PC3 Indeling gewijzigd B02C 1/04, B02C 1/02 E21C 27/30. E.P. 15992

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification: B02C 1/04, 1/02	A1	(11) International Publication Number: WO 79/01060
		(43) International Publication Date: 13 December 1979 (13.12.79)

(21) International Application Number: PCT/US79/00315

(22) International Filing Date: 11 May 1979 (11.05.79)

(31) Priority Application Number: 904,906

(32) Priority Date: 11 May 1978 (11.05.78)

(33) Priority Country: US

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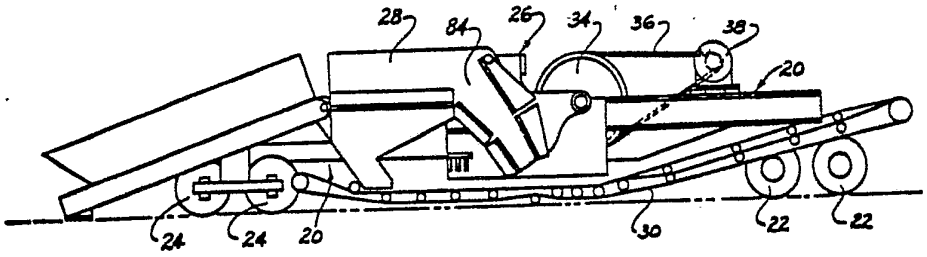
(81) Designated States: AT (European patent), DE (European patent), FR (European patent), GB (European patent), JP, SE (European patent).

Published with:
International search report

(54) Title: LOW PROFILE CRUSHING APPARATUS



(57) Abstract

An apparatus for crushing mine ore or hard rock primarily for initial reduction for transport of the material for further processing which is characterized by an extremely low vertical profile relative to its size and capacity. The crushing jaws (26) which form the crushing chamber (84) are uniquely arranged in an inclined relationship with the lower jaw (60) mounted for eccentric movement relative to the upper jaw (39) which is stationary to provide efficient crushing action and efficient movement of the crushed material through the chamber (84) while also permitting the associated inlet feed apparatus (28) to be disposed at a low attitude. Means (48 and 50, and 64, respectively) are included to provide for varying the size of the discharge opening (85) and for varying the action of the moveable crushing jaw (60) to permit greater versatility in the proper processing of a given material.

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LOW PROFILE CRUSHING APPARATUS

TECHNICAL FIELD

The present invention relates generally to a hard rock crushing apparatus and particularly to a novel, portable, low head room or low profile crusher for primary reduction of ore or hard rock close to the active working areas in underground mining operations.

BACKGROUND ART

Particularly as applied to underground mining operations, a reliable, efficient and low profile portable underground hard rock crusher has long been needed to improve underground ore handling systems. One of the primary causes of low productivity in underground mines is the inefficient ore handling which is currently experienced.

Studies sponsored by the United States Bureau of Mines (USBM) have documented the long-felt need for such a crushing apparatus which would make possible more efficient use of currently operated conveyor systems by bringing haulage closer to the face of the mine and eliminate expensive rock handling procedures. It has been estimated that as much as a 50% increase in productivity could be realized if primary reduction crushing apparatus could be employed at an earlier stage to permit smaller beltable material to be available close to the working site.

Present crushing apparatus having the required capacity for primary reduction application in this area are not easily transported and require too much head space for economical installation close to working areas to obtain optimum haulage from the face to the dump locations.

Prior art hard rock crushers which are currently well-known in the industry and used in hard rock crushing applications, such as the gyratory, Blake type, overhead eccentric and cone crushers, all have relatively high profiles for comparable capacity ranges to be employed to appropriately solve the ore handling problems facing the industry.

It has also been noted in a government sponsored study, the Rapidex report under USBM Contract No. JO285003 that an eccentric jaw crusher with overhead feed is unsuitable and that apparent use of an eccentric jaw crusher which has been turned on it's side for horizontal feed through the crushing chamber is not suitable due to the difficulty of conveying the material through the chamber and the need for a chain conveyor disposed near or adjacent to the length of the crushing chamber.

Other types of prior crushing apparatus which are of low profile design are not suitable for hard rock applications or do not possess the required size and throughput capacity for practical use in such applications. According to the same study, a rotary type jaw crusher has been proposed to attempt to meet the needs mentioned above. However, as compared to the present invention, I believe that such a crusher has serious limitations in the context of the applications described above which will render such a crusher less satisfactory than the present invention.

