and other objects of the invention are attained in an anti-spin device having an elastomeric body and a relatively rotating member engaged at a noncircular radially facing peripheral interface which may or may not be lubricated and which is generally arranged on an axis parallel to the crusher axis. The member or the elastomer body is attached to the crusher head, and the other is attached to the frame so that the resistive torque is applied to the crusher head from the frame through the engaging member and thence through the elastomer body.

The elastomeric body and the relatively rotating engaging member in the crusher experience a cyclic rise and fall of the torque having somewhat the nature of a sine curve. The amplitude and frequency of the sine curve are dependent on the cross-sectional shape of the engaging member and elastomeric body interface. The amplitude represents the torque, and the frequency represents the degrees of relative rotation of the two members. It is understood that the actual magnitudes of these values will depend upon the physical properties of the elastomeric material, its thickness, size and shape of interface, and the environmental factors such as temperature and lubrication.

Having selected the parameters which influence the resistive torque capability it will be clear that the peak amplitude represents the peak torque resistance, while the distance between torque peaks represents a rotational excursion through an angle defined by the equation $E = 360^\circ/n$ where n is representative of the number of sides or lobes

in the interface.

The torque resistance exerted by the elastomeric body on the engaging member derives from two sources. One source is the fluid-like pressure exerted by the elastomer on the engaging interfaces; the other source is due to surface friction opposing the relative rotation of the two members. The latter magnitude is influenced by the presence of lubrication in the interface, as well as by the aforementioned parameters of the design. The peak torque resistance is exerted opposite to the direction of relative rotation between the engaging members.

The selection of suitable parameters in the design utilizing the invention in an actual cone crusher depends on two different torques exerted on the head in opposite directions, under load and under no load conditions. Under no load operation, the anti-spin device must be designed to exert a resistive torque equal at least to the frictional torque exerted by the rapidly rotating eccentric. Under loaded operation, the anti-spin device should yield to the torque applied to the slowly reverse-rotating crushing head by the rock being crushed.

The design parameters are selected to ensure that a peak-resistive torque in excess of the eccentric frictional torque is available for no load operation and, conversely, that the peak-resistive torque is of low enough magnitude to allow the head to rotate backwards slowly in normal operation should the rock being crushed produce an applied torque on the head of sufficient magnitude to overcome the peak resistive torque. Dependent on the nature and gradation of the rock being crushed, the applied torque when crushing may be insufficient to "snap" the head through the peak torque resistance. In such case, the crusher head will not rotate in a continuous manner in either direction but will continue to conically gyrate while crushing. The above illustrates the relative simplicity of the invention when applied in the usually prevailing manner of operation.

A further advantage of the invention is the retarding

effect, in the presence of bearing distress, against head spin of a magnitude which can cause associated crusher component failure. The tendency for the head to accelerate
5 into synchronism with the eccentric, in case of bearing distress, is taken as an indication of crusher bearing failure. Too often it is a rapid phenomena and it is detected only after considerable damage has been done. The invention acts to produce enough decelerating torque, opposing the
10 eccentric, to keep the spin at a low level of rotational speed until the situation is observed by the operator and the crusher shut down.

Elimination of head spin reduces the no load (tare) power draw of the crusher. The power loss of the anti-spin
15 device during crushing is negligibly small due to the very slow backward rotation, even though the torque may be high as the power drawn is the product of the torque by the rotative speed.

The resilience of the elastomer body enables the
20 anti-spin device to function also as an integral coupling. The inherent lateral component of the gyrating motion of the head is easily accommodated by the resilient material of the elastomer without damage or significant stress to any component of the crusher. Indeed, this feature of the
25 invention actually provides an additional beneficial shock absorbing and damping effect.

A more thorough understanding of the present invention will be gained by reading the following description of the preferred embodiments with reference to the accompanying drawings in which:
30

The invention and its many attendant objects and advantages will become better understood by reference to the following detailed description of the preferred embodiment when read in conjunction with the following drawings,
35 wherein:

Figure 1 is a sectional elevation of a crusher incorporating the anti-spin device of this invention;

Figure 2 is a sectional plan of the crusher base in

Figure 1;

Figure 3 is an enlarged sectional elevation of the crusher shown in Figure 1 in the region of the top of the
5 crusher head;

Figure 4 is a plan view along lines 4-4 in Figure 3;

Figure 5 is a plan view of a portion of a second embodiment of the invention having a preferentially contoured elastomeric clutch member; and

