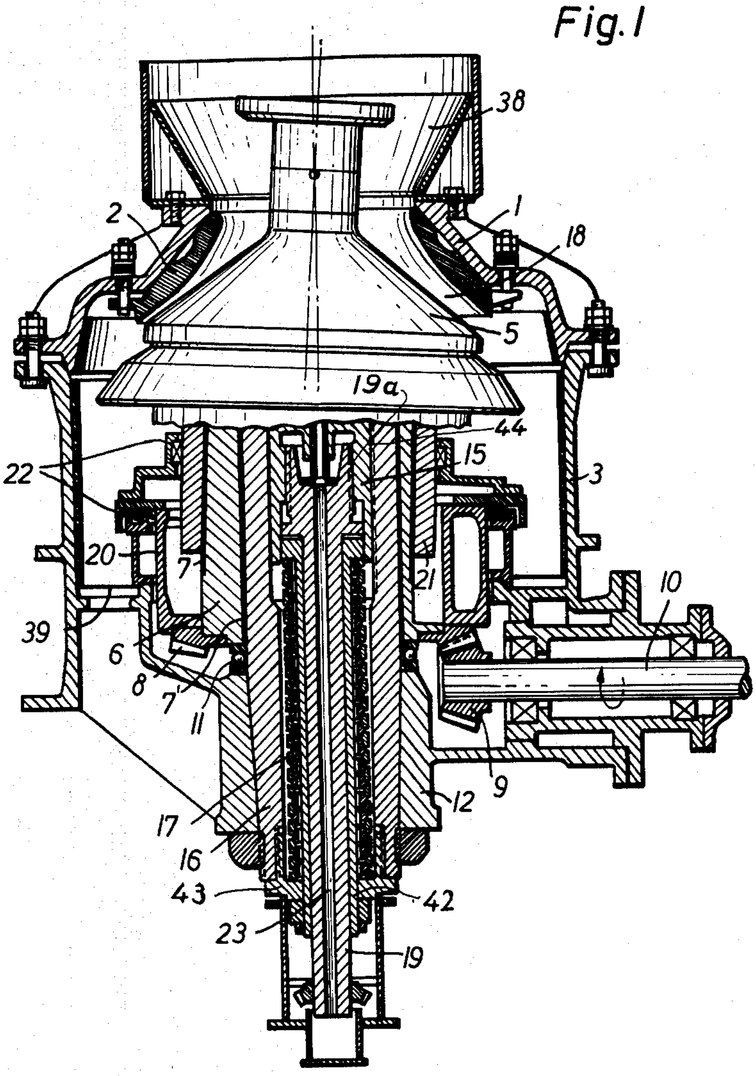
CONE CRUSHER

Filed July 1, 1963 3 Sheets-Sheet 1

Fig. 1



CONE CRUSHER

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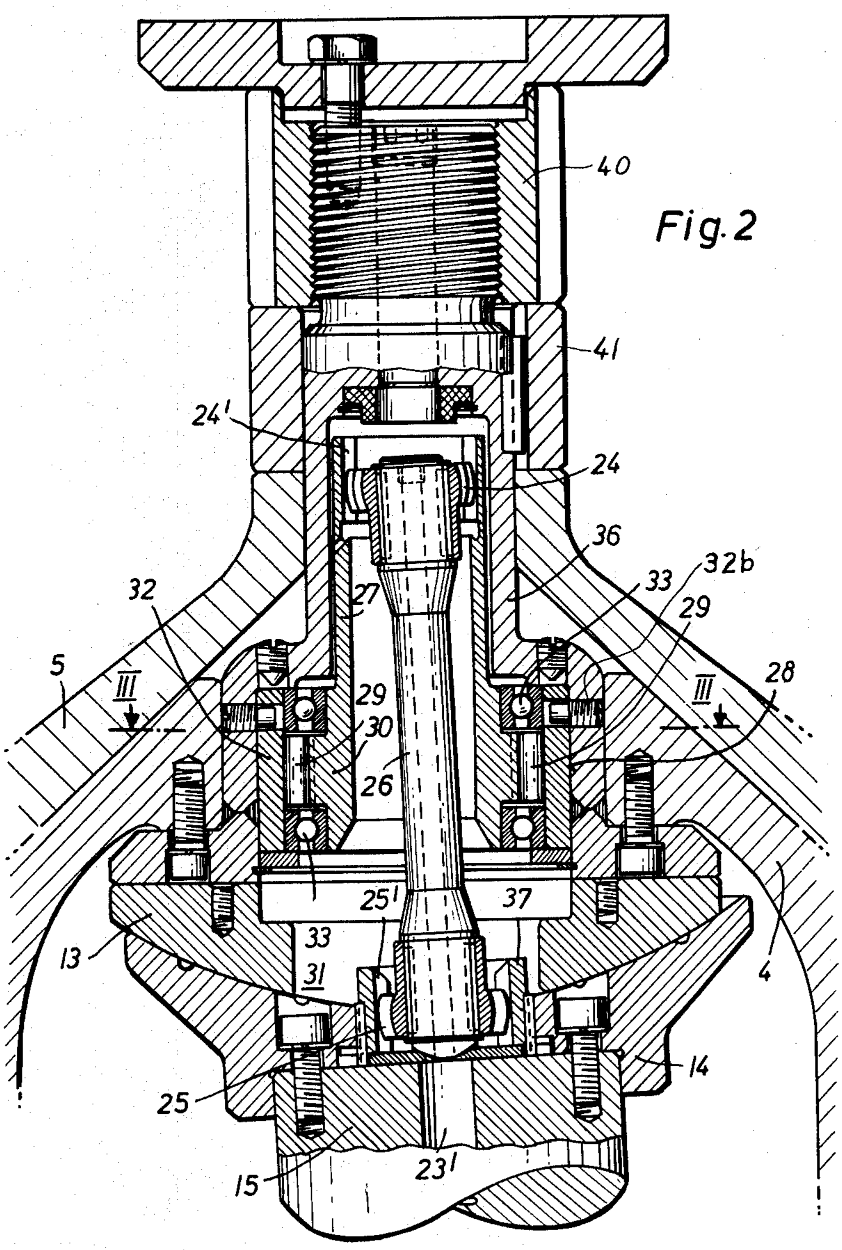
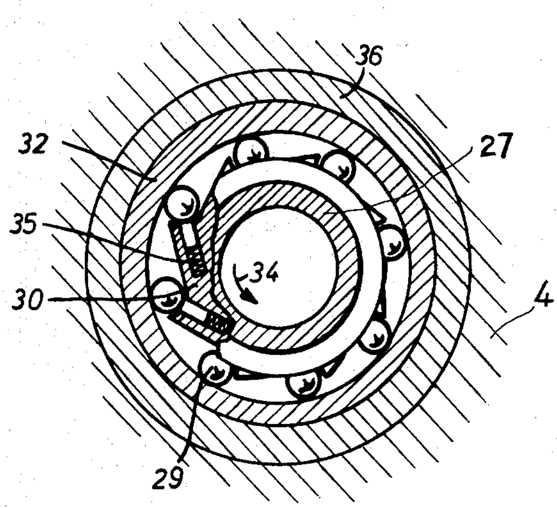


Fig. 2

Fig.3



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CONE CRUSHER

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8 Claims. (Cl. 241—208)

Our invention relates to a cone crusher with an eccentrically driven crushing cone and more particularly to a cone crusher for comminuting minerals such as rocks and ores.

In known cone crushers of this type, the crusher cone has a tendency during idling i.e. when no material is being crushed to rotate with the driving mechanism, such as an eccentric sleeve, due to its frictional engagement therewith. When the crushed is impacted with material to be crushed, the movement of the crusher cone is naturally braked. However it always takes a little time due to its inertia before the wobbling movement of the crusher cone is damped to such an extent that it is rendered motionless. As the crusher cone is being braked, the crushed granules that are produced are not of the granule size normally produced. Wearing of the components of the cone crusher which take part in the crushing operation also occurs because of the tangential friction produced in the crusher cone.

The aforementioned rotation of the crusher cone with the eccentric sleeve drive when the cone crusher is idling, has no special significance if the crusher is continuously being fed. When feeding is intermittant, on the other hand, rotation of the crusher cone with the eccentric sleeve driving mechanism creates the aforementtioned difficulties. The tendency for the crusher cone to rotate with the driving mechanism furthermore becomes greater when the gap or spacing between the crusher cone and the outer shell of the crusher is adjusted to such a width that the material to be crushed which is located between the crusher cone and the crusher lining of the outer shell fails to produce the required frictional results.

It is accordingly an object of our invention to provide a cone crusher in which there can be no rotation of the crusher cone with the driving mechanism during idling of the machine, i.e. when no material is being broken.

With this object in view and in accordance with a feature of our invention, we provide a crusher cone which is connected with a fixed member of the cone crusher by means of a free-wheeling clutch so that the crusher cone is prevented from rotating with the crusher drive mechanism during idling.

