Figure 2

Figure 3
This invention relates to improvements to skip hoists used for sinking mine shafts. It is particularly directed to an improved crosshead apparatus for skip hoists.

A common preliminary phase of mine development is the sinking of mine shafts to provide access to an ore body. Of the shaft sinking operation, a major and time consuming phase involves the loading and hoisting of broken rock and earth materials from the bottom of the shaft to the surface in skips or other receptacles such as buckets, said receptacles herein being referred to generically as skips throughout the specification for convenience of description. In the hoisting and lowering of skips in the process of sinking shafts, each skip is normally coupled to a crosshead which serves to steady and guide the skip in its upward and downward travel in the shaft and permits disengagement of the skip therefrom for loading broken rock at the bottom of the shaft.

To accomplish loading of the skip, the skip is lowered below the lowest set of frame timber to the bottom of the shaft, usually a distance of, for example, about 30 feet, while the crosshead is suspended on support members at a level in the shaft at a point above the skip, the skip thus being temporarily freed from the restraining and controlling influence of the crosshead. In the subsequent hoisting of the loaded skip, the skip must be re-engaged with or coupled to the crosshead for vertical travel in the timbered portion of the shaft. My invention provides positive and reliable means for locking the crosshead to the support members and for guiding the skip in its travel below the crosshead such that the skip is quickly and positively coupled to the crosshead after loading for travel together in the shaft above said support members.

Conventional crossheads and skips require the time consuming and expensive installation of guide rolls for rapid hoisting within the shaft. The embodiment of my invention illustrated herein incorporates a pair of guide cables for guiding the crosshead and skip for rapid hoisting within the shaft with or without conventional shaft guides.

Also, a disadvantage inherent in some skip hoisting devices is that the headframe must be of sufficient height to accommodate the length of the cable allowed for lowering the skip below the crosshead together with allowance for the height of the dumping scows above the ground surface level and other like considerations. Thus in practice the headframe must be upwards of 50 to 60 feet in height necessitating considerable lateral support and complex and expensive structures to carry wind and working loads. Since in preliminary development shaft equipment is normally of a temporary nature, the structural and erection costs of head frames are important considerations in the formulating of development plans. Thus reductions in costs as provided by the present invention can be of considerable significance in the overall development of ore bodies for mining purposes.

I have found that the above disadvantages can be substantially obviated by the use of the improved crosshead of the present invention. My invention comprises, briefly, an improved crosshead adapted, when the skip is being lowered to its loading position, to lock down automatically in positive engagement with cross-members of the lowermost shaft timber set or other supporting members near the shaft bottom while simultaneously releasing the skip in order that it may be lowered for loading the broken rock, or muck, at the bottom of the shaft. As the skip is raised from the muck pile, it is automatically guided into and positively engaged with the crosshead while the cross-member engaging mechanism referred to above is simultaneously released. The crosshead is adapted to guide and steady the skip in order to permit hoisting with speed to the surface with or without shaft timbering and conventional guides. Also, a cable and pulley system incorporated with the crosshead shown permits a substantial reduction of approximately ½ in the height of the headframe, thereby permitting an advantageous economy in the erection costs of headframes.

It is, therefore, a principal object of the present invention to provide a crosshead which permits and facilitates the positive engagement and disengagement of a skip with the said crosshead simultaneously with and controlled by the interaction and engagement of the crosshead with stationary support members.

A further important object of the present invention is to provide a crosshead apparatus which utilizes means for minimizing the necessary height of headframe structures and hence makes practicable its use with portable headframe constructions while reducing erection costs of conventional headframes.

A further object of the present invention is to provide a crosshead apparatus that is simple in construction and positive in operation to permit safe and substantially trouble-free operation.

A still further important object of this invention is to provide a crosshead apparatus which effectively stabilizes the skip and counters any tendency it may have to swing or rotate within the mine shaft.