10 Figure 6 is a plan view of a portion of a third embodiment of the invention having an elastomeric sprag clutch.

Referring now to the drawings, wherein like reference characters designate identical or corresponding parts, and
15 more particularly to Figures 1 and 2 thereof, a cone crusher of the type disclosed in US patent application S.N. 196,509 filed on October 14, 1980 is shown having a stationary frame 10 with a peripheral mounting flange 12 which rests on and is secured to a supporting foundation
20 (not shown). A central hub 14 is supported on the frame by a series of radial arms 15. A tapered axial bore 16 formed vertically through the hub 14 receives a similarly tapered end of the axially extending vertical shaft 18 on which is mounted an eccentric 20 having an attached bevel
25 gear 21 driven by a bevel pinion 22 mounted on the end of a drive shaft 24 by way of a sheave 26 connected by drive belts to a motor (not shown). A bearing bushing 28 is mounted in the bore of eccentric 20 to provide a journal bearing for the eccentric 20 on the shaft 18, and a thrust
30 bearing 30 supports the eccentric 20 in the axial direction. The shaft 18 has lubrication channels 32 and 34 which carry oil under pressure to the bearing bushing 28 and the thrust bearing 30 so that the eccentric 20 can be driven
35 for rotation about the shaft 18 with maximal life and minimal frictional losses.

A crusher head 36 is mounted on a spherical bearing 38 fastened to the top end of the shaft 18. The crusher head includes a lower transverse web 40 having a central

axial boss 42 through which extends a cylindrical axial bore 44 lined with a bearing bushing 46. Rotation of the eccentric 20 on the shaft 18 and in the bearing bushing 5 46 causes the axis of the bore 44 to follow the gyrating axis of the eccentric 20. The axis of the bore 44 is coincident with the axis of the crusher head 36, so the crusher head executes a gyrating motion as the eccentric 20 rotates on the shaft 18. The gyrating motion of the crusher head 10 is accommodated by the cylindrical bearing 38 whose center of curvature is equal to its distance from the apex of gyration of the crusher head 36.

The crusher head 36 gyrates within a stationary crusher bowl 48 fastened to the frame 10 of the crusher. 15 The spacing between the crusher head 36 and the crusher bowl 48 determines the size of the output material and can be adjusted by an adjustment mechanism 50 which rotates the crusher bowl in a threaded adjustment ring 52. A tramp iron release cylinder 53 can be operated to lift the ad- 20 justment ring 52 and the entire bowl off a beveled support ring 54 at the top of the frame 10 to allow the uncrushable tramp iron or other material to fall out between the bowl and the crusher head.

Material to be crushed, commonly rock for construction purposes or ore for metallurgical extraction, is fed 25 into a hopper 56 attached at the top of the crusher bowl 48. The rock falls into the converging gap between the crusher bowl and the crusher head 36 and is crushed by the gyrating action of the crusher head. The crushed rock falls 30 down between the mounting flange 12 and the central hub 14 and thence out of the machine. When the crushing gap is filled with rock, the gyrating action of the crusher head is reacted by a force from the crusher bowl 48 through the rock on the crusher head. The reaction force exerted on 35 the head tends to rotate the crusher head relative to the crusher bowl 48 with a slow rotation counter to the direction of rotation of the eccentric 20. Although this counter rotation is not absolutely necessary, it is desirable

because it tends to produce a rolling motion of the crusher head around the inside of the bowl and thereby prevents excessive abrasion of the liner of the bowl and the head thereby preserving the life of the liner.

When the hopper 56 and the crushing gap between the crusher bowl 48 and the crushing head 36 is empty because of some interruption in the flow of rock to the crusher, the friction between the rotating eccentric 20 and the bearing bushing 44 on the crusher head is greater than the resistive torque exerted by the spherical bearing 38. In these circumstances, the crusher head, if not prevented from doing so, would gradually begin to spin in the direction of the rotating eccentric and finally approach or reach the eccentric rotation speed. This is an extremely undesirable condition primarily because it constitutes a safety hazard to the operating personnel. The first rocks falling into the hopper 56 onto a crushing head 36 spinning at high speed can be thrown violently out of the hopper and against persons or equipment working or installed nearby. In addition, damage to the bearing 38 can occur if high speed rotation centrifugally "starves" the bearing of lubricant. Finally, high speed impingement of rock against the spinning crusher head or wedging of rock into the converging gap between the spinning crusher head and the crusher bowl can cause deep scoring and accelerated removal of the wear surfaces of the head and bowl. Such wedging of the rock under essentially impact conditions also tends to produce high shear forces parallel to the liner surfaces which may destroy the bond between liner and the bowl or crushing head. The bond is formed by backing material, usually a filled epoxy or zinc poured between the liner and the aforesaid head or bowl. Destruction of this bond causes the liners to loosen and to suffer premature failure before the wear life has been exhausted.

