United States Patent [19]

Craggs

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[54] **MONORAIL SUPPORTED FLEXIBLE FRAME ENDLESS CONVEYOR**

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[73] Assignee: **Peabody Coal Company,** St. Louis, Mo.

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[52] **U.S. Cl.** ..... **198/109;** 198/177 T; 198/204; 198/233

[51] **Int. Cl.²** **B41J 29/54**

[58] **Field of Search** ..... 198/109, 116, 204, 196, 198/89, 92, 93, 96, 97, 101, 233, 192 R, 192 A, 177 R, 177 T; 299/18, 19

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Primary Examiner—Evon C. Blunk
Assistant Examiner—James M. Slattery

[57] **ABSTRACT**

A flexible frame endless conveyor is supported by a monorail from a mine roof. Switching connections for the monorail permit use of a single conveyor to serve between a mining machine, which is periodically moved from room to room in a mine, and a main conveyor which runs up to the earth's surface.

6 Claims, 9 Drawing Figures

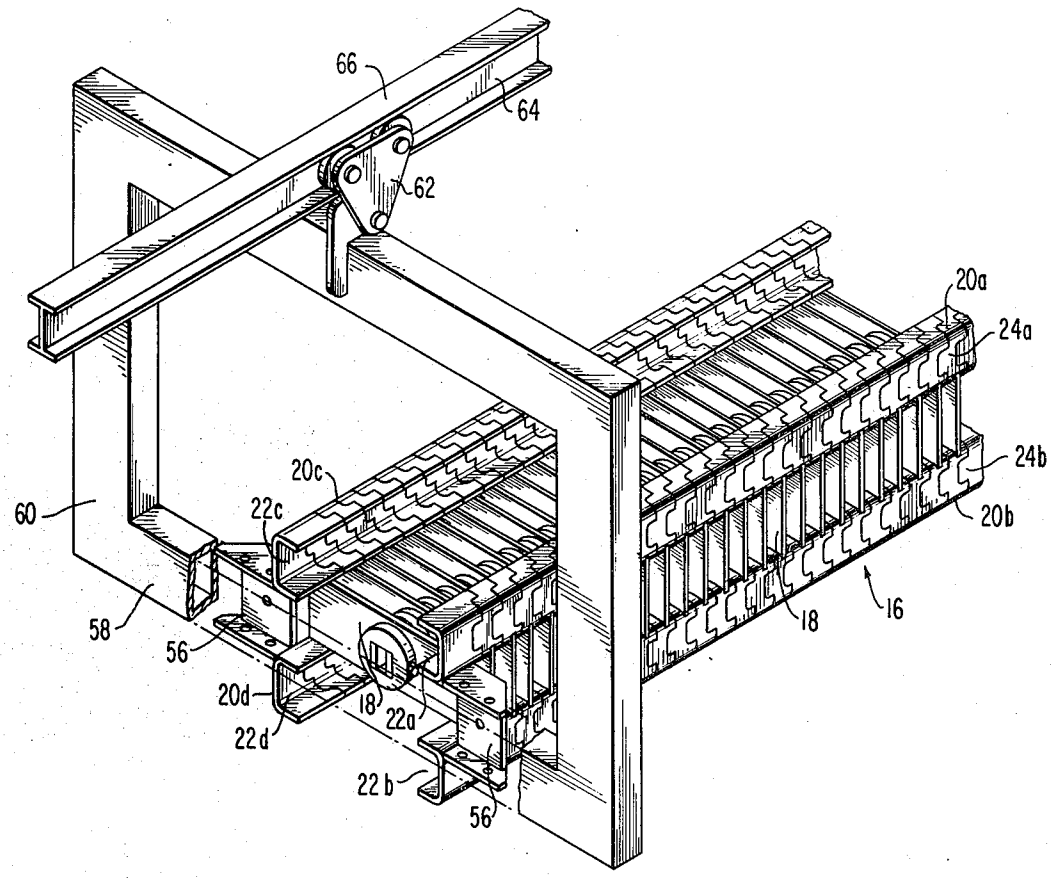

FIG. 9

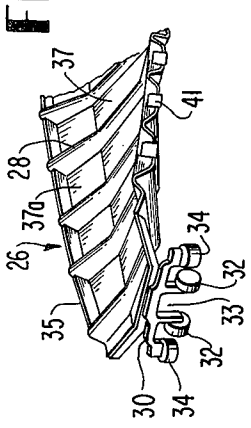
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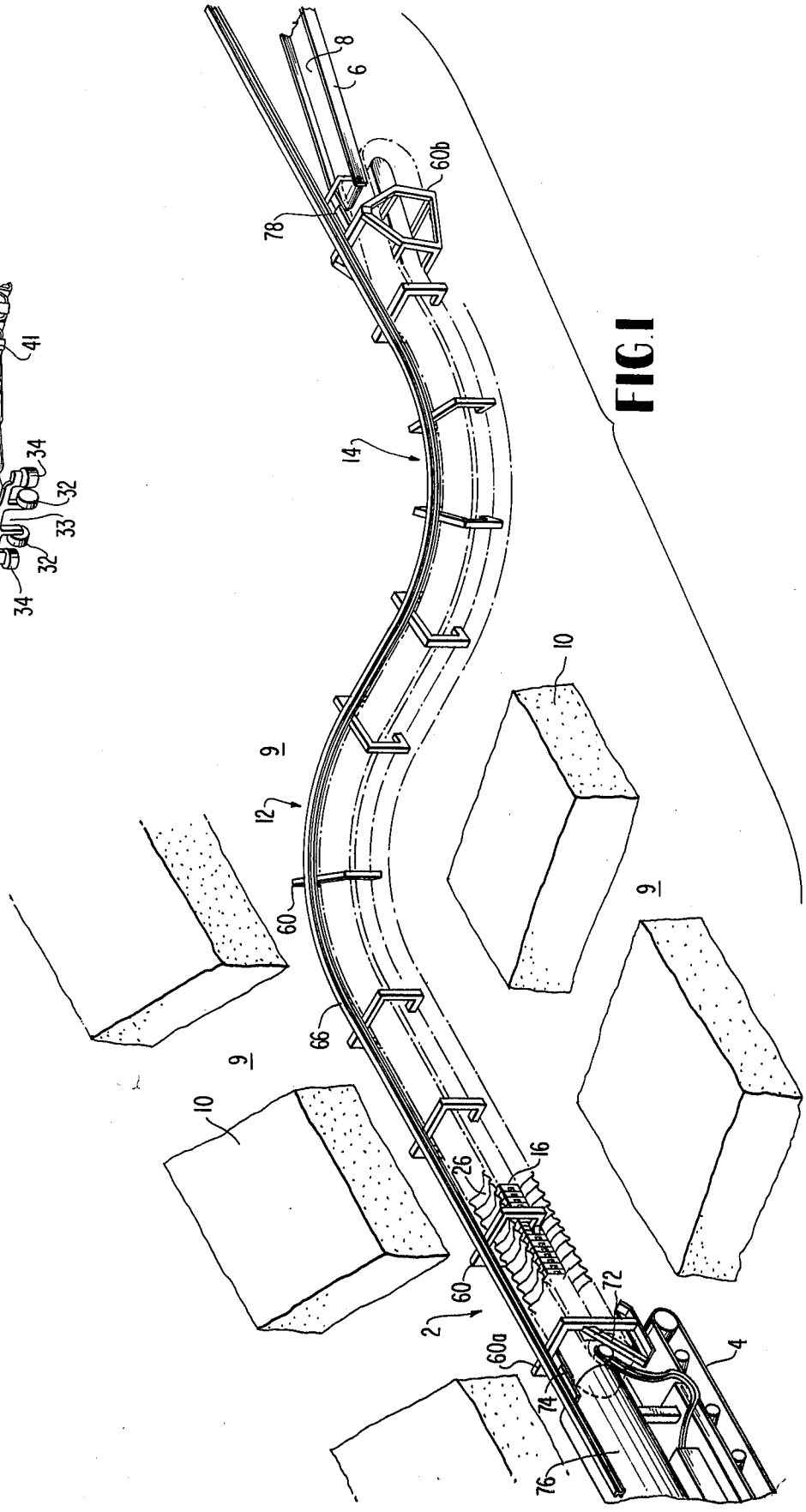
FIG. 1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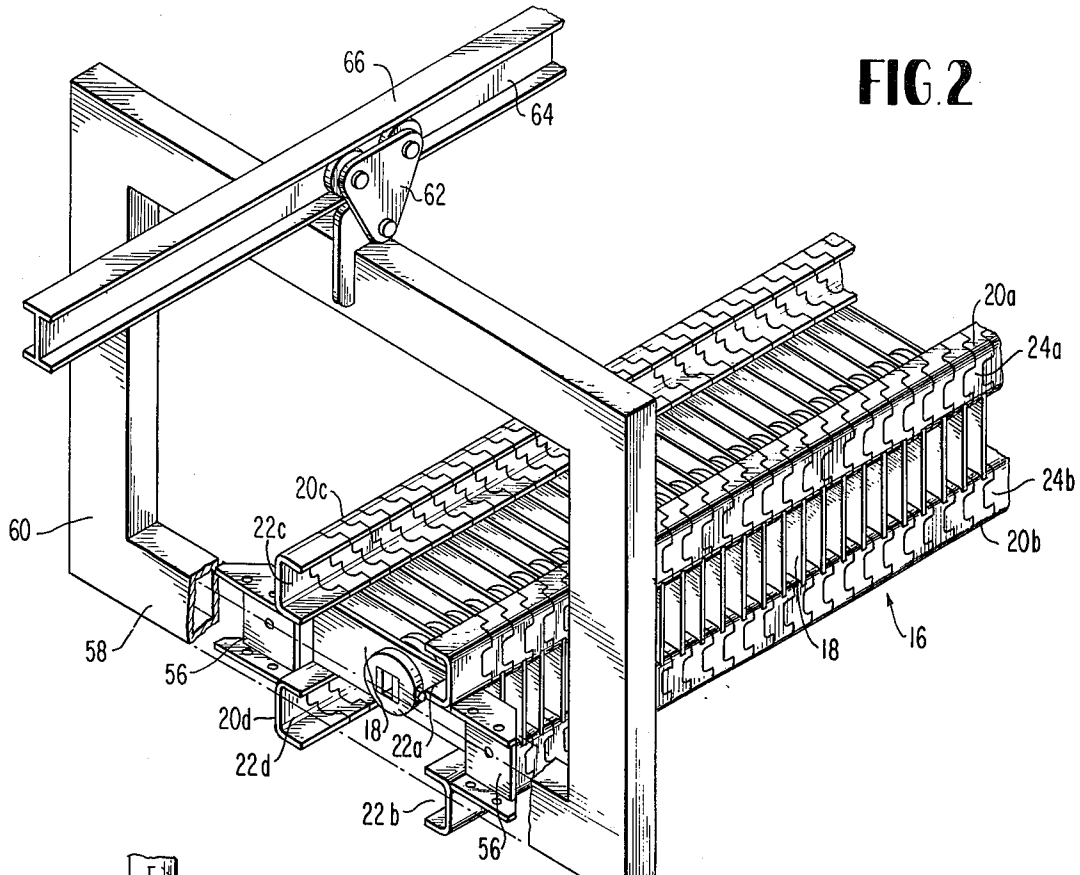


