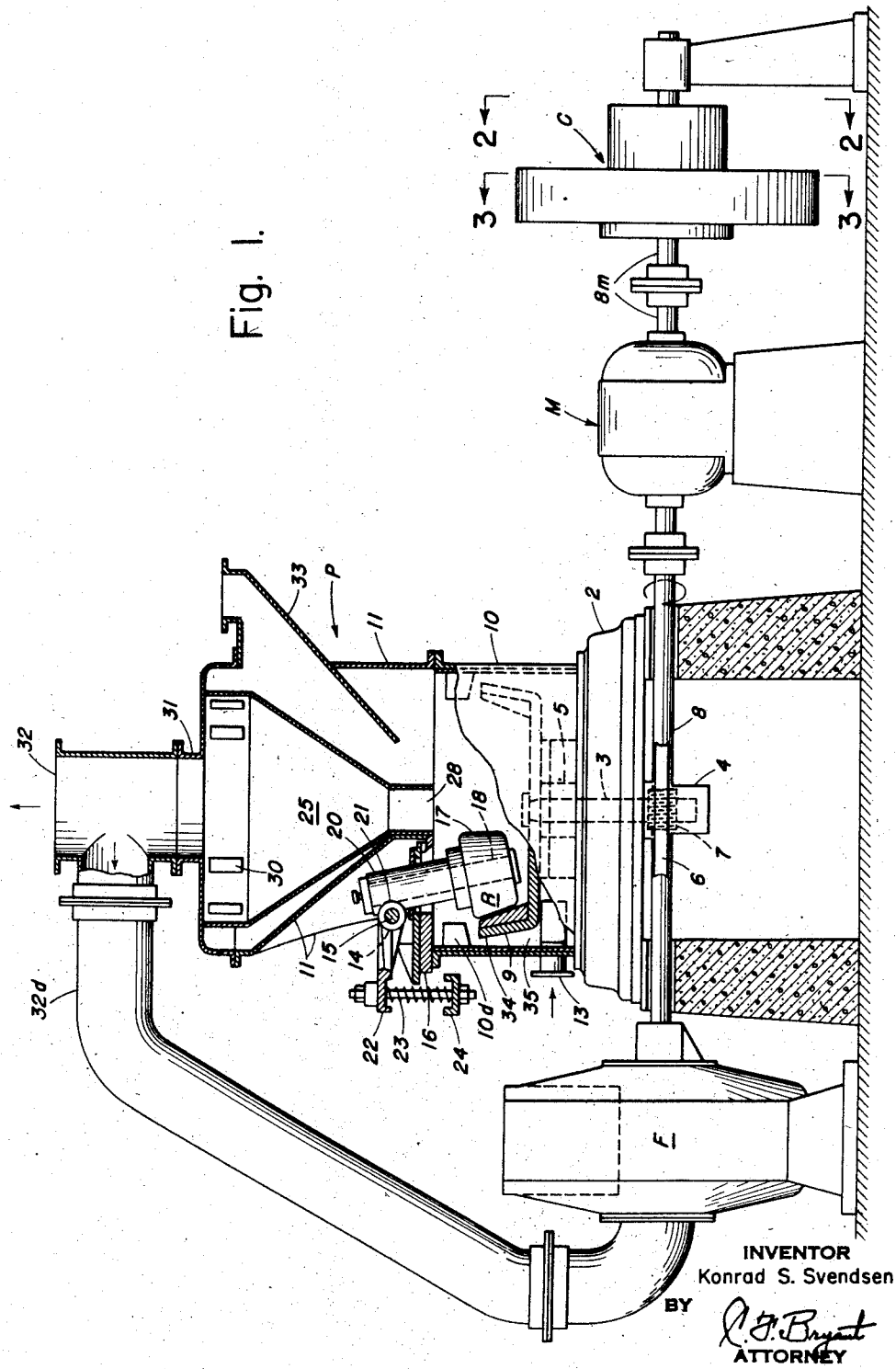
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PULVERIZING MILL WITH NOVEL FLYWHEEL MEANS

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Fig. 1.




