Dec. 19, 1961 J. M. A. HUBERT 3,013,499

CONVEYER SYSTEMS

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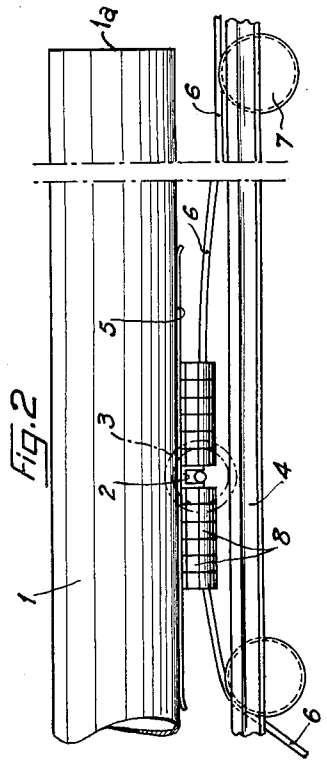


Fig. 2

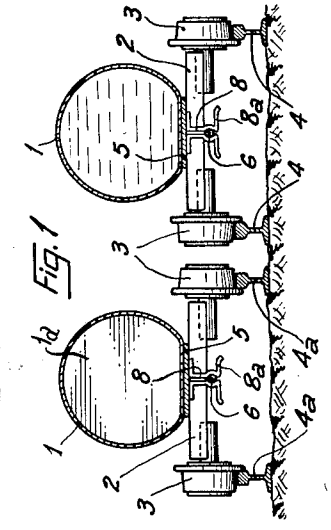


Fig. 1

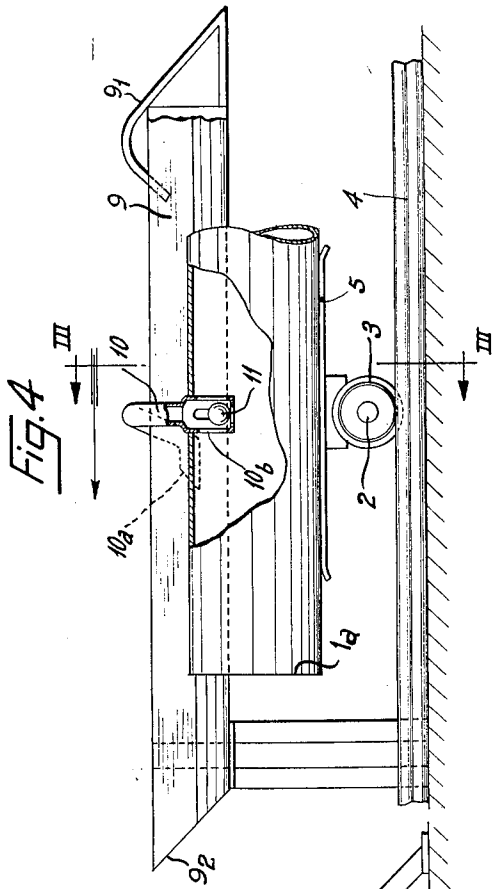


Fig. 4

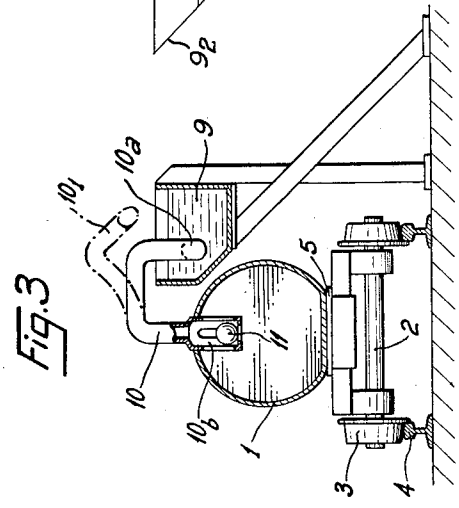


Fig. 3

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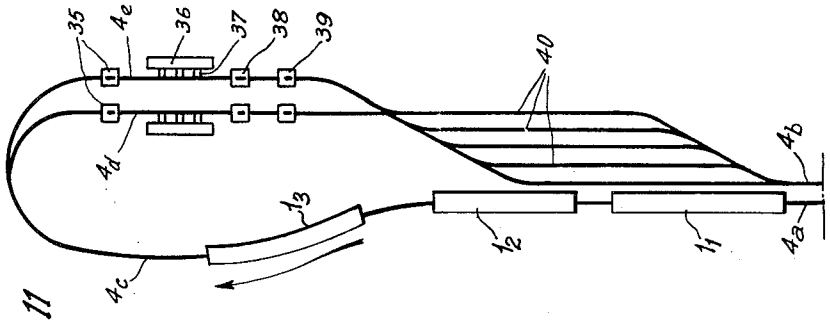