To prevent the crusher head 36 from spinning in the unloaded condition with the eccentric 20 and to allow the crusher head to rotate backward or remain rotatively sta-

tionary relative to the crusher bowl 48 during crushing operations, an anti-spin device 60 is coupled between the crusher head 36 and the stationary vertical shaft 18. The anti-spin device, most clearly shown in Figure 3 and 4, includes a spindle 62 fastened to the top of the stationary shaft 18 and extending axially upward therefrom. The upper end of the spindle 62 is reduced in diameter at 63, and the lower end of the spindle terminates in a spindle flange 64 having a plurality of axially extending holes there- through for receiving suitable fasteners such as screws 65 for fastening the spindle 62 to the top of the stationary shaft 18 in suitable aligned threaded holes in the floor of a shaft counterbore 66 which receives the spindle flange 64.

The spindle 62 has an axial lubrication channel 68 aligned with the lubrication channel 32 in the shaft 18 and through which lubrication may be conveyed to the anti-spin device as explained hereinafter. The axial lubrication channel 68 is sealed by an O-ring 69 in an O-ring groove in the floor of the shaft counterbore 66.

A clutch block member 70 is fastened to the reduced diameter top end 63 of the spindle 62 by an attachment mechanism, such as a key 72 held in a slot 73 in the member 70 by a screw or the like, which prevents the member 70 from rotating relative to the spindle 62. The member 70 has a cross-section on a horizontal plane which is square with rounded corners. Other configurations may be used instead, and are specifically contemplated, such as symmetrical or asymmetrical lobes, rounded vertex triangle, star, pentagon, hexagram and hexagon, and other configurations which will occur to one skilled in the art upon reading this disclosure. The member 70 has an axial bore 74 for receiving the reduced diameter end portion 63 of the spindle 62. A spindle plate 76 is screwed to the top of the reduced diameter portion 63 of the spindle to insure that the member 70 does not work upwardly off of the spindle as a consequence of its radial engagement with the other elements of the anti-

spin device, as described below. An axial hole 78 in the spindle plate aligns with the channel 68 in the spindle 62 to permit the flow of lubrication to the anti-spin device
5 through the lubrication channel 68 in the spindle 62.

An elastomeric body 80 having an axial opening 81 is attached to the interior of the crusher head 46 in radial alignment with the member 70. The axial opening 81 is the same shape and size in horizontal cross-section as the mem-
10 ber 70. The radially facing walls of the opening 81 engage the corresponding radially facing walls of the member 70 when the crusher head 36 rotates to provide the resistive torque to spinning, as explained below.

The elastomeric body 80 is fastened to a locking
15 collar 82 which in turn is threadedly engaged in an internally threaded wall 84 of an axial well 86 in the top of the crusher head 36. The locking collar 82 has a central inwardly extending annular flange 88 having an upwardly facing annular surface 90 which supports the elastomeric
20 body 80 between a pair of clamping rings 92 and 94. The rings 92 and 94, and the elastomeric body 80 clamped between the rings, are fastened to the flange 88 by a suitable fastening arrangement such as a series of screws 96 which pass through aligned holes in the clamping rings 92 and 94
25 and the elastomeric body 80 and are threaded into suitably aligned internally threaded holes which open in the top surface 90 of the flange 88. A cover plate 98 is removably fastened to the top surface of the upper clamping ring 92 to exclude dirt and confine the lubricating oil entering
30 the anti-spin device to the cavity defined within the clamping rings 92 and 94 and the body 80 to insure that the oil remains clean.

An annular locking nut 100 having a lower portion 102 internally threaded at 103 is threaded onto the externally
35 threaded upper portion of the locking collar 82 extending above the top of the crusher head 36. The top of the locking nut 100 is formed as an outwardly extending radial flange 104 to which a feed plate 106 is fastened by suit-

able fasteners such as bolts 108. The purpose of the feed plate 106 is to catch the rock falling into the hopper 56 and distribute it uniformly around the converging crushing gap between the gyrating crusher head 36 and the stationary crusher bowl 48. Other locking nut and feed plate arrangements are feasible and in use and are too varied to describe here.

In operation, the crusher head 36 moves relative to the crusher bowl 48 in a gyrating motion by virtue of its journal on the eccentric 20 and thrust bearing on the spherical bearing 38. When rock is in the crushing gap between the gyrating head 36 and the stationary bowl 48, the reactive torque exerted on the head 36 through the rock in the crushing gap by the crusher bowl 48 tends to cause the crusher head 36 to execute a slow counterrotation relative to the bowl 48. In effect, the crusher head 36 rolls around the inside of the crusher bowl 48. This rolling motion of the crusher head 36 around the inside of the bowl 48 is desirable because it minimizes abrasion of the crusher head liner and the bowl liner which could occur if the crusher head gyrated without this slow counterrotation relative to the shaft 18.