In accordance with another feature of our invention, the free-wheeling clutch is connected on the one hand rigidly with the fixed shaft of the cone crusher and on the other hand by means of a universal joint to the crusher cone.

In accordance with yet another feature of our invention, the universal connecting joint is a torsion rod which is non-rotatably though pivotably installed within the inner hub of the free-wheeling clutch. The inner hub, therefore, has an inner diameter of such length that the torsion rod can follow the movement of the crusher cone without hindrance.

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In accordance with additional aspects of our invention, the crusher cone is pivotally mounted with a spherical collet in a spherical shell on a movable piston which is held non-rotatable though axially shiftable within a bore of a fixed shaft of the cone crusher; a sleeve with inner teeth is provided in the center of the spherical shell and is in meshing engagement with arcuate teeth located at a lower end of the torsion rod; and the spherical collet is provided with a central cut-out of such diameter that the torsion rod can follow the movement of the crusher cone without hindrance.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended calims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of a specific embodiment when read in connection with the accompanying drawings in which:

FIG. 1 is a longitudinal section through a cone crusher constructed in accordance with our invention;

FIG. 2 is an enlarged fragmentary longitudinal section through the upper part of the cone crusher shown in FIG. 1; and

FIG. 3 is a cross section taken along the line III—III in FIG. 2 in the direction of the arrows showing a free-wheeling clutch that forms part of our invention.

Referring now to the drawings and particularly to FIG. 1, there is shown a frustoconical shell **1** to which is secured an annular crusher lining **2** and which is supported by a lower housing portion **3**. A crusher cone **4** (FIG. 2) is mounted within the crusher lining **2** and is provided with a crusher mantle **5** which is secured on the outer surface thereof by a sleeve **41** and nut **40**, respectively keyed to and threaded on a partly hollow throat portion **36** of the crusher cone. The crusher cone **4** is slidably supported on an eccentric sleeve **6** which in turn carries other sleeves **7** and **7'** respectively on its outer and inner sides that act as slide bearings respectively on the lower part **21** of the crusher cone and on a tubular shaft **16** which is fixed to a hub **12** of the lower housing portion **3**. A bevel gear **8** is threadedly mounted at the lower end of the eccentric sleeve **6** or secured by any other suitable means thereon, and meshes with a bevel pinion **9** of a drive shaft **10**. The shaft **10** is driven by an electric or other suitable motor (not shown) in clockwise direction, i.e. in the direction of the arrow shown in FIG. 1. The eccentric sleeve **6** is mounted at its lower end on an anti-friction thrust bearing **11** which is seated on the hub **12** of the lower housing portion **3**.

As shown in FIG. 2, a spherical collet **13** is secured to the interior of the crusher cone **4** by bolts and is carried in a spherical shell **14** that is in turn bolted to the upper end of an adjusting piston **15**. The width of the gap **18** between the crusher lining **2** and the mantle **5** is adjustable by raising and lowering the crusher cone **4** by suitably moving a spindle **19** which forms a lower extension portion of the adjusting piston **15** to which the spindle **19** is threadedly connected at **19***a*.

As seen in FIG. 1, the piston **15** is mounted in an axial bore of the fixed tubular shaft **16** and is slidable therein in the axial direction of the cone crusher but is held against rotation by a tongue and groove arrangement **44** or by a suitable key and slot arrangement or the like, but is slidable in an axial direction of the cone crusher. Coaxially surrounding the spindle **19** is an elongated bushing **42** having an annular flange at one end which engages an annular shoulder of the spindle **19**. An elongated annular spring **17** is coaxially mounted on the bushing **42** and abuts at one end the flange of the bushing **42** and at the other end the inner surface of a fitting **43** threadedly secured to an end of the fixed shaft **16**. Thus, whenever a lump of material that cannot be crushed, for example a piece of metal, enters the crushing space **18** between the crusher lining **2** and the crusher mantle **5**, the crusher cone **4** is smoothly displaced downwardly against the yielding bias of the spring **17** conveyed through the bushing **42** and piston **15**.

A ring **20** encloses the lower portion **21** of the crusher cone **4** separating the latter from the crusher housing **3**. Suitable gaskets **22** are also provided between the crusher housing and the crusher cone so that a substantially dust-proof seal of the interior of the cone crusher is assured.

The spindle **19** of the piston **15** is provided with a centrally located axial bore **23** (FIG. 1) which serves as an oil feed passage, the bore **23** continuing upwardly into a bore **23′** (FIG. 2) of the adjusting piston and leading to a central axial bore of a torsion rod **26**. All of the rotating and sliding components of the cone crusher are thus maintained in an oil bath which permits trouble-free operation of the cone crusher.