Fig. 11

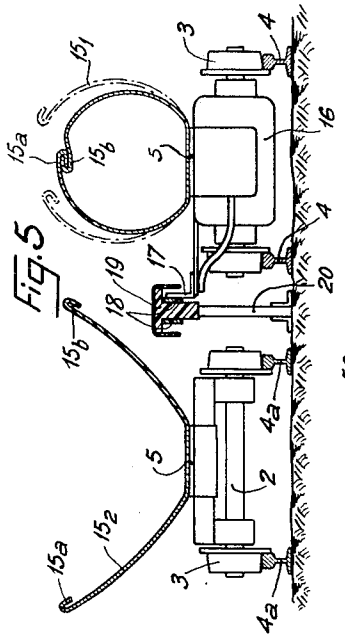


Fig. 5

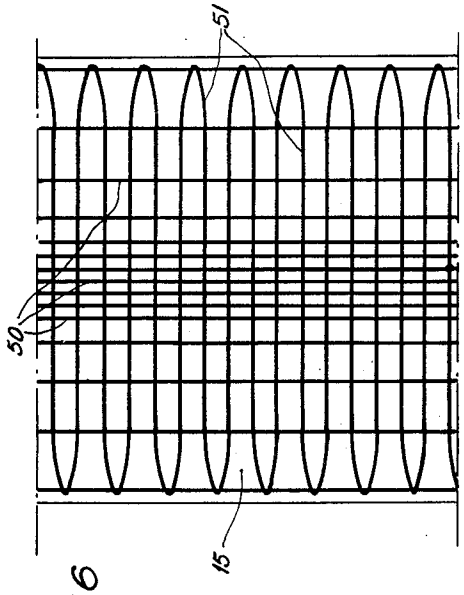


Fig. 6

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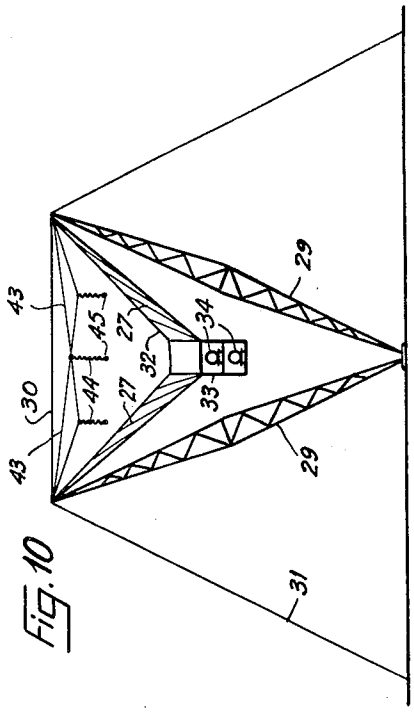