FIG. 2

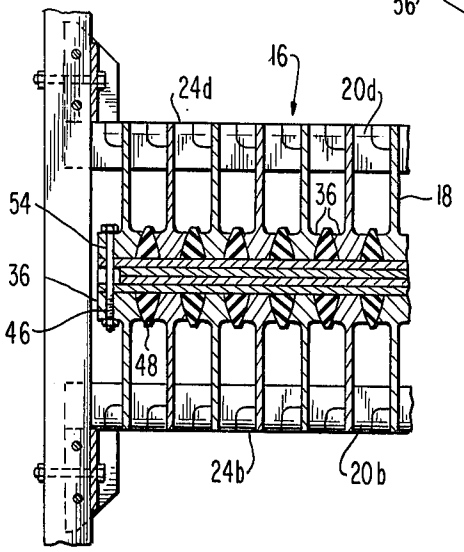


FIG. 3

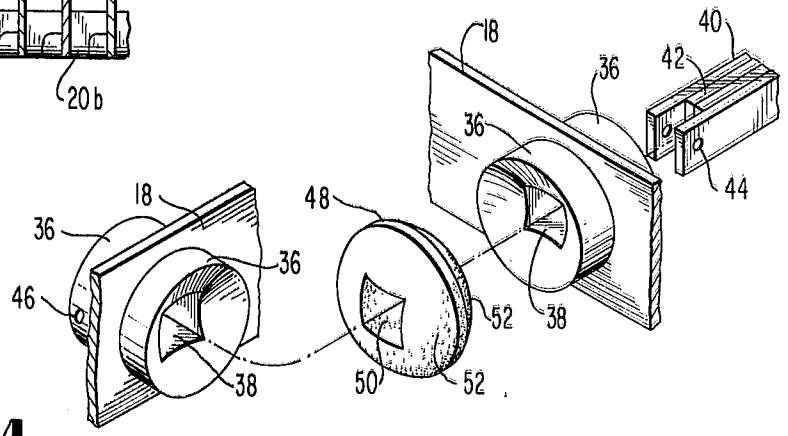


FIG. 4

FIG.5