The crusher cone **4** is operatively connected to a fixed part of the cone crusher by a free-wheeling clutch **28** and thereby prevented from rotating with the crusher driving mechanism during idling. The free-wheeling clutch **28** is accordingly securely connected against rotation with the fixed shaft **16** through the piston **15** on the one hand and is connected for universal movement with the crusher cone **4** on the other hand. The universal connecting member is the torsion rod or bar **26** which is mounted non-rotatably though pivotably within an inner hub **27** (FIGS. 2, 3) of the free-wheeling clutch **28**. The inner hub **27** has an inner diameter of such size that the torsion rod **26** is able to follow the wobbling movement of the crusher cone **4** without hindrance.

Teeth **24, 25** are disposed on both ends of the torsion rod **26** and mesh with inner teeth **24′** formed in the hub **27** and with teeth **25′** formed in a sleeve **37**, respectively, the sleeve **37** being secured in the center of the spherical shell **14** of the adjusting piston **15**. A central cutout or aperture **31** is provided in the spherical collet **13** and has such a large diameter as to similarly permit the pivoting movement of the torsion rod **26** to follow the movement of the crusher cone **4**.

The tooth profile of the teeth **24, 25** of the torsion rod **26** is arcuate. This shape advantageously prevents the formation of destructive stresses on the edges of the teeth **24, 25** which mesh with the teeth **24′, 25′** of the hub **27** and sleeve **37** respectively as the torsion rod **26** follows the wobbling movement of the crusher cone **4**.

The free-wheeling clutch **28** has an outer ring **32** and is secured in the hollow throat portion **36** (FIGS. 2, 3) of the crusher cone **4** by fastening the outer ring **32** to the throat portion **36** with screws **32*b***. The clutch **28** by means of the ratchet wheel **30** permits rotation of the crusher cone **4** only in one direction and in such a way that the forward turning of the cone crusher is prevented during idling of the machine. In the embodiment illustrated the forward rotation is in the direction of the arrow **34** (FIG. 3). When material to be crushed is fed into the cone crusher between the crusher cone **4** and crusher lining **2**, there occurs a counter-rotating motion of the crusher cone **4**, for example on the order of 10 revolutions per minute, because of the planetary or epicyclic movement of these components. This counter-rotating motion takes place only because the crusher cone **4** is released from the free-wheeling clutch. As can be seen in FIG. 3, when the crusher cone **4** rotates counter to the ratchet gear **30** i.e. opposite to the direction of the arrow **34**, the free-wheeling clutch serves primarily as a combination ball and roller bearing. Several rollers **29** are provided between the ratchet wheel **30** and the outer race **32** thereof, the position of the rollers **29** being accurately predetermined by the shape of the bearing surface area within the free-wheeling clutch. Ball bearings **33** space the clutch components **30, 32** evenly from each other, and also aid relative rotation therebetween. When the ratchet wheel **30** is turned, however, in the direction of the arrow **34** (in the forward direction) each of the rollers **29** is forced by the biasing action of the respective helical spring **35** into the corner that is formed between the respective teeth of the ratchet wheel **30** and the outer race **32** so that it is clamped therebetween and causes immediate braking of the rotary motion. The clutch is thus locked, and rotation of the crusher cone **4** in the direction of the arrow **34** which usually occurs during idling in cone crushers that have been previously made is consequently prevented by our invention.

The entire braking system comprising the free-wheeling clutch **28**, the torsion rod **26** with upper and lower teeth **24, 25**, as well as the inner toothed sleeve **37** is incorporated in the central oil circulatory system of the cone crusher. To effect proper lubrication of the parts the oil flows under pressure from an oil pump (not shown) through the central bores **23, 23′** of the torsion rod in an upward direction and flows across the teeth **24, 24′** back once again into the interior of the crusher cone **4**. From there it is returned in a known manner to the oil circulatory system of the cone crusher.

The general operation of the cone crusher constructed in accordance with our invention is as follows:

The material to be crushed is delivered by feeding equipment (not shown) to a feed hopper **38** and from there into the annular gap or crushing space **18**. The material is comminuted between the crusher mantle **5** and the crusher lining **2** by the movement of the crusher cone **4**. The crushed material then passes through an opening **39** in the crusher housing to an outlet from which it is removed.

While the invention has been illustrated and described as embodied in a cone crusher, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention. Other adaptations should and are intended to be comprehended within the meaning and range of the equivalents of the following claims.