Fig. 10

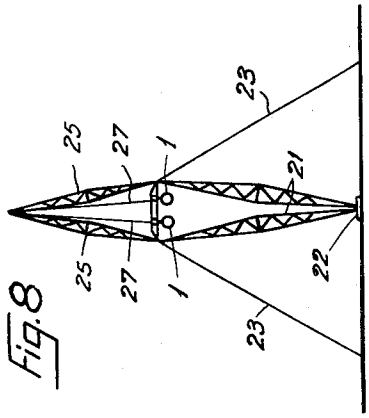


Fig. 8

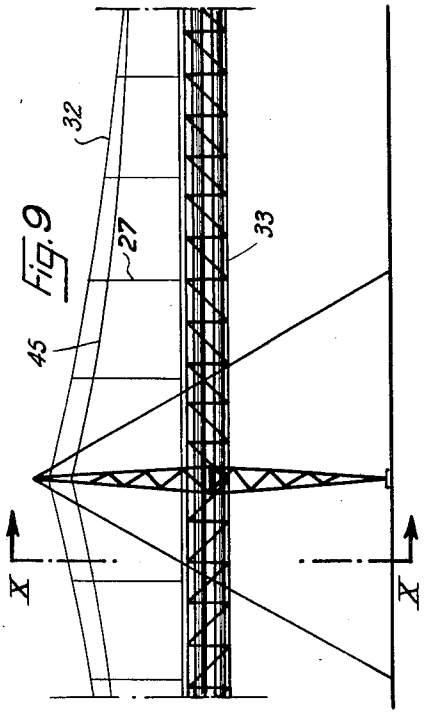


Fig. 9

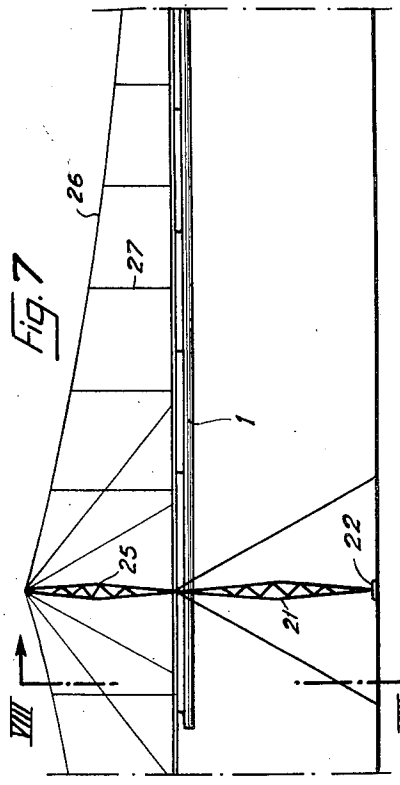


Fig. 7

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Fig. 12

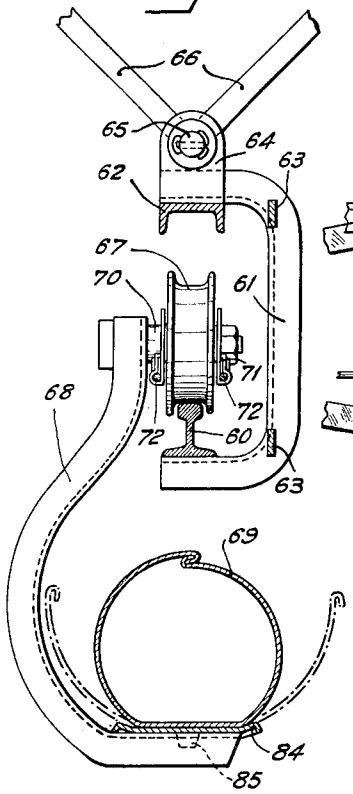


Fig. 13

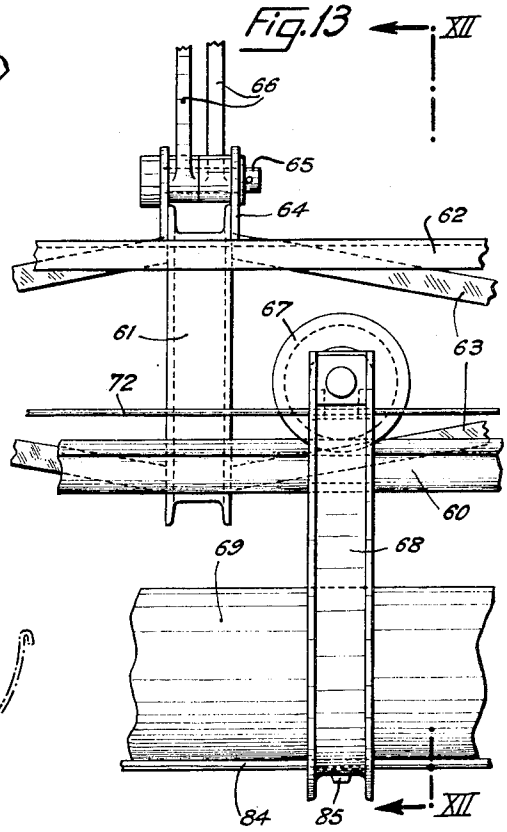
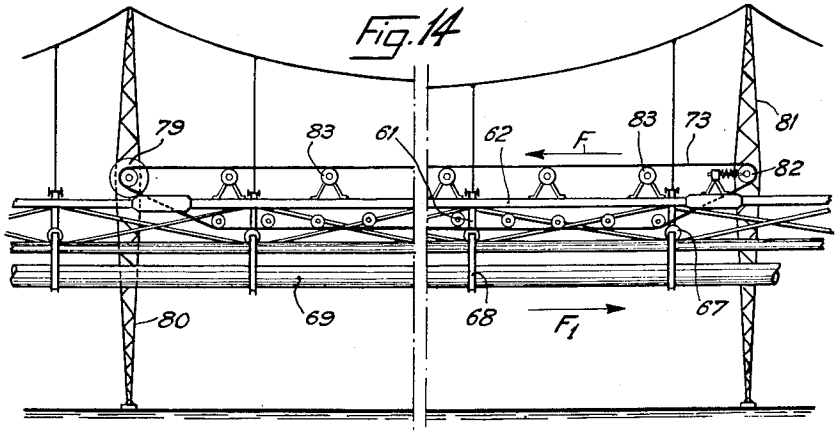