SUMMARY OF INVENTION

The present invention is characterized by its novel crushing jaw design which combines eccentric crushing action and a lower feed inlet in an efficient space-saving construction which provides comparable capacity in a much lower head room design in a reliable, efficient rock crusher. This low profile is achieved by a novel arrangement of the crushing jaws and the attendant arrangement

of the remaining necessary components.

In the present invention, unlike prior art eccentric crushers, the crushing jaws are inclined to form an inclined crushing chamber sloping downwardly from inlet to discharge with the lower jaw being movable to impart the crushing action between it and the stationary upper jaw.

This arrangement of the jaws provides a powerful and most efficient crushing of material while maintaining very adequate feeding of the material through the crushing chamber.

Additionally, the arrangement of the crusher jaws in this manner permits the attendant eccentric shaft, drive means, and movable jaw support to be positioned in a lower profile manner on the frame as well as reduce the height at which the conveyor system feeds the inlet of crusher chamber to permit the feeding system to be mounted at a lower position on the frame.

It is a primary object, therefore, to provide a portable, low head room, hard rock crusher which has a dramatically reduced profile compared to prior art apparatus suitable for use in underground mine applications, but which has a crushing chamber capacity comparably equal to prior art crushers which require significantly greater head room than required by apparatus constructed in accordance with the present invention.

It is another object of the present invention to provide an apparatus of the type described which may be more easily and efficiently transported from site to site compared to prior art hard rock crushers.

It is a further object of the present invention to provide an apparatus of the type described which includes the aforementioned features and yet is of comparable ease to manufacture and maintain relative to prior art hard rock crushers.

It is still another object of the present invention to provide an apparatus of the type described which may be advantageously utilized much closer to the working areas of underground mines for greatly improving ore handling and production in such mines.

It is another object of the present invention to provide an apparatus of the type described wherein the disposition of the moveable jaw and its associated eccentric drive means not only contributes to the lower head room requirement but further assures efficient transport of the crushed material from the crushing chamber inlet to the discharge opening.

Further objects and advantages of the present invention will be apparent from the following description, references being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevational view of a portable hard rock, low profile crusher apparatus construction in accordance with the present invention and shown with associated feed and discharge conveying systems;

Figure 2 is a partial side elevational view of the apparatus shown in Figure 1 illustrating the eccentric driven crushing jaw means and crushing chamber shown apart from the associated main frame and assessory equipment; and

Figure 3 is a top plan view of substantially that portion of the apparatus shown in Figure 2.

DETAILED DESCRIPTION

A portable, low profile, hard rock crushing apparatus constructed in accordance with the present invention is illustrated in Figure 1 and includes a main frame, indicated generally at 20, which is supported for movement by several pair of conventional wheel means such as at 22 and 24.

The crushing portion of the apparatus, indicated generally at 26, is centrally located on the frame adjacent to a conventional feed conveyor system 28 and above a discharge conveyor system 30. The feed and discharge conveyor system are of conventional nature and a variety of standard types could be employed within the context of the present invention. Further, a typical scalping mechanism is usually included to remove fine or the like prior to entry into the crushing chamber.

An eccentrically mounted shaft means 32 is operatively connected to a pair of fly wheels, such as at 34, which in turn is driven via a belt drive 36 connected to a conventional motor 38. Each of these components may be mounted on the frame in any conventionally suitable manner.

Now referring specifically to Figures 2 and 3, the crushing apparatus 26 is shown in greater detail and includes a stationary jaw means, indicated generally at 39, which includes supporting frame 40 mounted for pivoted movement at its upper end via a shaft 42, which in turn, is supported at each end to main frame 20 in a conventional manner. A replaceable jaw liner 44 comprising a highly wear resistant material, such as manganese for example, is releasably fixed to supporting frame 40 by means of threaded wedge-like member 46.

The lower end of the stationary jaw means is releasably fixed in position by a toggle arrangement 48 provided with a series of shims 50 which may be easily used to adjust the position of frame 40 pivoted about shaft 42 to vary the discharge opening between the jaws.

Toggle arrangement 48 is held in place by means of a plurality of rods 52 pivotally mounted to flanges, such as 54, carried by support 40 and provided with a threaded end 56 carrying a nut 58 extended through a suitable hole in main frame 20. By simple manipulation

of nuts 58 and shims 50, jaw means 39 may be pivoted and locked into a new position.