The torque exerted by the eccentric 20 in the direction of the eccentric axis of its cylindrical surface is considerably less than the reactive torque exerted by the bowl on the crusher head 36. This large differential in torque magnitudes is utilized in this anti-spin device by designing the configuration of the elastomeric body such that the torque necessary to turn the member 70 in the axial opening 81 of the elastomeric body is greater than the torque exerted by the rotating eccentric 20 on the bearing 44 in the boss 42, but less than the torque exerted by the bowl 48 through the rock in the crushing gap on the head 36. Thus, the head is enabled to rotate in a slow rolling motion backward relative to the direction of rotation of the eccentric 20 but does not spin in the direction of the eccentric rotation when the hopper is un-

loaded and the machine is running free.

When the crusher is first started, the frictional torque exerted through the bearing interface by the eccentric 20 on the crusher head bearing 44 is higher than it is when the crusher reaches its normal operating conditions of temperature, etc. Therefore, to prevent or slow down the head spin during start-up, the anti-spin device is designed to exert a somewhat higher resistive torque than the torque exerted through the bearing interface 20/44.

A second embodiment of the anti-spin device, shown in Figure 5, utilizes a preferentially contoured elastomer body 80' coacting with a square member 70'. The axial opening 81' has a series of four concave recesses 110 formed in one side of each face of the opening 81' so that the opening 81' is symmetrical about the machine axis. The recesses start at one corner of the opening 81' and end about midway across the face of the recess in a sloping surface that allows the clutch member 70' to rotate in one direction (clockwise in Figure 5) more easily than in the other direction. This arrangement is for the purpose of reducing the resistive torque exerted by the anti-spin device in the direction counter to the rotation of the eccentric, so the desirable slow counter-rotation of the head is permitted, while permitting the anti-rotation torque to be increased by material and dimension changes, as noted previously.

A third embodiment of the anti-spin device, shown in Figure 6, utilizes an elastomer body 80'' similar to that of the first embodiment, and a clutch member 70'' having a pair of spring loaded cam elements such as sprags 112 pivotally connected to the clutch member 70'' in horizontal slots 114 therein by pivot pins 116 and urged outwardly of the slots 114 by leaf springs 118. When the crusher head executes its slow rolling rotation in the direction (clockwise in Figure 6) counter to the direction of eccentric rotation, the rotation of the clutch member 70'' pushes the sprags 112 against the walls of the elastomer body 80''

- 15 -

to retract the sprags out of interfering relationship with the elastomer body 81' by rotating them against the leaf springs 118 into the slots 114, so the sprags 112 do not
5 impede the desirable counter-rotation of the head. When the crusher is running free, the frictional torque of the eccentric on the head bearing tends to rotate the head and the clutch member 70'' in the counter-clockwise direction. This rotation is prevented by a wedging action of the
10 sprags 112 into the corners 120 of the axial opening 81'' in the elastomer body 80''.

The use of other means for moving and retracting the cam elements into and out of interfering engagement is specifically envisioned. Positively acting mechanical, electrical and hydraulic actuators for moving and retracting
15 cam elements such as sprags and pawls are well known and could be incorporated in this anti-spin device without problem.

The resilience of the elastomer body 80'' accommodates the slight nutating motion of the clutch member 70'' and the sprags 112 to protect them from damage and thereby obviates the need for a separate coupling between the clutch and the frame. Likewise, the shocks and vibration which the machine experiences in normal operation, and the
25 resulting micromovement of the clutch components are accommodated by the elastomer body 80'' and do not cause damage to the sprags 112 or pivots 116.

A corollary benefit obtained from the described invention is related to the ability of elastomer materials
30 to absorb and dampen impact, shock and vibration forces. During crushing, sudden breakage of the rock tends to produce internal dynamic forces which can cause relative micro motion or micro-deformation between major components of the crusher. As an example of these phenomenae, the adjustment ring may jump or "jitter" relative to the mainframe
35 on which it is seated or the bowl may experience motion relative to the adjustment ring to which it is threadably engaged and hydraulically or mechanically clamped. Such

motion causes fretting, heating and fatigue initiation on the faying surfaces leading to mechanical or structural failure. The described invention has the effect of providing an alternative path to absorb vibration, shock and crushing impacts originating in the crushing cavity by virtue of the frictional damping between the elastomer which is supported by the head and the interfacially engaged member (70) which is supported by crusher shaft, frame and thence to ground. Any vibration of the crushing head tends to be dampened by the frictional contact and friction losses at the engaged interface.