Fig. 14



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Fig. 15

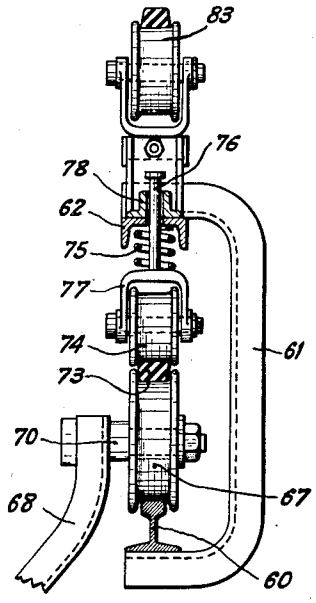


Fig. 16

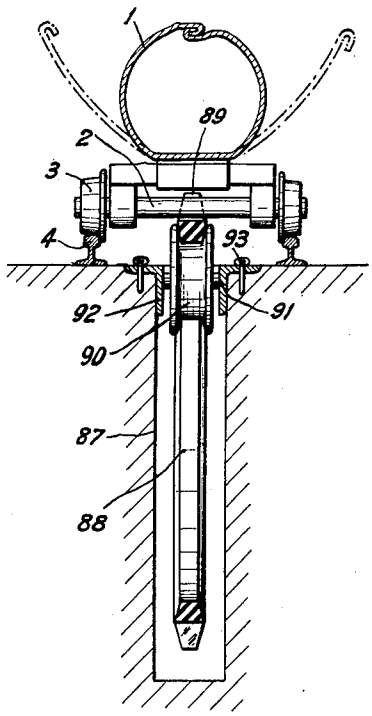
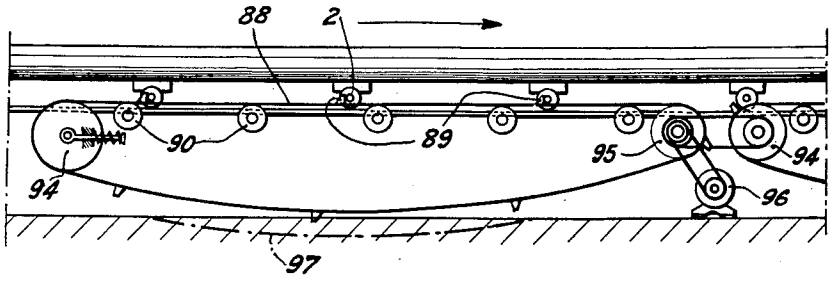


Fig. 17



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Fig. 18

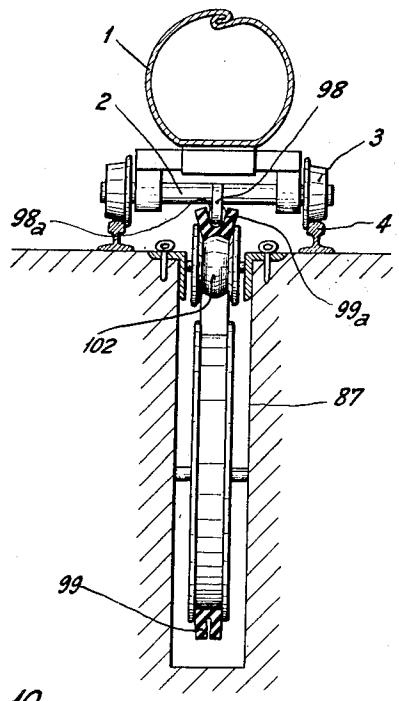
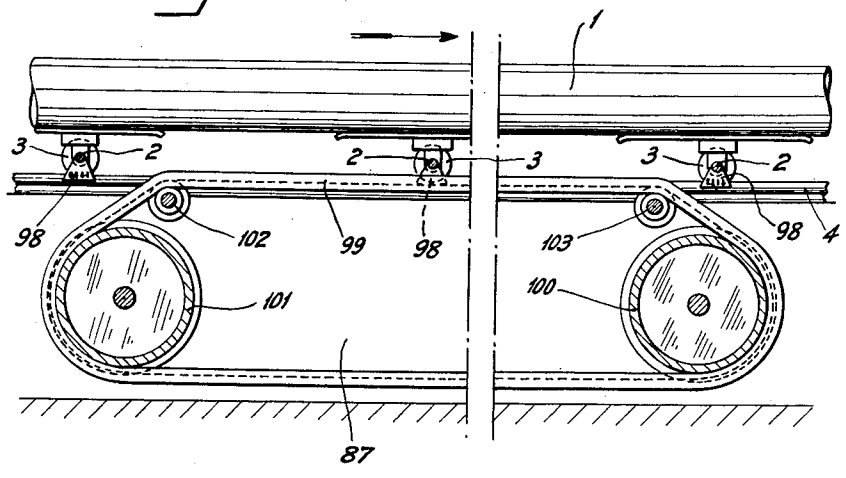


Fig. 19



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United States Patent Office 3,013,499 Patented Dec. 19, 1961

3,013,499

CONVEYER SYSTEMS

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Filed May 5, 1958, Ser. No. 732,859
Claims priority, application France May 6, 1957
2 Claims. (Cl. 103—82)

This invention relates to improved conveyer elements suitable for conveying various kinds of divided solid and liquid materials as well as articles and objects of relatively narrow elongated shape, in large quantities and over long distances.

When transporting materials in large quantities over comparatively great distances, as for instance from a minehead to a treating plant, railway station or harbour, etc., the cheapest means available at the present time include standard or narrow-gauge railways, belt conveyers, and pumping.

A factor detracting from the economical operation of railways, even of narrow gauge, is the discontinuous and intermittent character of their operation requiring the provision of comparatively heavy and expensive tracks in relation to the loads to be transported owing to the intermittent loading of the tracks.

Belt conveyers are of limited usefulness over long distances especially owing to their high power consumption due to the great amount of belt distortion and friction. Moreover they are useless in connection with liquids and solids requiring protection during transport.