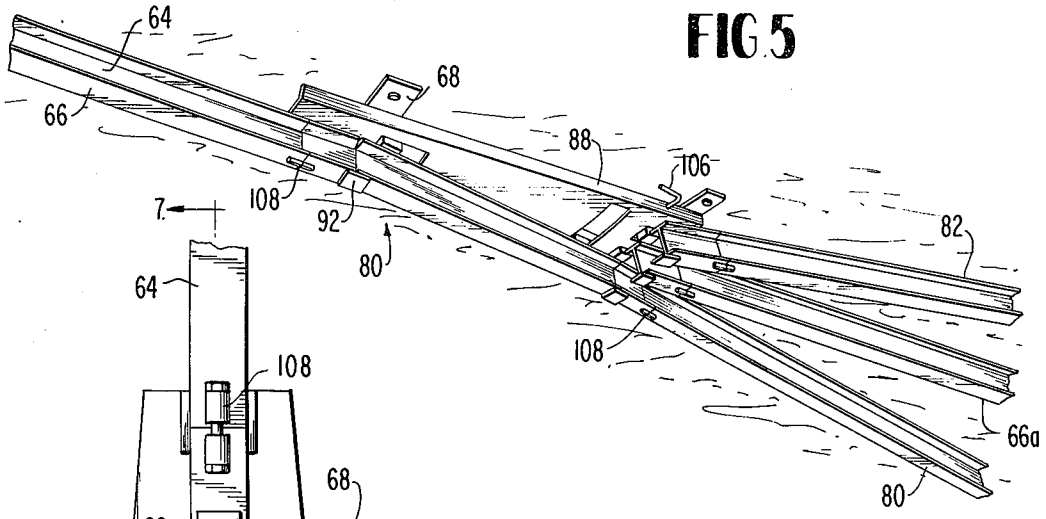


FIG.6

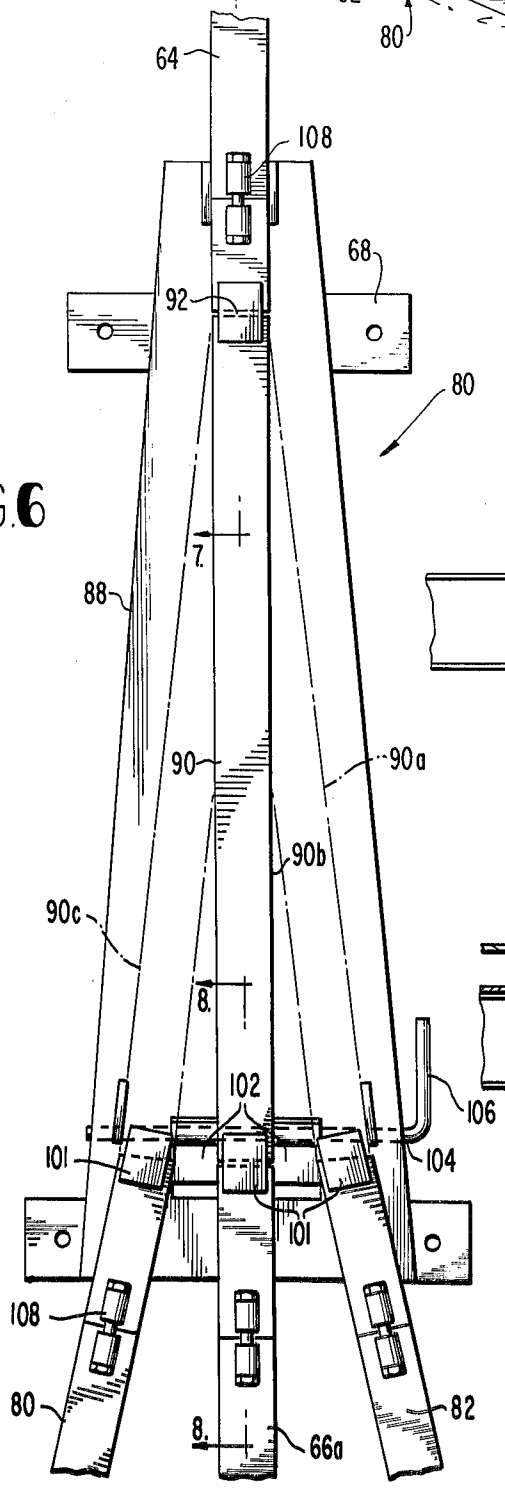
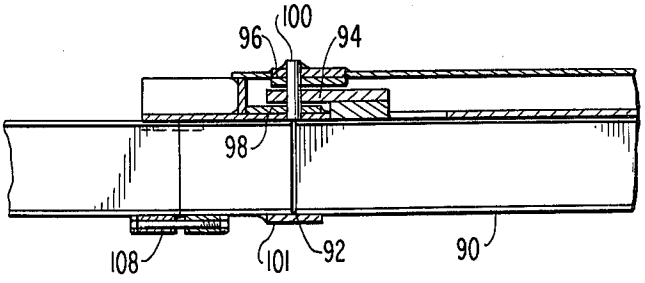