The servicing procedures for the anti-spin device of this invention are extremely simple and can be performed easily by the service personnel of the owner of the machine. It is merely necessary to remove the feed plate 106 by removing the bolts 108 and then remove the cover plate 98 from the top of the clamping ring 92. This exposes the anti-spin device for inspection and any necessary repair or replacement. If the elastomeric body 80 becomes worn or needs replacement after a number of years or cycles of operation, it is a simple matter to remove the screws 96 which hold the clamping ring 92, and replace the body 80 with a new one. Likewise, the member 70 can be similarly inspected and replaced if necessary. The cost of these items is quite low compared to the prior art one-way clutch and coupling devices, and it is extremely durable and tolerant of shock, wear, and dirt contamination. The intrusion of abrasive dirt into a one-way clutch mechanism can cause accelerated wear damage, but a similar intrusion of dirt into the anti-spin mechanism of this invention is tolerated because of the elastomeric body simply deforms locally and allows the dirt particle to embed itself temporarily into the elastomer wall as the member 70 rotates over it. Then, when the corner of the member 70 has rotated past the dirt particle it is expelled from the elastomer body wall and washed down by the lubricant flowing into the anti-spin device through the lubricating channels

68 and 74.

Obviously, numerous modifications and variations of the above described preferred embodiment will occur to those skilled in the art upon reading the foregoing disclosure. For example, the relative position of the number 70 and the elastomeric body 80 could be switched so that the elastomer body 80 is fastened to the stationary spindle and the member 70 is fastened to and rotates with the crusher head 36. Also, the position of the anti-spin device in the disclosed machine may be varied. The location in this disclosed machine is chosen at the apex of gyration of the crusher head (the intersection of crusher and crusher head axes) so that the lateral movement component of the relatively moving portions of the anti-spin device is a minimum and the lateral bending on the spindle 62 is negligible. Thus, the primary resistive deformation of the elastomer body produces a resistive torque on the head 36 to prevent it spinning with the eccentric 20. However, other forms of deformation to produce the desired resistive torque on the head 36 are possible and are intended to be encompassed by the spirit and scope of the invention as defined in the claims.

CLAIMS

1. An anti-spin device for a cone crusher having a stationary spindle (62) and a gyrating crusher head (36)
5 driven by an eccentric (20) and running within a stationary crusher bowl (48), said anti-spin device comprising:

an elastomeric body (80) fastened to one of said spindle and said crusher head;

10 a member (70) fixed to the other of said spindle and said crusher head in telescoping, approximately coaxial relation to said body;

said body having a regular, noncircular peripheral surface (81);

15 said member having a similar, regular, noncircular surface in radially opposed, approximately coaxial, juxtaposed relation to said body surface;

whereby said elastomer body will deform under the reactive torque exerted on said crusher head during crushing operations, and said elastomer body will damp
20 vibrations in said crusher and will exert sufficient resistive torque during free running operation to prevent said crusher head from spinning with the eccentric.

2. The anti-spin device defined in claim 1, wherein said crusher head gyrates about an apex of gyration, and
25 said juxtaposed surfaces of said member and said body lie across the horizontal plane through said apex of gyration so that vertical scrubbing and rectilinear deformation of said body is minimized, and the primary action is relative angular translation and the concomitant deformation of
30 said body.

3. The anti-spin device defined in claim 2, wherein said elastomer body is fixed to said crusher head and includes an axial opening (81) therein defined by said peripheral surface, said member having a cross-sectional shape
35 similar and slightly differing in size to the cross-sectional shape of said opening to obtain varying proportions of frictional and deformational component which together are the total resistive torque.

4. The anti-spin device defined in claim 3, wherein said member is mounted on an axially extending stationary spindle rigidly mounted to a frame (10) of said crusher, and said spindle includes an axially extending duct (68) for conveying lubricant to the interface of said member and said body.