Pumping is convenient with liquids unless corrosive but requires the use of expensive large-diameter and pressure resistant conduits for conveying large amounts of materials. For pumping solid and pulverulent materials great amounts of suspending liquid are required entailing the expenditure of considerable amounts of excess power, up to 40% and more of the useful load.

It is a general object of this invention to provide improved conveying elements which will combine many of the desirable features of the various conventional conveying elements listed above while being free of their drawbacks. Another object is to provide improved economical transportation means for large quantities of goods over comparatively long distances, which will be especially useful in underdeveloped areas of the world where means of transportation are inadequate or non-existent.

In accordance with one basic aspect of the invention, the system comprises elongated semi-rigid tubular container elements each mounted on a plurality of roller truck running on a track.

By way of indication, the tubular containers may be, say, 10 to 15 cm. in diameter and about 25 meters long, and each is supported on a suitable number of spaced single-axle truck having small-diameter rollers running on a narrow-gauge track, or a monorail. The containers are disposed in an uninterrupted string or chain in a preferred embodiment of the invention, and preferably this string extends continuously around a two-way track forming a closed loop between the ends of the transportation line. Also, in a preferred form of the invention this chain is continuously driven around the loop by imparting drive impulses to spaced points of the chain from power stations spaced along the line. Means are then provided for loading and unloading the containers while in motion as they move past loading and unloading stations.

The semi-rigid character of the containers, which may be made, e.g., of suitable reinforced plastic sheet material, enables them readily to take up considerable variations in the elevation and grade of the track.

For conveying liquids closed tubular containers may be used, provided with suitable filling and discharging means. Where solids are to be conveyed, the tubular containers are slotted along an uppermost generatrix and closure means are provided along the edges of the slot. Matters are preferably so arranged that all necessary operations on the containers, including the opening and closure thereof and loading and unloading are automatically performed as the containers move past corresponding stations.

While the containers may be made of light gauge sheet metal, preferably corrugated in the longitudinal direction, a preferred construction involves the use of plastic sheet materials reinforced with steel wire preferably both in the longitudinal and transverse directions. The resulting tubular containers are stiff enough to be self-supporting under full load, while possessing enough flexibility to conform to changes in direction and grade of the track as required by the considerable length of the containers.

The tracks may comprise two-rail tracks conventionally supported on a ballast and sleepers. Alternatively an overhead track may be used and in one desirable construction a catenary suspension is used and the track may be a monorail supported within a box-girder suspended from the catenary and housing the tubular containers within it. Obviously a given line may contain both ground track sections and overhead track or monorail sections in which case the trucks may be provided with a first pair of rollers for riding the ground track rails, and another roller or pair of rollers for riding the monorail or overhead track.

The invention contemplates various systems for imparting drive to the trucks. One way is to provide an endless cable extending alongside the track and coupled with suitable drive means provided on the trucks. In another embodiment some or all of the trucks may be self-propelled.

However, as already mentioned, maximum benefit is probably derived from the invention when the tubular containers form a continuous string around a closed loop between the terminals of the line, since this achieves maximum flow rate together with uniform loading. In this aspect the novel system has a close similarity to a closed-loop hydraulic conduit line, in which the conduit walls are bodily moved together with the material being transported, thereby simultaneously driving and protecting it. In such an arrangement, a particularly advantageous method of powering the system is to provide fixed power stations at spaced points along the line, which serve to impart short drive impulses to the trucks as these move past each station. These drive pulses are transmitted through the continuous string of interconnected trucks so as to impart a bodily movement thereto.

In one form of such a drive system, each power station comprises an endless drive chain or the like extending alongside the line over a limited distance. Such a drive belt may be arranged to engage frictionally the uppermost points of the truck rollers as they move past the station, thereby imparting to the trucks a linear forward velocity one half the linear velocity of the belt. Such a driving arrangement is especially desirable in connection with the monorail type of system mentioned above wherein each truck has a single symmetrical roller from the axle of which the tubular containers are suspended.

In a modified form of this system, especially applicable to double-rail tracks, the endless drive belt at each station may have driving lugs projecting from its outer surface into engagement with the truck axles or other suitable parts of the trucks. This requires that a substantially equal spacing be provided between the driving lugs on

the belt and between the truck axles on the track, although some latitude is permissible in this connection.

Another method of driving the trucks—both on a ground track and monorail—is to provide the endless belt in the form of two parallel closely spaced belt sections, or a single longitudinally slotted belt, means being provided for gripping a suitable projection on each truck, such as an extension of its axle, between said belt sections or in the slot for the limited distance where the truck is moving past the belt.

Although particular emphasis is laid on the case where the tubular elements form a continuous string, it should be understood that in some cases it may be found convenient to provide and maintain a predetermined spacing between all, or some, of the tubular containers, as when it is desired to remove and insert tubular container units from and into the chain in accordance with current capacity requirements. A constant spacing may be maintained between adjacent elements all along the round trip, by coupling all the elements to an endless cable or a plurality of endless cables or belts spaced along the line.