We claim:

1. A cone crusher comprising a stationary shaft; a crusher cone rotatable with respect to said stationary shaft, means for feeding crushable material into crushing engagement with said cone; rotating drive means for eccentrically driving said cone whereby material fed into engagement therewith is crushed, said cone tending to rotate about its axis in the rotating direction of said drive means when no material is being crushed by said cone; clutch means for holding said crusher cone against its tendency to rotate in said direction, said clutch means comprising a hollow hub; and a torsion rod extending into said hub, said torsion rod being pivotably though non-rotatably secured at one end to said stationary shaft and being connected for universal movement with said crusher cone at the other end, said hollow hub having an inner diameter providing clearance therein for the universal movement of said torsion rod in response to the movement of said crusher cone.

2. A cone crusher according to claim **1**, wherein said hollow hub is formed with teeth on the inner surface thereof and said torsion rod is formed at one end with arcuate teeth meshing with the teeth of said hub.

3. A cone crusher comprising a stationary hollow shaft; an adjusting piston at least partially received in said stationary hollow shaft and being axially movable to selected adjusting positions, said adjusting position being constrained against rotation with respect to said stationary hollow shaft and being provided with a concave shell at one end thereof; a convex collet slidingly seated in said concave shell; a crusher cone secured to and supported by said collet, said crusher cone being rotatable with respect to said stationary shaft; means for feeding crushable material into crushing engagement with said cone; rotating means for eccentrically driving said cone whereby material fed into engagement therewith is crushed, said cone tending to rotate about its axis in the rotary direction of said drive means in a condition of said cone crusher in which no material is being crushed by said cone; clutch means for holding said crusher cone against its tendency to rotate in the rotary direction of said drive means; and a torsion rod fixedly connecting said clutch means on one hand to said stationary shaft and connected for universal movement on the other hand with said crusher cone.

4. A cone crusher according to claim **3**, wherein a sleeve formed with teeth on the inner surface thereof is secured in the center of said concave shell, said torsion rod being provided at one end with arcuate teeth meshing with the teeth of said sleeve, said convex collet being formed with a central aperture wide enough to provide clearance for the universal movement of said torsion rod in response to the movement of said crusher cone.

5. A cone crusher comprising an upright stationary hollow shaft; an adjusting piston at least partially received in said stationary hollow shaft, said adjusting piston being movable in the axial direction of said shaft to selected adjusting positions and being constrained against rotation with respect to said stationary hollow shaft, said adjusting piston having a concave shell at the upper end thereof; a centrally apertured convex collet slidingly seated in said concave shell; a crusher cone secured to and supported by said convex collet on said concave shell, said crusher cone being rotatable with respect to said stationary shaft; means for feeding crushable material into crushing engagement with said cone; rotating means for eccentrically driving said cone whereby material fed into engagement therewith is crushed, said cone tending to rotate about its axis in the rotary direction of said drive means when no material is being crushed by said cone; free-wheeling clutch means for holding said crusher cone against its tendency to rotate in the rotary direction of said drive means, said clutch means comprising a hollow hub formed with teeth on the inner side thereof, said concave shell having a sleeve secured to the center thereof, said sleeve being formed with internal teeth; and a torsion rod extending through said apertured collet into said hub, said torsion rod being formed at its ends with arcuate teeth meshing respectively with the teeth of said sleeve and the teeth of said hub, whereby said clutch means is fixedly connected on one hand to said stationary shaft and connected for universal movement on the other hand with said crusher cone.

6. A cone crusher according to claim **5**, wherein said torsion rod is formed with an axial bore providing a path for the flow of lubricating oil to the upper end thereof and passage means in said free-wheeling clutch means for returning the flow of the oil over the arcuate teeth at both ends of said torsion rod and over the inner teeth of both said hub and said sleeve.

7. A cone crusher comprising stationary means; a crusher cone rotatable relative to said stationary means; means for feeding crushable material into crushing engagement with said cone; rotating drive means for eccentrically driving said cone whereby material fed into engagement therewith is crushed, said cone tending to rotate about its axis in the same direction as that of said rotating drive means when no material is being crushed by said cone; and a free-wheeling clutch for holding said cone against its tendency to rotate in the same direction as that of said rotating means, said free-wheeling clutch being fixedly connected on one hand to said stationary means and being connected on the other hand for universal movement with said crusher cone, said free-wheeling clutch being effective only when substantially no material is being crushed by said crusher cone.

8. A cone crusher according to claim **1**, wherein said torsion rod is formed with teeth at both ends thereof, said hollow hub and said main shaft having corresponding teeth meshing respectively with the teeth at the ends of said torsion rod.

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