It should be pointed out that stationary jaw means 39 is inclined relative to the horizontal, sloping downwardly from the feed inlet of the crushing chamber of the discharge outlet.

A moveable jaw means, indicated generally at 60, includes a supporting frame or pitman 62. The upper end of pitman 62 is supported by a toggle arrangement indicated generally at 64, located beneath the feeder end. The upper and lower ends are attached to a tube-like support 66 provided with eccentric bearings 68 mounted on eccentric shaft 32.

A pair of main frame bearings 70 are mounted on the main frame and connected to shaft 32. Each end of shaft 32 is mounted to a fly wheel 34 provided with counter weights to offset the unbalanced weight of pitman 62.

One of fly wheels 34 is connected to a conventional electric motor 38 via belt drive 36 to provide rotary power to shaft 32.

It should be pointed out that pitman 62 includes side plates 74 and the extended collar-like portion 76 which is connected to tube-like support 66 such that the eccentric motion of shaft 32 is imparted to pitman 62 and the replaceable jaw liner 77 mounted thereon by a removable threaded wedge-like member 78.

It is desirable to provide detachable wear plates such as 80 to each of the side plates to pitman 62 in view of the abuse normally encountered in the crushing chamber during operation.

The moveable jaw means 60 is also disposed in an inclined position with the upper end adjacent to the feed inlet 82 of the crushing chamber 84 defined between the respective jaws and the pitman side plates.

The lower end of chamber 84 includes a discharge opening 85 for the processed material which falls to the discharge conveyor 30.

Toggle arrangement 64 includes an adjustable and replaceable toggle seat 65 mounted on a cross member 67 fixed to the main frame.

Another replaceable toggle set 69 is provided at the top end where it is connected to pitman 62. It may be desirable to provide for positive retention of toggle 64 in seat 69 by means of a releaseably mounted spring or the like to prevent inadvertent unseating of the toggle during adverse operating conditions.

By adjustment of the position of toggle arrangement 64, the motion of the feed end of jaw means 60 may be varied according to the most desirable action for a given crushing application.

Further, both toggle arrangements 48 and 64 serve as a safety mechanism as they may be designed to break should uncrushable material enter chamber 84. Being easily replaceable and relatively inexpensive, this provides a safety factor for preventing more serious damage to the other components which represent more difficult and expensive repair or replacement.

CLAIMS

1. An improved low profile crushing apparatus for mine ore or hard rock comprising, in combination, a base means; a first crushing jaw means mounted in a releasably fixed position on said base means in a vertically inclined position; a second crushing jaw means mounted on a support means and disposed below and spaced from said first jaw means in a similar vertically inclined position to define a crushing chamber between said respective jaw means and said support means, said support means being movably mounted on said frame means; eccentric drive means mounted on said frame means and operatively connected to said support means carrying said second jaw means to impart repetitive predetermined motion to said second jaw means relative to said first jaw means; feeding means mounted adjacent to said crushing chamber to feed material into the upward portion of said chamber and means mounted adjacent to the lower end of said crushing chamber to collect and transport material passing through said crushing chamber.

2. The apparatus defined in Claim 1 wherein the uppermost portion of said second crushing jaw means is disposed lower than the uppermost portion of said first jaw means to define said crushing chamber inlet and wherein the upper portion of said material feeding means is disposed at a height not substantially higher than the uppermost portion of said first jaw means.

3. An apparatus crushing mine ore or hard rock comprising, in combination, a base frame means; a pair of crushing jaw means mounted on said frame means in spaced relationship to one another to define a crushing chamber, said jaw means being inclined in the same direction relative to the vertical to define an inclined passageway through the crushing chamber having discharge opening being disposed lower than the feed opening, the lower one of said jaw means relative to ground level being mounted

to an eccentrically moveable support operatively mounted on said base frame means; means for conveying chamber mounted adjacent to the upper end of said crushing chamber and means mounted adjacent to the lower end of said crushing chamber for collecting and conveying material passing through said chamber.