In the case of self-propelled trucks, a sufficiently rigid support may be obtained therebetween by providing long coupling rods or links which, if required, may in turn be supported on intermediate trucks riding the track.

In accordance with know railway practice, uniform spacing between the elements may be maintained by dividing the line into sections in each of which power is applied to the motors carried by the self-propelled trucks by way of relay mechanisms in such a manner that one element is only allowed to enter a section after the preceding element has left that section; any suitable interlocking means, mechanical or electronic or otherwise, might also be used.

It will be seen that the conveying system comprising the conveyer elements of the invention when seen from one angle has indisputable kinship with conventional ground and overhead rail conveyances. However, it radically differs therefrom in the fact that while such rail systems are basically discontinuous, i.e., the track is heavily loaded for relatively brief periods of time and is idle for long intervening periods, the novel system of the invention is practically continuous in operation, each section of the line being constantly under a comparatively light load. This manifestly achieves great economy in the strength requirement of the track. The draft force required is, of course, substantially the same in both cases; but since this force can now be derived from continuously, rather than intermittently, operative sources, the overall power expenditure is greatly reduced.

From another angle there exists a definite similarity between the novel conveying system and a fluid pumping system, as already mentioned. However, whereas in a pumping system a large proportion of the power input is used in overcoming friction forces, viscous drag and the like passive resistances, such resistances are minimized herein since the power is applied to rolling stock. This enables the use of relatively high displacement velocities and a corresponding reduction in the pipe diameters required; also, since the materials being displaced are at atmospheric pressure, the wall thickness of the necessary pipes is likewise reduced.

In spite of this there is a striking resemblance between this system and a fluid pipeline system in that aspect of the invention where the containers form a continuous string or chain to which drive pulses are applied from power stations at spaced points of the chain. Such power stations then play a function equivalent to that of pumping stations.

Exemplary embodiments of the invention will now be described with reference to the accompanying drawings, wherein:

FIG. 1 is a cross-sectional view of one embodiment of conveying means of the invention;

FIG. 2 is fragmentary side view corresponding to FIG. 1;

FIG. 3 is a sectional view of a filling station for filling a tubular element with liquid on line III—III of FIG. 4;

FIG. 4 is a side elevation of FIG. 3;

FIG. 5 is a cross-sectional view of another embodiment wherein the conveying elements are self-powered;

FIG. 6 is a developed view of part of an element illustrating the reinforcing means thereof;

FIG. 7 is a side view of part of an overhead track and catenary support therefor;

FIG. 8 is a section on line VIII—VIII of FIG. 7;

FIG. 9 is view similar to FIG. 7 relating to a modification of the catenary support;

FIG. 10 is a section on line X—X of FIG. 9;

FIG. 11 is diagram illustrating the layout of a conveying system according to the invention at one end of the line;

FIG. 12 is a vertical section of a monorail conveying system according to the invention, on line XII—XII of FIG. 13;

FIG. 13 is a fragmentary side view of the system of FIG. 12;

FIG. 14 is a reduced-scale view of the system embodiment shown in FIGS. 12 and 13 with its power drive mechanism;

FIG. 15 is a section similar to FIG. 12 showing details of the power drive;

FIGS. 16 and 18 are transverse vertical sections of further conveying systems according to the invention with their power drive mechanisms; and

FIGS. 17 and 19 are partly diagrammatic side views on a reduced scale of the structures respectively illustrated in FIGS. 16 and 18.

The embodiment of the invention shown in FIGS. 1 and 2 is a system for conveying liquids. The system comprises a container in the form of a tube section **1** of semi-rigid character closed at its ends by end walls **1***a*. By way of indication the tube diameter may be in a range of from 1 to 3 decimeters and the length of the tube element may amount to several dekameters, so that the order of magnitude of the weight of liquid with which the element **1** is loaded may be a few tons. This load is distributed among a suitable number of trucks which, in this construction, each comprise a single axle **2** carrying small flanged wheels or rollers **3** at its ends, which ride the tracks **4**.

The tube container **1** is supported upon each axle preferably through a load distributor plate **5** a substantial area of which is engaged by the underside of the tube both forward and rearward of the axle, so as to minimize the unsupported length of tube between axles. The spacing between adjoining truck axles may be from 1 to several meters in length as required.

The gauge of the track formed by the rails **4** is on the order of a few decimeters. Extending parallel to and spaced from said first track is a return track comprising a pair of rails **4***a*. It will be understood that loaded tube elements may be continually running on track **4** while empty tube elements are running on track **4***a*.

In the construction being described the tubular container elements are driven by an endless cable **6** which extends between each pair of rails **4** and **4***a*, being supported at intervals upon rollers **7** journalled between the rails. Driving engagement between this cable and the rolling stock is effected by clamps **8** which may, as shown, project from the underside of the plates **5**. Each clamp consists of two parts which embrace the cable **6** between them and are formed with outturned flanges **8***a* at their ends to permit automatic camming actuation of the clamps to open condition as by means of suitably positioned rollers or ramps adapted to be engaged by said flanges wherever required to cause the clamps to engage, or release, the cable.