FIG.7



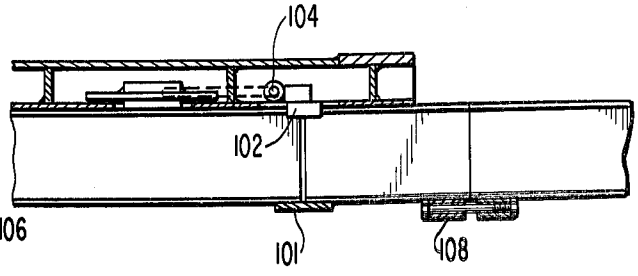


FIG.8

MONORAIL SUPPORTED FLEXIBLE FRAME ENDLESS CONVEYOR

BACKGROUND OF THE INVENTION

In "room and pillar" type coal mining, a mining machine extracts from a number of interconnecting rooms, leaving between them a sufficient number of pillars to support the mine roof. Ordinarily, the maximum distance that a machine can be used to penetrate into the mine face is about 21 feet, whereupon the machine is backed out and set to work onto the mine face of another room while roof bolts are installed in the roof of the recently mined room so as to keep roof material from falling onto the miners. Then, after mining another **21** feet in the second room, the machine is backed out and set to work either on the recently roof-bolted room or it may go on to still another room.

Coal is transported from the area being mined to the surface by a main conveyor moving along a fixed path. In a typical mine, this main conveyor runs through an upwardly inclined tunnel, and since the lower end of this main conveyor is at a fixed location, the newly mined coal must be transported from the mining machine to the conveyor terminal. Sometimes the coal is hauled with shuttle cars (and this is dangerous to the miners and time-consuming) or it may be transported on an endless belt conveyor which is capable of being adjusted to move around various turns in the path between the surge car and the main conveyor terminal. Such a conveyor, now used in coal mining, is shown in the Payne et al patent (supra), and is sold under the trademark "Serpentix".

The present invention is an improvement over that shown in the Payne et al patent. In short, the Serpentix conveyor has an endless trough-shape, accordion-pleated belt supported on a vertebrae-like member which, in turn, is supported on the mine floor by stanchions.

In prior art conveyors of the subject type, the stanchion supports are cumbersom and do not lend themselves to the frequent shifting of the conveyor path from room to room, and certain problems have been encountered in that the series of vertebrae are not of precise and predetermined over-all length because the vertebrae spread apart, and the interconnection between the vertebrae are subject to breaking. It is to the solution of these problems that the subject invention is addressed.

SUMMARY OF THE INVENTION

The object now is to provide a flexible frame conveyor suspended from the mine roof by a monorail, upon which monorail conveyor vertebrae are supported by rollers. Thus, although the monorail functions as a static support for the belt conveyor which transports the coal, the input end of the latter may be attached to the surge car behind a mining machine so that the conveyor follows the mining machine as the latter digs its way into the mine face; and, by use of switches and branching monorail tracks, the input end of the belt conveyor can be made to follow the mining machine from room to room.

A further object is to provide for the vertebrae plates which constitute the flexible frame of the belt conveyor, an inter-connection arrangement somewhat comparable to a spinal column, featuring rubber grommets having opposite convex faces which engage in concave sockets formed in adjacent plates. A series of vertebrae plates and grommets are held together by flexible torsion bars which are pinned to the endmost plates in a series, thereby eliminating problems heretofore caused by spreading apart of the vertebrae plates.

These and other objects will be apparent from the following specification and drawing, in which:

FIG. **1** is a perspective view showing a typical lay-out of the conveyor in a coal mine;

FIG. **2** is a perspective view, broken off, showing the monorail suspension of the flexible belt frame, with the belt removed;

FIG. **3** is a fragmentary cross section of an end portion of the flexible frame;

FIG. **4** is an exploded view showing the interconnections between the vertebrae plates;

FIG. **5** is a perspective view showing a monorail switch;

FIG. **6** is a plan view of the switch shown in FIG. **5**;

FIG. **7** is a fragmentary cross-section along the line **7—7** of FIG. **6**;

FIG. **8** is a fragmentary cross-section along the line **8—8** of FIG. **6**; and

FIG. **9** is a fragmentary perspective view of a portion of the belt suspended by the flexible frame.