5. The anti-spin device defined in claim 3, wherein said cross-sectional shape is square with rounded corners.

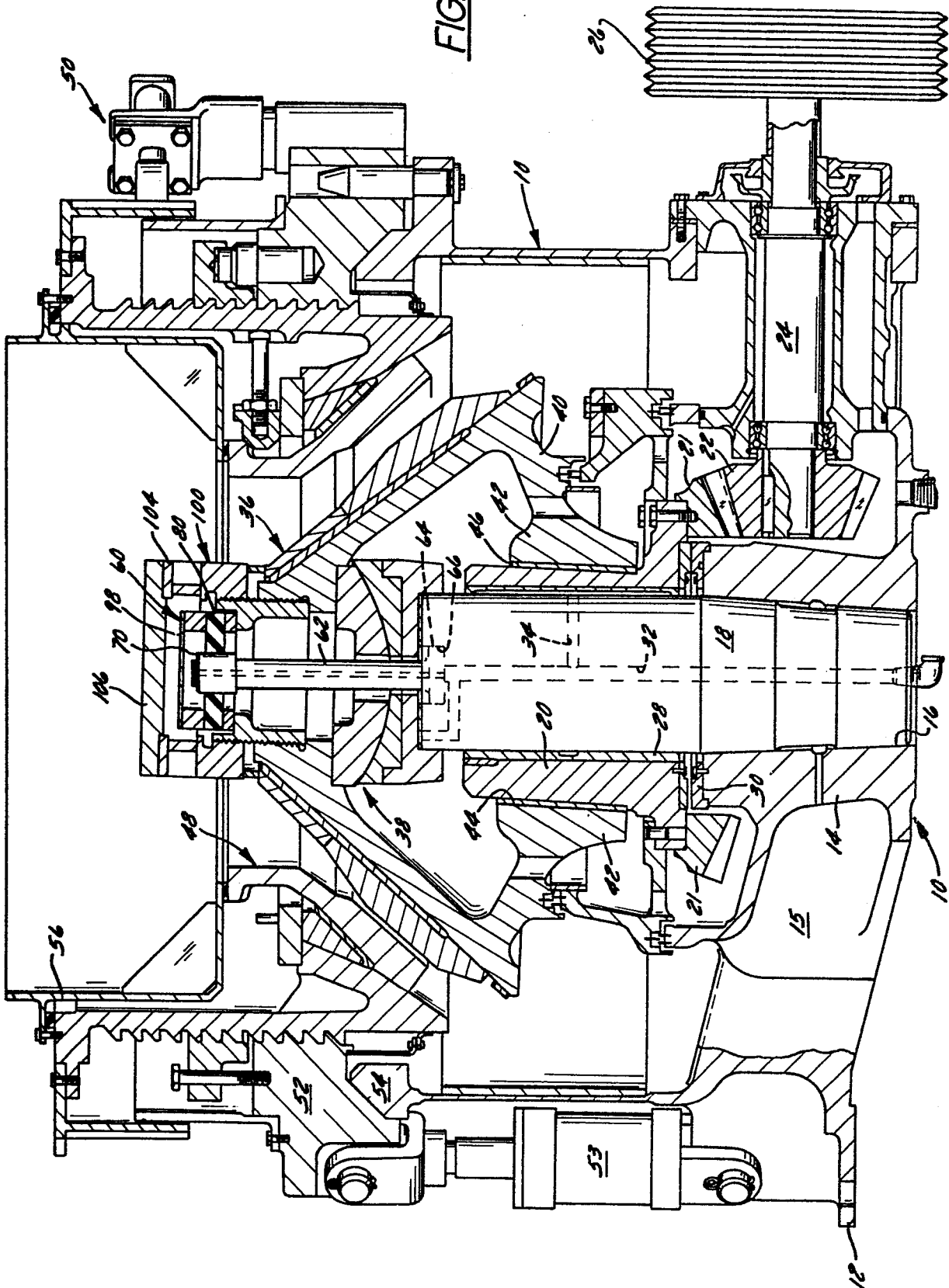
6. The anti-spin device for a cone crusher having a substantially stationary assembly including a frame and a crusher bowl mounted on said frame, a crushing head mounted for gyration within said crusher bowl about an apex of gyration to crush rock between the head and bowl, and an eccentric driven about an axis and having an eccentric surface on which a portion of said head is journaled, said eccentric exerting a spinning torque on said head tending to spin said head relative to said bowl in the direction of rotation of said eccentric, said anti-spin device comprising:

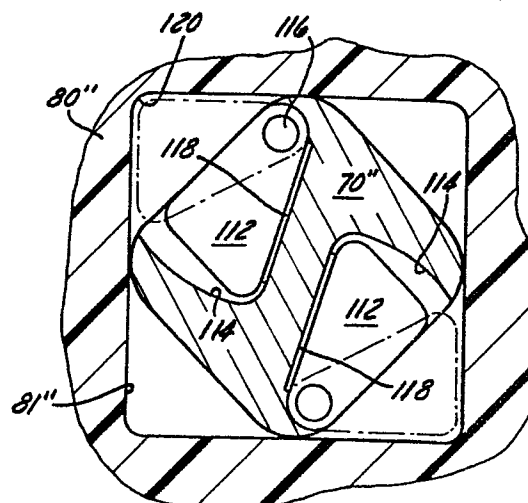
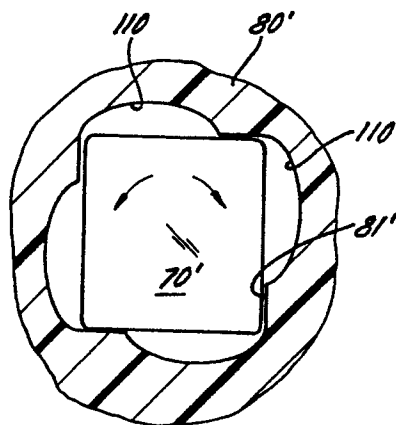
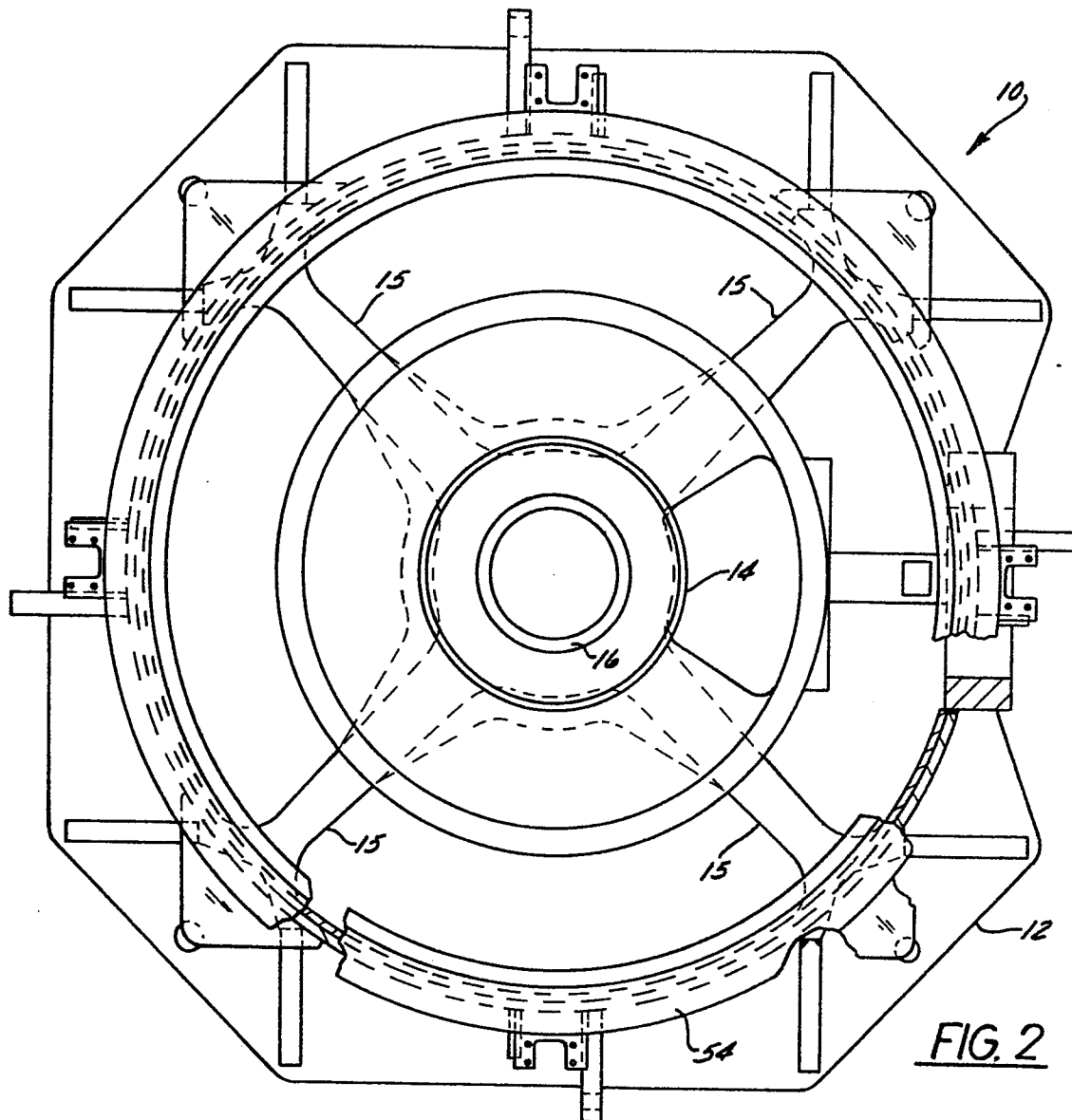
an elastomer body attached to said one of said stationary assembly and said head, and having an engagement surface therein;

a member coupled to the other of said stationary assembly and said head and having an engagement surface facing and engageable with said body engagement surface, said engagement surfaces having interfering projections that require torque of a predetermined magnitude to deform said elastomer enough to enable said interfering projections to pass one another and allow said surfaces to rotate relative to each other;

whereby said crushing head can rotate relative to said crusher bowl during loaded operation by the reactive torque greater than said predetermined torque exerted by said bowl through the crushed rock on said head by deformation of said elastomer body, and said elastomer body exerts a resistive torque greater than said spinning torque to prevent said head from spinning with said eccentric in the unloaded condition of said crusher.

