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METHOD OF STARTING CRUSHERS

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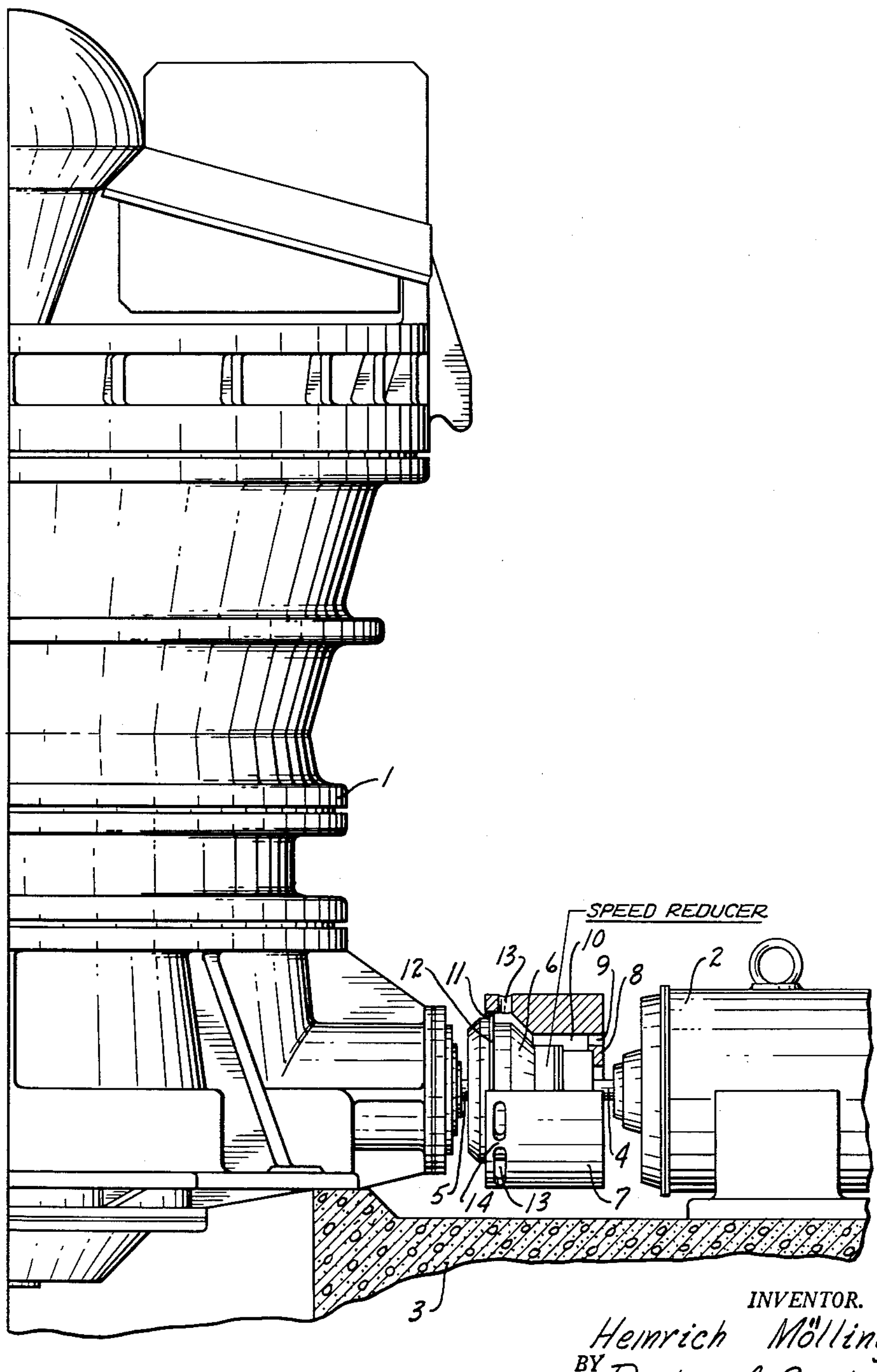

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METHOD OF STARTING CRUSHERS

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2 Claims. (Cl. 241—30)

This invention relates to a means for and method of starting gyratory crushers or the like, and is particularly adaptable for starting crushers loaded with crushing materials.