Referring now to the drawings in which like reference numerals denote similar elements, the subject invention is a monorail supported belt conveyor **2** which, in typical usage, is installed in a coal mine to transport newly mined coal to a main belt conveyor **4** which runs up an incline to the surface of the ground, the input end of the monorail supported belt conveyor being disposed to receive coal from a chute **6** in which runs a belt conveyor **8** so as to receive coal from a surge car (not shown) following a mining machine (not shown). Typically, rooms **9** are cut between pillars **10**, and since the mining machine not only advances into the mine face but also must move from room to room, the subject conveyor must be capable not only of advancing with the mining machine and surge car but also it must run around curves such as indicated at **12** and **14**.

The upper and lower runs of an endless belt **26**, detailed below, are supported on a flexible frame **16** which consists of a series of vertebrae plates **18** terminating at their corners **20***a*, **20***b*, **20***c* and **20***d* in channel sections which, inter alia, define inwardly facing channel guideways **22***a*, **22***b*, **22***c* and **22***d*. On the outer sides of these channel guideways are outer surface runs **24***a*, **24***b*, **24***c* and **24***d*. While the channel guideways and outer surface runs appear as being substantially continuous, there is sufficient play between the individual elements to permit the flexible frame **16** to bend around curves. Belt **26** (FIG. **9**) is trough-shaped and formed with accordion pleats **28** so that the belt also can negotiate turns. At spaced intervals, the belt is supported by chassis **30** on which are a pair of rollers **32** which turn about horizontal axis and which engage in the channel guideways **22***a*, **22***b*, **22***c* and **22***d*, and another pair of rollers **34** which turn about vertical axis and which engage against the outer surface runs **24***a*, **24***b*, **24***c* and **24***d*. The belt is attached to an endless chain (not shown) which nests in space **33** and which runs over sprockets at the ends of the conveyor. The sprockets, at least one of which is driven, drive the chain which, in turn, drives the belt. As thus far described, the mechanism is substantially similar to that shown in the Payne et al patent (supra), except in that rubber end closure plates **35** are attached to the up-

turned outer end portion 37*a* of pans between the pleats 39 by means of metal angle brackets 41 which are bolted or otherwise secured to the belt pans. These end closure plates keep the coal from falling off the belt and have increased the coal hauling capacity of the belt by about 25%. The further improvements are as follows.

The central part of each vertebrae plate 18 is provided with an outwardly concave socket 36 through which runs a rectangular central aperture 38 (FIG. 4). Extending through the central apertures 38 is a flexible torsion rod 40 comprised of four lamina strips 42, the outer lamina strips being slightly longer than the inner ones and being provided with apertures 44 which register with apertures 46 in the sockets 36 of the endmost ones of the lamina ones in any given series. Engaged between vertebrae plates 18 are rubber grommets 48 which have rectangular apertures 50 for accommodating flexible torsion rod 40 and convex opposite sides 52 which seat in concave sockets 36 on the adjacent vertebrae plates 18. The series of lamina plates 18, flexible torsion rods 40 and rubber grommets 48 are held in backbone-like configuration by pins 54 which engage through the apertures 44 at the ends of flexible torsion rods 40 and apertures 46 in the endmost sockets 36. Hence, although flexible frames 16 may bend sidewise, the overall length of its mid portion always remains the same, i.e., the length of flexible torsion rod 40 to which the endmost plate sockets are pinned.

Formed into endmost vertebrae plates 18 are cross channels 56 which accommodate and are bolted to the bottom cross members 58 of supporting frames 60, the frames being, in turn, supported by trolleys 62, which run in channels 64 on opposite sides on a monorail 66, the latter of which is supported from the mine roof by flange plates 68. The frame 60*a* at the output end of the conveyor 2 is provided with suitable bearing supports 72 for a chain sprocket shaft and is coupled as at 74 to a power car 76 which is also supported on monorail 66. Coal from conveyor 2 is either dropped directly onto the main conveyor belt 4 or diverted sidewise to such a belt. The input end frame 60*b* is also provided with a suitable nested chain sprocket support (not shown) and is coupled as at 78 to the chute running from the surge car.