An understanding of the manner in which the above and other objects of the present invention can be obtained may be had from the following description, reference being made to the accompanying drawings, in which:

FIGURE 1 is a perspective view of the crosshead which incorporates the features of the present invention shown in a stationary, supported position disengaged from the skip;

FIGURE 2 is a side view of the crosshead, partially cut away, showing, in greater detail, the arrangement and disposition of the various parts of the latching mechanism with the crosshead in a stationary supported position;

FIGURE 3 is a side view of the crosshead, partially cut away, showing the arrangement and disposition of the various parts of the latching mechanism with crosshead and skip locked together for travel in a vertical plane up or down the frame;

FIGURE 4 is a section taken on lines 4—4 of FIGURE 3;

FIGURE 5 is a bottom view of the crosshead with crosshead and skip in the engaged position;

FIGURE 6 is a section taken on lines 6—6 of FIGURE 3; and

FIGURE 7 is a perspective view, partly cut away, of the hoisting apparatus used for raising and lowering the skip and crosshead.

Like reference characters refer to like parts throughout the description and drawings.

Referring to FIGURE 1, the numeral 11 generally designates the crosshead of the invention having an elongated rectangular housing 12. In its stationary position, crosshead 11 is supported at each end by rigid lateral support members 13—13a. In this position, crosshead 11 is restrained from vertical movement in either direction by means of upper support shoulders 14 of housing 12, which bears upon members 13—13a, and by means of retractable latches 15—15a, which in their extended position, underlie
support members 13–13a, as shown. Support members 13–13a may be the crossbeam members of the lowermost shaft timber set, or stationary supports affixed to the shaft walls, or the framework of a shaft mucking machine, as described in my United States Patent No. 3,123,240 entitled Portable Shaft Sinking Assembly issued Mar. 3, 1964.

In the particular crosshead embodiment herein described, a main pivotal member 16 is rotatably mounted in housing 12, intermediate the ends thereof. As shown in FIGURES 2, 3 and 5, wheel 16 is provided with a claw member 18, rigidly mounted thereon as at 18a, the purpose of which will become apparent as the description proceeds. Also mounted on wheel 16 is a pin 19 which projects through, and is adapted to travel in, aruncate slot 21 formed in sidewall 20 of housing 13.

A pair of L-shaped trip arms 22 and 23 are mounted on sidewall 20, the outer ends of which are substantially co-extensive with support shoulders 14 of housing 12. Adjacent their outer ends, trip arms 22 and 23 are each pivotally mounted in a pair of rollers 24–24a. The inner L-shaped ends of arms 22 and 33 overlie one another and are provided with elongated slots 25 which are aligned with slot 21 and are adapted to accommodate pin 19 for slidable travel therein.

The outer ends of trip arms 22 and 23, as shown in more detail in FIGURE 2, are undercut to define inwardly directed upwardly inclined support-engaging surfaces 26 and 27, the purpose of which will be described hereinafter.

Retractable latches 15–15a are mounted on wheels 25–28a for travel along rails 29. Latches 15–15a are also provided, at their outer, upper corners, with rollers 30–30a which facilitate travel of the latches along the undersurfaces of members 13–13a. Latches 15–15a are connected to wheel 16 by means of connecting links 31–31a which are pivotally secured to latches 15–15a at 32–32a and to wheel 16 at substantially diametrically opposed points 33–33a adjacent the periphery thereof.

Referring to FIGURE 5, latches 15–15a are provided with openings 34–34a which permit the passage of cables 43–43a therethrough. The width of openings 34–34a is a maximum at the inner ends of latch 15–15a and gradually tapers to a minimum width, as shown, towards the center of the latches. The purpose of this configuration is described hereinafter.

An actuating lever for the crosshead mechanism, generally designated by reference numeral 35, is mounted on the lower part of housing 12 and comprises a pair of elongated members 36–36a pivotally mounted on the sidewalls of housing 12 at 37–37a. A shaft 38 extending between the free ends of members 36–36a is adapted to rotatably support a roller 39 between the side walls of housing 12. A link 40 is pivotally mounted at one end on shaft 38 and at its other end on wheel 16 at 41. The operation of actuating mechanism 35 is described in detail hereinafter.

Referring again to FIGURE 1, a conventional skip 42, preferably of rectangular configuration, as shown, is suspended from crosshead 11 by means of a pair of cables 43–43a, which are rigidly anchored at one end to the roof 44 of crosshead 11 as at 45. Cables 43–43a pass over pulleys 46–46a carried by bridge 47, through guideways 48–48a in crosshead 11 and apertures 34–34a in latches 15–15a, and are rigidly secured, at their lower ends, to pivotal connections 49–49a on skip supports 50–50a.