Under normal operating conditions, crushers are allowed to run empty before they are stopped, which means that for a certain period before stopping there will be no crushing materials fed to the machine. This is done so that when the crusher is restarted, the drive motor, used with the crusher, will only have to overcome the inertia of the crusher and the bearing friction of the moving parts.

If the driving motor is an electric motor, there will be instances when the crusher will be stopped with a full load because of a power failure or similar malfunction of the electric system. In such a situation the crushing cavity will be loaded with crushing material, and as a consequence, much greater starting power or starting torque will be needed to restart the crusher than if it was being started empty. In order to provide the higher starting torque needed it would be possible to use a motor with a much higher torque, but this has been found to be inefficient because under normal operating conditions such a motor would be operating at a relatively poor efficiency. Under present practice, if a crusher is stopped during operation it becomes necessary to empty the crushing chamber before restarting. This requires a considerable period of time with resulting high labor cost, and additionally requires the crusher to be inoperative for a time causing a delay in production.

It is one object of this invention to provide a means for starting a gyratory crusher or the like when the crushing chamber is full.

Another object of the invention is to provide a high torque starting system for a gyratory crusher or the like.

A further object is to provide a high torque starting system for a gyratory crusher, which system is only used to start the crusher when loaded.

Other objects will be apparent from the following specification, drawing and claims.

The invention is illustrated more or less diagrammatically in the accompanying drawing wherein **1** indicates the outer casing of a conventional gyratory crusher or the like, which is mounted on a foundation **3**. A drive motor **2**, for example an electric motor, is also shown mounted on the foundation **3**. Projecting outward from the drive motor is a shaft **4** upon which is mounted a speed reducer **6**. Various forms of speed reducers have been found to work satisfactorily, for example, a fluid coupling or a centrifugal coupling may be used. The speed reducer has been shown diagrammatically as the details of it form no part of the present invention.

Projecting outward from the base of the crusher is a shaft **5** which is connected to the other end of the speed reducer **6**. A flywheel mass **7** is shown concentric with the speed reducer and spaced outwardly therefrom so as to form an air gap **10** between the speed reducer and the mass. The particular form of the flywheel mass is not essential to the invention as there are many sizes, shapes and forms of the mass which will work satisfactorily. For example, the drawing shows a single cylindrical mass concentric with and disposed around the speed reducer, but for some size crushers it has been found that a plurality of individual masses each concentric with the speed reducer works more satisfactorily. Similarly, a flywheel mass mounted on and concentric with the drive motor is satisfactory. The flywheel mass is supported on the speed reducer at one end by means of a ring **8**, and stays **9** interposed between the ring and the mass. The other end of the mass is supported on the outer periphery or bearing surface **11** of a tie member **12**, the tie member being a part of the outer casing of the speed reducer.

In order to reduce the heat of the speed reducer a plurality of slots **13** have been formed in one end of the flywheel mass. Between adjacent slots are stays **14** which provide a blower-like effect and draw air out through the slots **13**, the air being drawn through the space between the stays **9**, into the air gap **10**, and out of the slots **13**.

The use, operation and function of the invention is as follows:

Under normal operating conditions crushers of the gyratory type are started with no crushing material in the crushing cavity. However, at times, it becomes necessary, due to a malfunction in some part of the drive system, to start the crusher with the crushing cavity full. In order to overcome the high starting resistance or high inertia of a loaded crusher a very high starting torque must be provided. It is possible to use a motor having a very high torque, but this is found to be inefficient because under normal operating conditions such a motor would be operating at low efficiency.

In order to efficiently provide a high starting torque, an additional flywheel mass, in the preferred form mounted on and concentric with a speed reducer, has been provided. A flywheel mass constructed in accordance with the invention may have a moment of inertia approximately five times greater than the moment of inertia of the drive motor. Such a flywheel mass may be permanently connected into the starting system or it may be connected only when starting under a heavy load. If the mass is designed to be permanently connected into the system the speed reducer should be constructed to have a minimum slip of 20% to produce a torque of from 2 to 10 times, preferably 7 to 10 times, greater than the normal operational torque. This type of speed reducer is overdimensioned in such a manner that there would be minimal slip during normal operating conditions so that the energy load of the speed reducer on the drive motor would be very small. Such a slip also would provide protection for the drive motor against sudden changes in speed. The disadvantage of such a speed reducer is that the additional weight of the flywheel places a strain on the bearings. Therefore it has been found to be advantageous to connect the flywheel mass only when starting under heavy load. The flywheel mass could rest on a bearing block and be shifted into position by means of a claw type coupling.