FIGS. 3 and 4 illustrate an arrangement for loading

liquid into the tubular container elements in motion. The elements ride past an overhead trough 9 supported alongside the track and containing the liquid to be transported. Projecting upwards from the forward end of tube element 1 is a pipe 10 bent to inverted U shape as shown to provide a siphon and having its outer end 10*a* directed forwardly and cut to a bevel to provide a scoop. This scoop 10*a* is adapted to dip into the trough to scoop out liquid therefrom. The inner end 10*b* of the pipe 10 projects into the container element and is enlarged as shown, and contains a lightweight ball valve 11 freely positioned therein and cooperating with apertures in said pipe end 10*b* to act as a float valve. When the container element is full the ball 11 floats and seals the inner inlet of pipe 10. The entire pipe 10 is preferably made of flexible material and, as the container element approaches the filling station, the flexible pipe 10 is arranged to be distorted as indicated at 9_1 by a suitable ramp or incline, until it has penetrated the trough. A similar device is used for moving the scoop pipe 10 out of the trough at the far end of the latter, e.g., by a suitably inclined end wall 9_2 of the trough.

The container elements may be discharged of their liquid contents by gravity. Thus a discharge opening may be provided at the rear end of each container element and the elements may be passed at the discharge end of the line over a track section at a steep grade.

In the embodiment shown in FIG. 5 a similar pair of parallel tracks 4 and 4*a* are provided for respectively supporting the loaded and empty conveyer elements. The conveyer elements in this construction are in the form of openable tubular containers. Thus, each element comprises a trough structure 15 made of thin-gauge sheet metal or, preferably, suitable reinforced plastic sheet. One suitable construction for the reinforced plastic sheet material is to mould it with a reinforcing network of high-tensile steel wire or the like, e.g., as shown in FIG. 6, where there are shown parallel spaced longitudinal wires 50 and cross-wires 51 in zigzag. The trough-like container is moulded or extruded from such material in the somewhat expanded shape indicated at 15_1 in FIG. 5. When filled with heavy, non-pulverulent solid material it may assume the fully expanded or spread-out shape shown at FIG. 5, left.

The free upper edges of the trough are formed, in a known manner, with lips or flanges 15*a*, 15*b* bent in the same direction, so that they can be made to interlock as shown at FIG. 5, right, when the two side walls of the trough are forced towards each other as by suitable rollers acting on the outer surfaces of the walls. The container then assumes a closed tubular shape which is retained due to the inherent resiliency of the sheet material. Where required to open the element, rollers are arranged to act on the wall surfaces to force them further inwards until the interlocking lips snap apart, and the trough then assumes and retains its open condition again owing to its resiliency. However, any other suitable closure means may be provided for the trough sides instead of the interlocking flanges shown, e.g., slide-fastener means may be used.

In the embodiment of FIG. 5, one or more of the trucks for each element are shown as being self-powered. Any suitable motor means may be used, and may be mounted at any suitable position, as under suitable encasing bulges formed in the bottom of the container element. It is to be noted that the power required for each truck is extremely low so that small-size electric motors 16 may be used. Further, in view of the small diameter of the wheels or rollers 3 said wheels may be directly affixed to the motor drive shaft. Electric power is supplied to the motor 16 by way of a sliding trolley or shoe 17 riding a power rail 18 supported upon an insulating longitudinal member 19 which in turn is supported above the ground by spaced posts 20. The live rails 18 are supported between both tracks 4 and 4*a* so as to employ a common supporting structure.

In the embodiment shown in FIGS. 7 and 8 overhead tracks are used suspended from catenaries supported on spaced gantry towers or masts such as 21. Thus each supporting structure may be V-shaped and comprise a pair of upwardly diverging lattice masts 21, see FIG. 8, supported on a base 22 by means of stays 23. A cross member 24 interconnects the tops of the masts. Each V-support may further comprise a pair of upwardly converging upper members 25 supporting a catenary cable 26 from which a track apron or girder extending over the cross members 24, is suspended by means of double slings 27. In this construction the tracks comprise a pair of parallel horizontally spaced monorail tracks interconnected by suitable bracing means; the trucks ride the monorails and the tubular container elements 1, which may be of a type similar to that shown, e.g., in FIG. 1, may be suspended from said trucks through any suitable means an exemplary form of which will be later described.

In the modified construction of FIGS. 9 and 10, each V-support comprises a pair of diverging masts 29 interconnected at their tops by a tie cable 30 and maintained by stays 31. Attached to the upper ends of the masts are catenary cables 32 from which double slings 27 serve to suspend the tracks girder. The tracks may be in the form of monorails as in the preceding embodiment or, alternatively, may be two-rail tracks disposed in superposed relation, and supported in a lattice box-girder 33, defining two floors on each of which is a pair of rails similar to what is shown in FIGS. 1 and 2 or FIG. 5, supporting the tubular container elements 34.