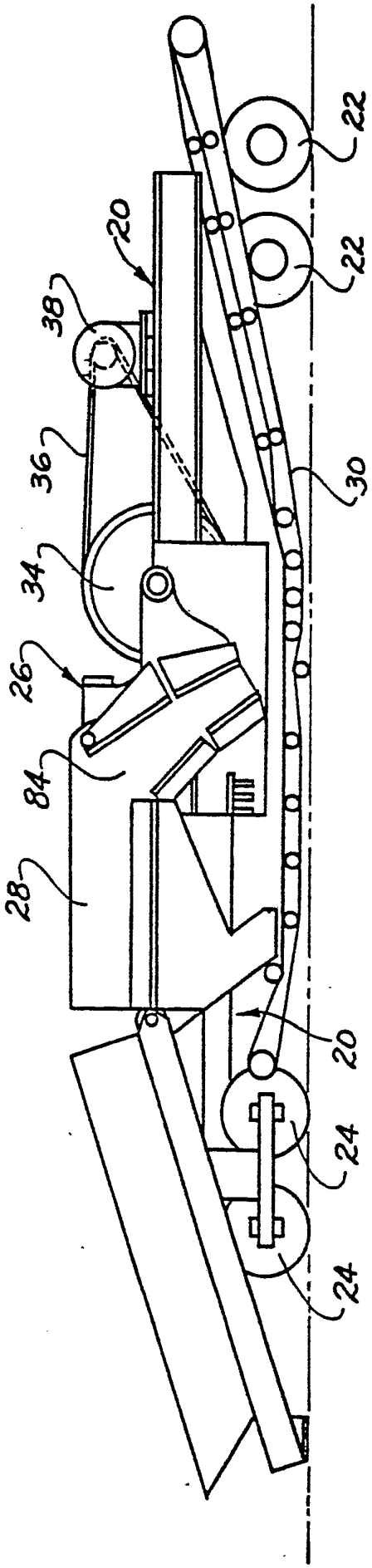

FIG. 1.

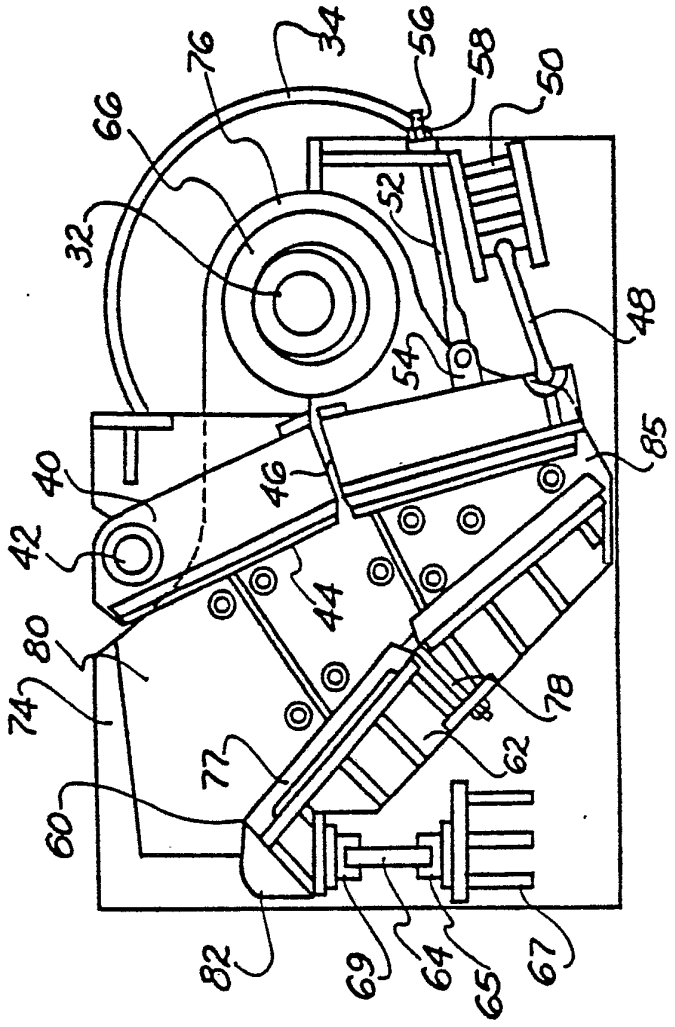

FIG. 2.