In the drawing, the flywheel mass is shown as a single cylindrical member. It should be understood that the size, shape and number of masses may be adapted to meet the size of the crusher. For example, when very large crushers are used, it has been found necessary to separate the flywheel mass into a plurality of masses, each one operatively connected by a suitable coupling device, in order not to place a strain on the motor. The plurality of masses can be placed side by side or could be positioned on top of each other, and are arranged to be successively connected to the motor.

The speed reducer, which has been shown diagrammatically, can take numerous forms. For example, a fluid coupling is satisfactory as is a centrifugal coupling or a claw type coupling. The details of the coupling have not been shown as they form no part of the present invention. It has also been found to be advantageous to provide a gearing mechanism associated with the speed reducer which will increase the speed of the flywheel so as to provide more starting power.

In the preferred form the drive motor and rotating flywheel mass are not connected to the crusher until the crusher is to be started under heavy load. The drive motor is started and when it has reached full speed it is coupled to the stationary flywheel mass. The flywheel mass and motor are then brought up to maximum speed at which point they are coupled through a speed reducer to the gyratory crusher. The high inertia or high starting resistance of the loaded crusher tends to retard or slow down the flywheel mass, which retardation in turn provides kinetic energy to move the crusher. The flywheel mass will continue to provide kinetic energy until the crusher comes up to speed. Once the crusher is started it is quickly emptied and no new material is fed into it. The crusher is then ready to return to normal operation.

When the drive system includes a plurality of rotating flywheel masses, the operation is similar to that described above, except that each mass is successively coupled to the motor. After each mass and the motor are brought up to speed, a new mass is coupled, and that in turn is brought up to speed. When all the flywheel masses and the motor are rotating at maximum speed the system is coupled to the crusher, the high torque combining with the torque from the drive motor to overcome the inertia of the crusher.

Normally the heat generated by the retardation of the flywheel mass and motor is not excessive. However, temperature controls for the motor and speed reducer can be provided if it is necessary. One form of cooling device for the speed reducer is shown in the drawings wherein the rotating mass and the speed reducer have an air gap formed therebetween. Air is drawn into one end of the gap and is forced out the other end, the passage of the air having a cooling effect on the machinery.

The specification and drawing should be taken as broadly illustrative and diagrammatic. As many variations and modifications of the size, shape, and disposition of parts can be made without departing from the scope of the invention, the invention should only be limited by the following claims.

I claim:

1. A method of emptying a gyratory crusher which has stalled in a load condition utilizing its normal source of driving power, said source having a power output shaft constructed and arranged to provide rotary impetus to the crusher, said method including the steps of bringing the normal power source of the crusher up to substantially normal operating speed while disengaged from the crusher, selectively coupling a mass to the output shaft of the normal source of power to thereby increase the starting torque available to the crusher, generating a temporarily increased starting torque by increasing the speed of the shaft and coupled mass to at least a normal operating speed, applying the temporarily increased starting torque to the crusher to thereby overcome the stalling forces in the crusher, operating the crusher for a time sufficient to clear the crusher of any contained material, shutting down the crusher after the contained material has cleared the crusher, and disengaging the coupled mass to thereby enable the crusher to resume normal operation under a normal starting torque.

2. A method of emptying a gyratory crusher which has stalled in a loaded condition utilizing its normal source of driving power, said source having a power output shaft constructed and arranged to provide rotary impetus to the crusher, said method including the steps of bringing the normal power source of the crusher up to substantially normal operation speed while disengaged from the crusher, selectively coupling a mass consisting of individual increments of mass to the output shaft of the normal source of power to thereby increase the starting torque available to the crusher, generating a temporarily increased starting torque by increasing the speed of the shaft to a substantially normal operating speed after each increment of mass is coupled to the shaft until a temporarily increased starting torque is obtained, applying the temporarily increased starting torque to the crusher to thereby overcome the stalling forces in the crusher, operating the crusher for a time sufficient to clear the crusher of any contained material, shutting down the crusher after the contained material has cleared the crusher, and disengaging the coupled mass to thereby enable the crusher to resume normal operation under a normal starting torque.

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