Cables 43–43a are provided with torpedo stops 51–51a rigidly mounted thereon adjacent pivotal connections 49–49a. As shown in FIGURE 3, housing 12 embodies a pair of cavities 52–52a aligned with guideways 48–48a and located intermediate of latches 15–15a and guideways 48–48a. Cavities 52–52a are of a size and configuration adapted to accommodate torpedo stops 51–51a and to restrain them from further upward movement relative to crosshead 11.

Referring to FIGURE 1, a cross member 53 is rigidly mounted, at its ends, adjacent the upper ends of skip support arms 50–50a and at a sufficient height above skip 42 to permit the skip to be freely pivoted about pivotal connections 49–49a. A stud 54 carried on cross member 53 substantially centrally thereof has a locking pin 56 slidably mounted on the tip thereof. Locking pin 56 may, if desired, be spring loaded, as shown, to urge the pin into its normally extended position.

Referring to FIGURES 3 and 4, a socket 57 is formed within housing 12, with which stud 55 on member 53 is aligned. Socket 57 is adapted to receive locking pin 56 when the skip is raised to about the underside of crosshead 11. With particular reference to FIGURE 3, locking pin 56 and torpedo stops 51–51a are mounted in a spaced relationship such that when locking pin 56 has reached its position of accommodation within socket 57, stops 51–51a will have passed through apertures 34–34a of latches 15–15a and have been accommodated within torpedo cavities 52–52a.

Referring now to FIGURE 7, the raising and lowering of skip 42, crosshead 11, and its substationary, roller motor 58 through drum hoist 59, on which is wound main hoisting cable 60. As shown in FIGURE 1, cable 60 is secured, at its lower end 61, to bridge 47. The raising and lowering of the skip coupled with the crosshead above supports 13–13a can be guided by cables 62–62a which are wound on drum hoists 63–63a driven by motor 64 through a differential gear to exert tension on each cable. In development shafts which do not carry guide rails, guide cables of this type can be used to stabilize the movement of the crosshead and skip.

In the embodiment illustrated, cables 62–62a passing through guideways 66–66a formed at opposite ends of bridge 47 pass through guideways 71–71a formed at the opposite ends of bridge 47 and through guideways 71–71a formed at the opposite ends of crosshead 11 and are anchored in the crosshead supporting members 12–12a as at 67, as shown in FIGURE 2. Hoists 63–63a are employed to tension the cables and ratchet controls 68 are provided on drum hoists 63–63a to anchor the drums and to prevent cable slippage.

It will be appreciated that the dumping of skip 42 can be accomplished in any of a number of well known ways. For example, it might be effected by means of conventional scroll plates which engage guide shoes 74 and followers 69–69a aligned with the guide channels of the scroll plates for engagement therewith.

In operation, the raising and lowering of skip 42 beneath lateral support members 13–13a is achieved by main hoisting cable 60 raising or lowering bridge 47 and thereby acting through pulleys 46–46a and cables 43–43a while crosshead 11 is being held stationary on support members 13–13a between support shoulders 14–14a and extended retractable latches 15–15a. Crosshead 11 is held in this position until skip 42 is raised from a position below crosshead 11 to the point where cross member 53 contacts roller 29. As the upward movement of skip 42 proceeds, crosshead 11 and its associated cable 43–43a and shaft 38 approach housing 12, causing wheel 16 to be rotatably displaced in the direction of the arrow "X" in response to the motion imparted to it by link 40 mounted on shaft 38 while pin 19 on wheel 16 travels upwardly in slot 21. Approximately halfway through its travel in slot 21, pin 19 engages the upper ends of elongated slots 25 in trip arms 22 and 23 and rotates the inner ends of trip arms 22–23 in an upward direction by causing them to rotate about rollers 24–24a adjacent their respective outer ends until they have reached a substantially horizontal position, as shown in FIGURE 3. As trip arms 22–23 are being thus urged to a horizontal position, retractable latches 15–15a are retracted in response to the motion imparted to them through connecting link 31 until they are clear of supports 13–13a, as shown.
in FIGURE 3, thereby releasing crosshead 11 free for upward travel.