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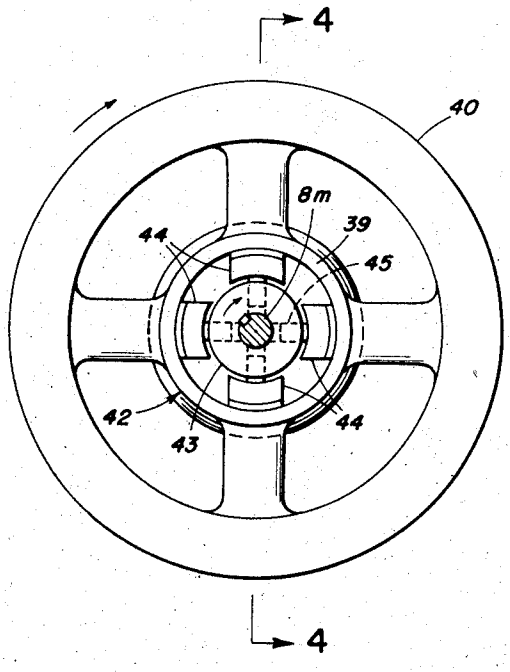
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Fig. 2.



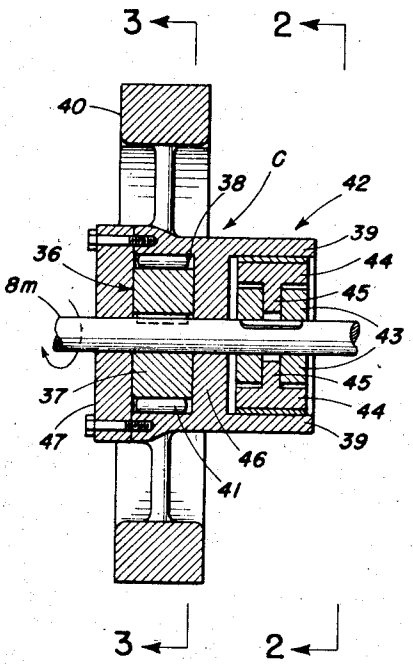




Fig. 4.

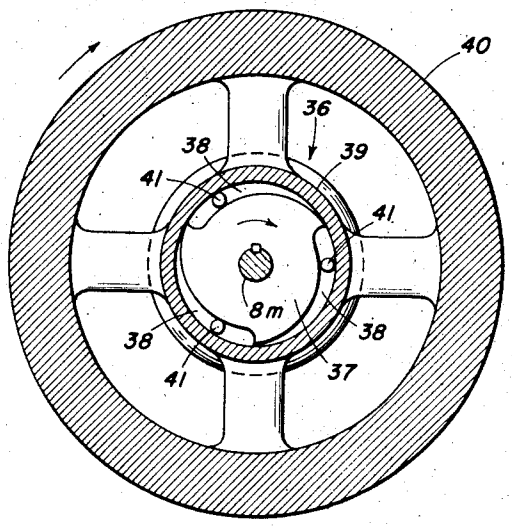



Fig. 3.

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# PULVERIZING MILL WITH NOVEL FLYWHEEL MEANS

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5 Claims. (Cl. 241—36)

This invention relates to a machine equipped with mechanism operative to automatically limit the rate of deceleration of the moving elements of the machine that are actuated through a rotating shaft driven by a motor without appreciably increasing the rated torque-time requirement of the motor during periods when the motor is effective to drive and accelerate the moving elements.