FIG. 1





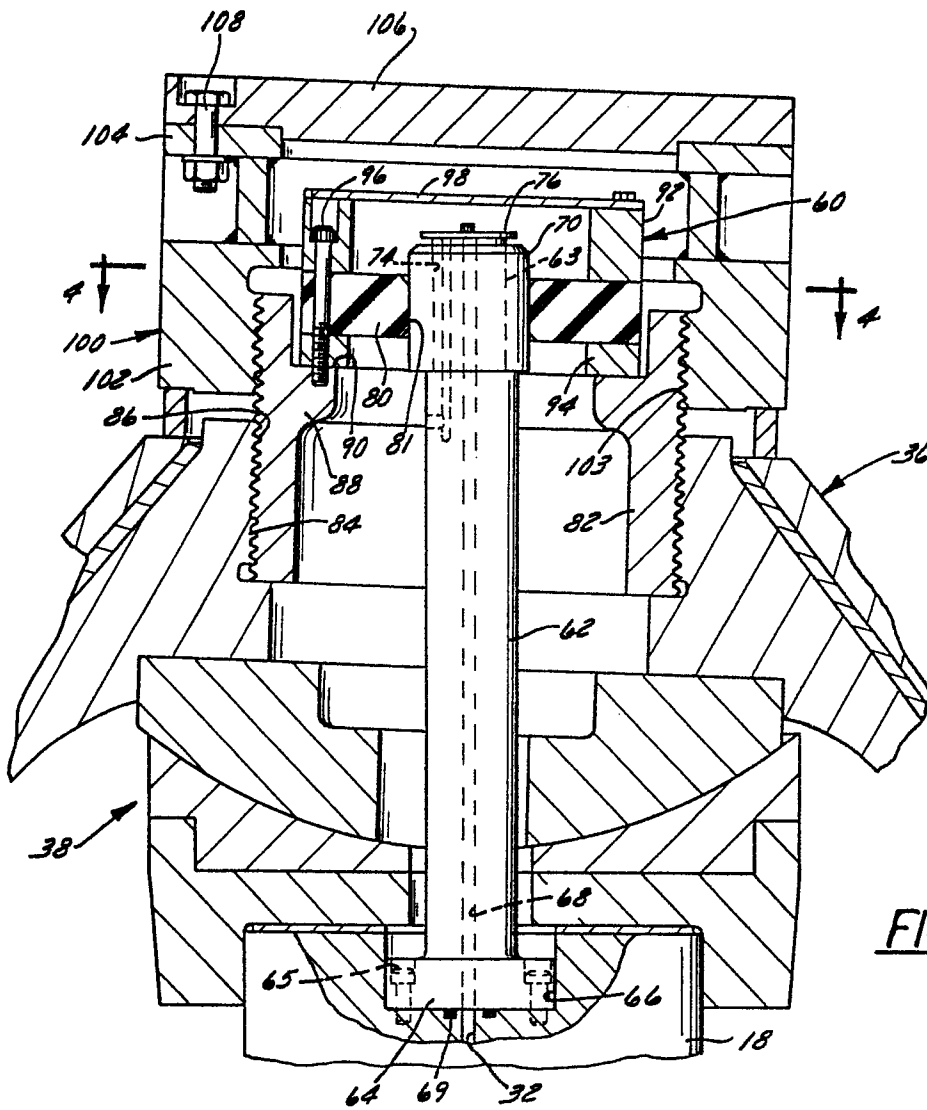


FIG. 3

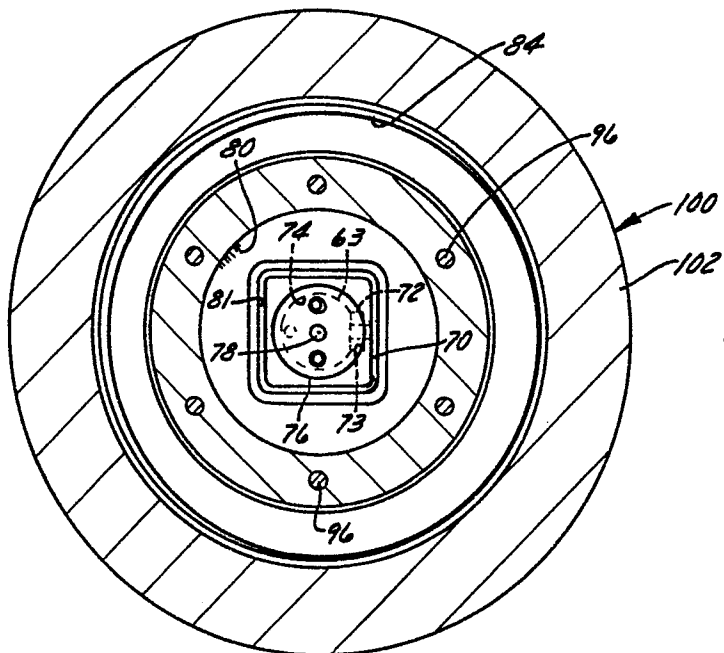


FIG. 4