Simultaneous with the release of crosshead 11 from engagement with crosshead support 12-13a, the skip is simultaneously engaged with the crosshead, as shown in FIGURES 3 and 5. That is, the locking pin 26 has hardened its position of accommodation within socket 57, torpedo stops 51-55a will have cleared latches 13-15a and have been received within torpedo cavities 52-52a. Meanwhile, latches 15-15a will have been retracted to a position by the reduced diameter of tapered openings 34-34a effectively locking torpedo stops 51-55a in place and claw member 18 on wheel 16 will have been rotatably displaced to a position underlying locking pin 56, thereby effectively locking the crosshead and skip together at three points, such that the skip and crosshead are positively coupled together for travel in an upward direction in the shaft above supports 13.

As mentioned hereinbefore with reference to FIGURE 7, guide cables 62-62a tensioned by motor 64 through differential mechanism 65 and wound on drum 63-63a provide a guiding influence on the bridle and crosshead to prevent rotation or swinging of the skip as it travels in the shaft. Ratchet control mechanisms 68 are provided on drum 63-63a to prevent slippage of cables 63-63a and to ensure that the tension in cables 62-62a is substantially equalized. It is for stabilizing the travel of the skip within the shaft that guide cables can be mounted on the ends of bridle 47 and crosshead 11 and the guide wires omitted from the system. However, guide rails can be displaced by guide cables, and in development shafts of a temporary nature, especially in shafts sunk with the use of portable mucking machines, the use of guide cables is preferred for minimizing development costs.

Upon reaching the discharge point, the contents of skip 42 are unloaded by means of an upsweeping device such as the conventional scuff plate which engages guide shoes 76 and followers 69 mounted on the skip. Skip 42 and crosshead 11 are then lowered together. Upon reaching the lowermost timber set, trip arms 22-23 come into contact with supports 13-13a and, by virtue of the upward and inwardly inclined surfaces 26-27, trip arms 22-23 are caused to pivot about rollers 24-24a urging the skip and crosshead 11 upward and inward along a direction causing pin 19, in turn, to be forced downwardly in slot 21, thereby causing wheel 16 to be rotatably displaced in the direction of the arrow "Y." At the same time, latches 13-15a, by virtue of linkages 31, are moved to their extended positions underlying supports 12-13a, engaging locking pin 56, thereby causing torpedo stops 51-55a for downward travel through openings 34-34a. Also, claw member 18 on wheel 16 is rotatably displaced with wheel 16, freeing locking pin 56 on stud 55 for downward travel.

Skip 42 may then be lowered to the base of the mine shaft for re-loading and the hoisting operation is then repeated.

The present invention possesses a number of important advantages. The height of headframe housing the hoisting and control equipment can be materially reduced permitting, for example, the use of portable headframe equipment heretofore precluded because of excessive height and structural requirements. The skip can be positively engaged with the cross head member for high speed, safely guided travel within shafts with or without conventional guide rails. Also, the novel assembly permits reliable engagement of the crosshead with the shaft bulkhead or like supporting member together with concurrent, automatic release and re-engagement of the skip and crosshead for loading of the skip with broken rock at the shaft bottom.

It will be understood, of course, that modifications can be made in the preferred embodiment of the invention described and illustrated herein without departing from the scope of the invention defined by the appended claims. What I claim as new and desire to protect by Letters Patent of the United States is:

1. A crosshead for use in a mine shaft in combination with a skip, guide means extending from the upper extremity of said shaft to a point above the bottom of the shaft for guiding and stabilizing the travel of the crosshead within the shaft, and stationary support means disposed in the shaft at the level of the lower extremity of said guide means comprising, locking means carried by said crosshead for engaging said support means in positive locked engagement and for simultaneously disengaging the skip from the crosshead upon abutment of the crosshead with said support means in its downward travel, means for lowering the skip to the bottom of the shaft and for raising the skip to the crosshead, means actuable by abutment of the skip with crosshead during downward movement of the skip relative to the crosshead for releasing said locking means from engagement with the support means while concurrently positively coupling the skip with the crosshead for travel together in the guided portion of the shaft, and hoisting means for raising and lowering the skip and crosshead in the shaft.