The invention is particularly applicable to coal pulverizing mills wherein the motor driven elements are of low inertia but at times require high inertia characteristics for successful operation. These mills are driven by electric motors and may be connected into a steam-electric plant organization so as to supply pulverized coal directly into the furnaces of the steam generators of the plant. In such plants the electric motors that drive the auxiliary machinery are supplied with energy from two or more sources so interlocked that only one source may be connected at one time. The transfer from the bus bar of one source to that of another is necessarily accompanied with a time delay during which neither source is connected, this system of transfer being designated as "open transition." Depending upon the duration of the open circuit during the "open transition," the delivery of fuel and air to the furnace as the low inertia pulverizing apparatus slows down, may quickly become insufficient to sustain combustion. Should this happen the fire in the furnace will be extinguished and an extremely dangerous condition will prevail when the transfer is complete, the motor reenergized and the pulverizing apparatus brought up to speed, since there may be a delayed ignition of the fuel then delivered to the furnace which will cause a severe furnace explosion.

It is an object of this invention to provide an improved pulverizing apparatus driven by an electric motor and having means for automatically limiting the rate of deceleration of the apparatus to maintain an adequate fuel supply during transfer from one motor energizing source to another and yet not appreciably increasing the rated torque-time requirements of the standard motors employed with such pulverizing apparatus.

It is a further object to provide a flywheel mechanism mounted on a rotating shaft and operative to retard the normal deceleration of the shaft but only slightly retard the normal acceleration of the shaft.

Additional objects and advantages will become apparent from the following description of an illustrative embodiment of the invention when read in conjunction with the accompanying drawings wherein:

Figure 1 is a vertical section of a preferred and illustrative embodiment of the pulverizing mill organization of the present invention.

Figures 2 and 3 are sectional views of the flywheel mechanism of the present invention taken on lines 2—2 and 3—3, respectively, of Figs. 1 and 4.

Figure 4 is a sectional view taken on line 4—4 of Fig. 2.

Referring now to the drawings, the pulverizing mill generally designated P in Fig. 1 comprises a base 2 within which is supported vertical shaft 3 by means of bearings 4 and 5. To the upper end of shaft 3 is secured bowl 9 which is centrally positioned within housing portion 10 and which, together with the shaft, is suitably rotated by motor M through shaft 8, worm 7 and wormwheel 6.

Supported on the upper rim of housing portion 10 is uppermost housing portion 11 which in turn supports roller assemblage R so that its lower portion depends within bowl 9. The assemblage R extends through a



suitable opening provided in housing portion 11 through which the assemblage may be removed if necessary and which is normally closed by removable member 16. The number of roller assemblages that are employed depends upon the size of the pulverizing mill with but one assemblage being shown in the illustrative embodiment.

As embodied assemblage R comprises sleeve 20 which is rotatably mounted on shaft 15 by hub 21 and which is provided with shaft 18 to the lower end of which is rotatably mounted roller 17. Extending laterally from sleeve 20 is arm 22 and compressed between the outer end of this arm and stationary member 24 is spring 23 effective to urge roller 17 toward the edge or side of bowl 9.

Material to be pulverized is fed to the center of bowl 9 through chute 33 and due to rotation of the bowl is thrown outwardly against the side wall of the bowl where it is crushed by roller 18. The crushed material overflows the rim of the bowl and is picked up by upwardly flowing air in the mill housing which is admitted through opening 13 provided in housing portion 10.

Deflectors 10*d* are provided to deflect coarse fractions back into the bowl for regrinding with the remaining material passing upwardly through housing portion 11 and into classifier 25 through inlet openings 30. A final separation of the sufficiently fine fractions from the coarse fractions is effected in classifier 25 with the rejected material returning to the bowl 9 through passage 28 and the sufficiently fine material passing through outlet 31 to conduit 32 from which it may be conveyed directly to a furnace or the like or to fan F and then to the furnace. As illustratively disclosed fan F is also driven from shaft 8 and is operative to effect the necessary air flow through the mill.

Upon shaft 8*m*, which is connected to the opposite end of motor M from shaft 8, is mounted flywheel assemblage C which, in addition to generally conventional flywheel 40 journaled to shaft 8*m* by bearing members 47 and 46, includes free wheeling or unidirectional clutch 36 and centrifugal clutch 42.