In a typical room and pillar type mine, for each general location in which a single mining machine is working there is a network of monorails which include switches such as shown in FIGS. 5–8. In this example, a switch 80 connects an on-coming monorail 66 alternatively to one or the other of two branches 80 or 82 or to a straight forward on-coming monorail 66*a*. The switch is suspended from the mine roof by a plate 88 and consists of a switch rail 90 capable of swinging between three positions 90*a*, 90*b* or 90*c* about pivot point 92. As detailed in FIG. 7, the pivoted end of switch rail 90 is supported by a bracket 94 engaged between upper and lower jaw plates 96 and 98 through which jaw plates and bracket runs a pivot pin 100. The swinging end of switch rail 90 is supported in its switched position by one of plates 101 which are rigid with the on-going monorail section. The pivoted end of monorail 90 is likewise vertically supported by a plate 101 rigid with the on-coming monorail section 64. Once the switch rail has been moved to a selected position, it is held there by eccentric dogs 102 on the shaft 104 of a locking lever 106. The fixed monorail sections are secured together by tie bolts 108.

In operation, the monorail network is created by installation of the various curves and switches necessary for the input ends for conveyor to follow the mining machine with which it is associated. Obviously, when the mining machine backs out of one room to start another, the output end of conveyor 2 and its associated power car back up over the main conveyor belt 4 which runs to the mine entrance; and, of course, as the mine progresses, as it may do, for several miles underground, the main conveyor belt 4 may be lengthened from time to time so as to follow the mining progression.

I claim:

1. A conveyor system for transporting coal and the like material from a mining machine to a main conveyor in a room and pillar mine, wherein there are a plurality of straight and curved paths of varying distance between various rooms having mine face against which the machine works and the main conveyor, comprising

a flexible frame for supporting upper and lower runs of an endless belt, said frame being characterized by capability of sidewise curvature sufficient to follow the curves of said paths and said belt being characterized by capability of running around the frame curves, and

a roof-mounted monorail system extending along at least some of said paths, said system including a main line having a portion overlying said main conveyor and a plurality of branch lines extending from said main line to at least some of said different rooms.

2. A conveyor system as claimed in claim 1, and switches between said main line and said branch lines.

3. A conveyor system as claimed in claim 1, said switches including

a switching rail pivoted at one end to an end of the rail of said main line and having its other end swingable to register respectively with ends of the rail of a branch line or a rail which is a continuation of the main line, and means on the ends of said main line rail, said branch line rail and said main line continuation rail for supporting the ends of said switching rail against downward displacement.

4. A spine-like flexible frame for an endless conveyor belt, comprising

a series of generally rectangular vertebrae plates each having at the corners thereof

an inwardly-facing channel portion and an outwardly-facing flat surface portion,

said portions providing guide channels and flat surfaces for engagement by rollers on the endless belt, each of said plates having a central aperture therethrough, an elongate flexible member extending through said central aperture, and means on the endmost plates for fastening the same directly to the flexible member for preventing movement of the same along the length of said flexible member, the plates between the endmost ones being movable to a limited extent along the length of the flexible member.

5. A spine-like flexible frame for an endless conveyor belt comprising

a series of generally rectangular vertebrae plates each having at the corners thereof

an inwardly-facing channel portion and

an outwardly-facing flat surface portion, said portion providing guide channels and flat surface for engagement by rollers on the endless belt,

each of said plates having

a central aperture therethrough and

outwardly facing concave sockets on opposite sides thereof surrounding said aperture,

rubber grommets engaged between the sockets of adjacent plates and constituting spacing between adjacent plates, and

an elongate flexible member extending through said grommets and the apertures in said plates, said grommets having convex opposite sides engaging in the sockets on adjacent plates.

6. A flexible frame for an endless conveyor belt as claimed in claim **5**, and pin means fastening sockets on the endmost plates in said series to said flexible member.

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