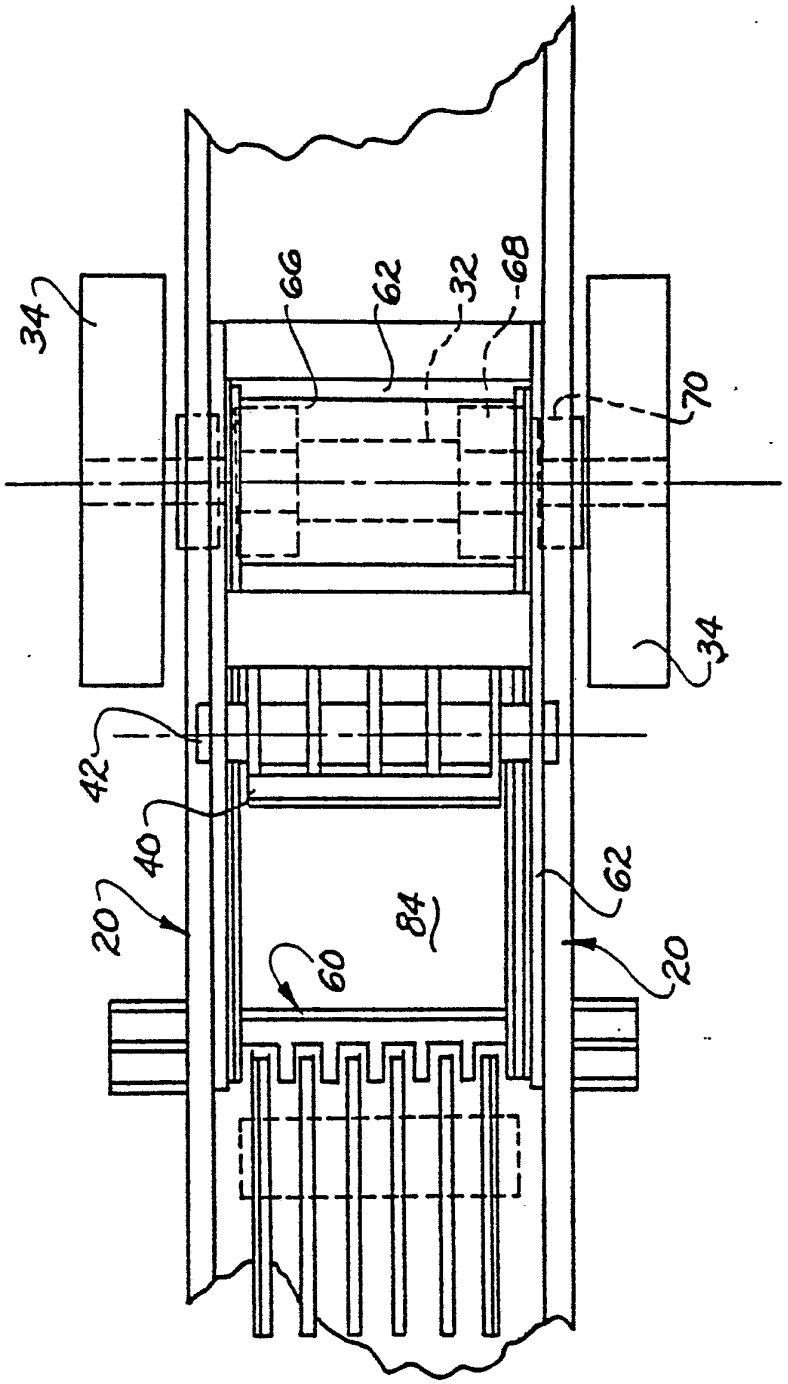

FIG. 3.

INTERNATIONAL SEARCH REPORT

WO 79/01020

International Application No PCT/US79/00315

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. B02C 1/04 1/02

U.S. CL. 241/264

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
U.S.	241/264

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	US, A, 2,873,922 PUBLISHED 17 FEB. 1959 FAHRENWALD	1-3
A	US, A, 3,386,667 PUBLISHED 04 JUNE 1968 MAY	1-3
A	US, A, 3,946,955 PUBLISHED 30 MARCH 1976 BOND	1-3
A	US, A, 3,804,345 PUBLISHED 16 APRIL 1974 DE DIEMAR	1-3
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IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
16 AUGUST 1979	22 AUG 1979
International Searching Authority [1]	**Signature of Authorized Officer [19]**
ISA/US	Richard Bernard Lazarus

RICHARD B. LAZARUS
EXAMINER
GROUP ART UNIT 322

Form PCT/ISA/210 (second sheet) (October 1977)