As embodied unidirectional clutch 36 comprises cam member 37 keyed to shaft 8*m* and positioned within a cylindrical relieved portion provided in hub 39 of flywheel 40 intermediate bearing members 47 and 46. The periphery of cam 37 is provided with a plurality of symmetrically arranged tapered surfaces which cooperate with the inner surface of the relieved portion to form wedged-shaped openings or slots 38 which decrease in depth in the motor drive rotative direction of the cam (indicated by arrows in Figs. 3 and 4) and within each of which is disposed a roller 41 having a diameter less than the depth of the slot at its deepest end. Through this arrangement when cam 37 rotates in its motor driven direction relative to flywheel 40, as indicated by the arrows, clutch member 36 will occupy what may be called its disengaged position permitting such relative rotation while relative rotation in the opposite direction, as when flywheel 40 is rotating at a greater speed than cam 37 and in the direction indicated by the arrows in Fig. 3, will cause clutch member 37 to become engaged thereby positively connecting flywheel 40 to shaft 8*m* causing the shaft, cam and flywheel to rotate in unison.

Centrifugal clutch 42 comprises hub member 43 keyed to shaft 8*m* and positioned within a cylindrical relieved portion provided in hub 39 and located outwardly of bearing member 46. A plurality of symmetrically arranged radial bores or guideways are formed within hub 43 and within each of these bores is slidably disposed stem 45 of one of the weighted clutch shoes 44. The outer surface of the clutch shoes are arcuate to conform to the surface of the associated relieved portion of hub 39 and as a result of the rotation of shaft 8*m* and hub 43 the shoes are thrown outwardly into contact with this surface with a force that is dependent upon the rotative speed of these members. This action will permit motor M to bring shaft 8*m* up to its normal rotational speed in a period of time only slightly greater than that required when flywheel assemblage C was not employed, with flywheel 40 being brought up to speed slowly as compared with shaft 8*m* because of slippage of centrifugal clutch 42.

Since the effectiveness of clutch **42** is dependent upon centrifugal force, the addition of flywheel assemblage C to the system will not impose a great starting load on motor M because during the initial starting period motor M and shaft **8***m* rotate relatively slowly so that there will be little centrifugal force and clutch **42** will be substantially ineffective.

In operation of the illustrative embodiment of the present invention, motor M is first energized causing rotation of shafts **8** and **8***m* in the direction indicated by the arrows and consequently actuating pulverizing mill P in the usual manner through rotation of bowl **9**. During the starting up period unidirectional clutch **36** will occupy its disengaged position and centrifugal clutch **42** will exert a frictional drag the magnitude of which depends upon the rotational speed of shaft **8***m*. The clutch is designed so that with shaft **8***m* rotating at its operating speed it continually slips during the acceleration period of flywheel **40** causing the flywheel to accelerate at a much slower rate than shaft **8***m* so that the additional torque imposed on the motor because of the flywheel does not exceed a small percentage of the total motor torque. In one preferred design this additional torque is about 10% of the total motor torque, although it is to be understood that this is a function of the particular clutch and may be varied by varying the clutch proportions.

This flywheel-centrifugal clutch combination greatly reduces the effect of the inertia of flywheel **40** when starting motor M and permits the use of the standard motors used with pulverizing mills without necessitating an increase in the heat dissipating capacity of the motor by enlarging the frame or providing auxiliary cooling means.

When it is necessary to transfer motor M from one energizing source to another in a conventional power plant hook-up the transfer necessitates a delay of approximately four seconds during which time the motor receives no current. With this type of mill herein illustratively disclosed an absence of power supply to motor M for much greater than a half a second will cause unsatisfactory operation of the mill and a delay of four seconds will, in all probability, result in extinguishing the fire within the furnace being supplied by the mill. Thus, in the organization of the present invention when the power supply to motor M is interrupted flywheel **40** because of its inertia will attempt to rotate faster than shaft **8***m* causing engagement of clutch **36**. With clutch **36** engaged the inertia of the flywheel will prevent the rotative speed of shaft **8** and bowl **9** from decreasing to any appreciable extent during the limited interruption of the power supply thereby maintaining proper operation of the mill during the aforementioned transfer from one power supply to another.