2. An improvement in skip hoists for use in a shaft comprising, in combination, a skip, a crosshead, guide means extending from the upper extremity of said shaft to a point above the bottom of said shaft for guiding and stabilizing the crosshead within the shaft, stationary support means disposed in the shaft at the level of the lower extremity of said guide means, means carried by the crosshead for engaging said support means in positive locked engagement and for concurrently disengaging the skip from the crosshead by abutment of the crosshead with said support means during the downward travel of the crosshead, means for lowering the skip to the bottom of the shaft and for raising the skip to the crosshead, means actuable by the contact of the skip with the crosshead during the upward travel of the skip relative to the crosshead for disengaging the crosshead from its locked engagement with said support means while concurrently positively coupling the skip with the crosshead for travel together in the guided portion of the shaft, and hoisting means for raising and lowering the skip and crosshead in the shaft.

3. A skip hoist for use in a shaft opening having a main hoisting cable, means for raising and lowering said cable, and a skip connected to said cable for transporting material from the bottom to the top of said shaft opening, the improvement which comprises, in combination, a pair of support members stationed at a level near the bottom of the opening, a guide cable means for engaging each support member and extending therefrom to the top of said opening, means for tensioning said guide cables, a bridle having guide sleeves formed at opposite ends thereof adapted to slideably receive said guide cables, means for securing said hoisting cable to said bridle, a crosshead disposed below said bridle, guide sleeves formed in the opposite ends of said crosshead for slideably receiving said guide cables, a pair of pulleys mounted on said bridle, a pair of support cables each secured at one end to said crosshead extending upwardly over one of said pulleys and downwardly through an opening formed in said crosshead, a skip disposed below said crosshead, means for connecting said skip to the lower ends of the pair of support cables, means for positively engaging the skip with the crosshead in locked engagement for travel together in the guided portion of the shaft, locking means carried by the crosshead actuable by abutment of the crosshead during downward travel with the stationary support members for engaging said support members in positive locked engagement and for simultaneously disengaging the skip from the crosshead, and means actuable by the upward motion of the skip relative to the crosshead for releasing said locking means from engagement with said stationary support
members while concurrently positively coupling the skip with the crosshead in locked engagement for travel in the shaft opening above said support members.

4. A crosshead of the type used for the guidance of a skip during raising and lowering of the skip in a shaft above stationary support means having upper and lower faces projecting from the walls of the shaft comprising a shoulder formed at each end of the crosshead for engagement with the upper face of said support means, a latch slidably mounted at each end of the crosshead for engagement with the lower face of said support means, a wheel rotatably mounted in said crosshead operatively connected to each latch for extension and retraction of said latch by rotation of said wheel, first trip means disposed at each end of said crosshead operatively connected to said wheel and actuable by abutinent with said stationary support means during downward travel of said crosshead for rotating said wheel for extension of each latch, a cable passing through each end of said crosshead for engaging and disengaging said torpedo releasable by extension of said latch for lowering the skip below the crosshead and engageable by retraction of said latch for securing the skip to the crosshead, and second trip means carried by said crosshead operatively connected to said wheel and actuable by abutment of the skip with the crosshead during upward movement of said skip relative to said crosshead for rotating said wheel for retraction of each latch releasing the crosshead from the stationary support means and engaging the cable torpedo for securing the crosshead to the skip.

5. In a crosshead as claimed in claim 4, an upwardly projecting pin carried by said skip, and detent means carried by said wheel for receiving said pin and engaging said pin during the retraction of the latches and releasing said pin during the extension of the latches.

6. In a crosshead as claimed in claim 4, a bridle disposed above said crosshead in the same plane as the crosshead, a pulley rotatably mounted at each end of said bridle, the cable passing through an end of the crosshead extending upwardly over the pulley and downwardly for securement to the crosshead for raising and lowering the skip below the crosshead.

References Cited by the Examiner

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventors</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>628,923</td>
<td>3/99</td>
<td>Troutman et al.</td>
<td>187—96</td>
</tr>
<tr>
<td>824,269</td>
<td>6/06</td>
<td>Wilson</td>
<td>187—76</td>
</tr>
<tr>
<td>1,829,917</td>
<td>10/31</td>
<td>Fisher</td>
<td>187—96</td>
</tr>
<tr>
<td>2,875,807</td>
<td>3/59</td>
<td>Morrell</td>
<td>187—9</td>
</tr>
<tr>
<td>2,937,773</td>
<td>5/60</td>
<td>Pierce et al.</td>
<td>214—95</td>
</tr>
</tbody>
</table>

SAMUEL F. COLEMAN, Primary Examiner.