While I have illustrated and described a preferred embodiment of my novel pulverizing mill organization it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of my invention.

What I claim is:

1. Apparatus of the type described comprising in combination an electric motor connected to a pulverizing mill to drive the same, a shaft connected to and rotated by said electrical motor about its axis in a predetermined direction, a flywheel rotatably mounted on said shaft, a centrifugal clutch secured to said shaft and having radially movable shoes engageable with a cylindrical surface formed on said flywheel concentric with said shaft upon radial outward movement, said shoes being proportioned so that they will slip sufficiently to cause the flywheel to accelerate sufficiently slowly compared with the acceleration of the motor and the mill so that only a small percentage of the torque developed by the motor is applied to accelerating the flywheel, and a unidirectional clutch secured to said shaft and operatively associated with said flywheel to prevent the flywheel rotating relative to the shaft in said predetermined direction while permitting relative rotation in the opposite direction.



2. Apparatus as defined in claim 1 wherein the percentage of the motor developed torque applied to accelerate the flywheel is in the order of ten percent.

3. A pulverizing mill of the type described comprising in combination a housing, means within said housing for pulverizing material and including a motor driven rotating member of relatively small mass, driving mechanism for said rotating member including a motor, flywheel means connected to said drive mechanism and including a shaft rotated in a predetermined direction by said drive mechanism, a flywheel rotatably mounted on said shaft, a centrifugal clutch secured to the shaft and having a radially movable shoe engageable with a concentric cylindrical surface formed on the flywheel upon outward radial movement, and unidirectional clutch means secured to said shaft and operatively associated with the flywheel to prevent the flywheel rotating relative to the shaft in said predetermined direction while permitting said flywheel to rotate relative to said shaft in the opposite direction.

4. In an organization of the type described the combination of a work performing machine having a movable portion of relatively low inertia driven by an electric motor, flywheel means operatively associated with said motor and including a shaft rotated in a predetermined direction about its axis by said motor, a flywheel rotatably mounted on the shaft, a centrifugal clutch secured to said shaft within a concentric cylindrical surface formed on the flywheel and having centrifugally operated members movable outwardly into frictional contact with said surface, said clutch being proportioned so that it slips during acceleration of the flywheel sufficiently to maintain the percentage of the torque developed by the motor and applied to the flywheel during starting of the machine relatively low, a unidirectional clutch secured to said shaft including a member having a surface disposed immediately adjacent a surface formed on the flywheel, one of said surfaces having a relieved portion which cooperates with the other surface to form a wedge-shaped slot tapering so that it decreases in depth generally in the predetermined direction of rotation of the shaft, and means disposed within said slot operative to prevent the flywheel rotating relative to said member in said predetermined direction while permitting said flywheel to rotate relative to said member in the opposite direction.

5. In combination, a pulverizing mill including a housing with a driven member disposed therewithin, driving mechanism for said member including a motor, flywheel means connected to said driving mechanism and including a shaft rotated in a predetermined direction by said driving mechanism, a flywheel rotatably mounted on said shaft, means associated with said shaft and flywheel and constructed and arranged to cause said shaft and flywheel to rotate together but said flywheel to accelerate at a slower rate than said shaft upon initial activation of said driving mechanism, and unidirectional clutch means secured to said shaft and operatively associated with the flywheel to prevent the flywheel rotating relative to the shaft in said predetermined direction while permitting said flywheel to rotate relative to said shaft in the opposite direction.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 707,389 | Churchward | Aug. 19, 1902 |
| 1,955,960 | Hirsch | Apr. 24, 1934 |
| 2,159,429 | Dunn et al. | May 23, 1939 |
| 2,529,919 | Cunningham | Nov. 14, 1950 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 410,252 | Great Britain | May 17, 1934 |