The V-supports of the type shown in FIGS. 9 and 10 provide a convenient way of supporting an overhead power line comprising the conductors 45 suspended through suitable cables or tie-members 43 and insulators 44 from the tops of the diverging masts 29.

In both embodiments just described with reference to FIGS. 7 and 8 and FIGS. 9 and 10, the conveyer means are, or may be, provided as monorail conveyers as mentioned above. FIGS. 12 and 13 now to be described illustrate one suitable arrangement for such monorail conveyers embodying the invention.

As shown, the single overhead rail 60 is supported at intervals on the lower horizontal legs of C-brackets 61 suitably of channel cross-sectional shape. The upper horizontal legs of the brackets are supported on a continuous channel member 62. The rail 60 and channel 62 constitute the lower and upper longitudinal elements of a lattice girder having the C-brackets 61 as vertical spacer members and further including cross bracing provided by flat elements 63. In case of tracks of considerable length all or part of the assembly comprising monorail 60, vertical spacers 61, channel member 62 and flat bracers 63 are desirably replaced by a box-girder which may be made of stamped or press-formed steel sheet, suitably perforate. Secured on top of each of the vertical elements 61 is a clevis member 64 supporting a pivot 65 on which the lower ends of rigid bars or cables 66 are pivoted for suspension from catenary supports.

Riding the single rail 60 is a series of flanged rollers 67 each journalled on a pivot 70 projecting from the upper end of a depending arcuate bracket 68 the lower horizontal arm of which supports the tubular container element 69 which, as shown, may be of the openable type above described with reference to FIG. 5.

Preferably the flat bottom section of tubular element 69 is secured to a bedplate 84 for reinforcing it in the area of engagement with the bracket 68 and distributing the support reaction force therefrom over a substantial length of said tubular element. The bedplate has a boss 85 projecting from its under side into engagement with a socket in the horizontal bracket arm to retain the tubular element in position thereon. Such removable connection makes it possible very easily and quickly to separate the tubular element from its supporting brack-

ets, e.g., for loading the container element or for replacing a damaged element.

A balancing weight may be provided on the lower bracket leg to prevent lateral displacement of the tubular element from the vertical plane of the rail **60** by more than a predetermined amount in case of strong side winds. The weight may be made of metal or concrete.

In providing a double monorail track according to the invention with both tracks side by side, two sets of C-brackets or girders may be provided back to back and firmly secured to each other in pairs.

The tubular container elements such as **69** constituting adjacent sections of predetermined standard length are preferably interconnected to provide a continuous chain. Such interconnection may be effected in the following way, referring to FIGS. 12 and 13. Non-rotatably secured on the pivots **70** of the rollers **67** to either side of the rollers, are flanges **71** carrying suitable means, such as depending clamps as shown, for securing thereto cables **72** thus serving to interconnect the consecutive roller pivots. The cables used have sufficient tensile strength to withstand the draft force developed in a long continuous set of tubular elements only selected ones of which are positively driven along the rail **60**.

The drive may be accomplished in a variety of convenient ways one of which will now be described with reference to FIGS. 14 and 15. An endless drive belt **73** in the form of a V-belt has its lower leaf applied into engagement with the upper surfaces of the peripheries of rollers **67** by presser rollers **74** biassed downwardly by springs **75**. Each presser roller **74** is journalled in a clevis **77** secured to the lower end of a pivot pin **76** surrounded by spring **75** and extending through the channel member **62**. Additional guide means **78** are provided through which the pivot rods **76** extend to retain said rods vertical. The belt **73** is driven from a motor **79** which may be mounted on a V-support **80** of the catenary suspension system, the drive belt being trained about a pulley secured on the motor shaft.

Rotatably mounted on a nearby V-support **81** is a pulley **82** imparting an adjustable tension to the drive belt **73**. Further intermediate rollers **83** supported on bearings spaced along the span between supports **80** and **81** engage the underside of the upper leaf of drive belt **73** to prevent excessive sag.

It will be understood that the drive system just described including drive belt **73** and the power means therefor are provided in only a selected one or selected ones of the spans such as the span between **80** and **81**, of the catenary system. Such spans therefore are subjected to substantially greater loading than are the normal spans of the catenary system and said spans should be provided correspondingly shorter. Alternatively, the drive and power system described may be supported between a pair of independent supports which may conveniently be provided at either side of a main support of the catenary system.

When the drive belt **73** is displaced by motor **79** at a certain linear velocity equal to 2V in the direction indicated by arrow F, the rollers **67** are rotated by the belt to displace the tubular elements **69** at a reduced linear velocity V in the opposite direction as indicated by arrow F_1, and owing to the interconnecting cables **72** the entire chain of tubular elements is correspondingly displaced. Any suitable number of power driving systems of the kind shown in FIG. 14 may be provided along the full length of the conveyer line to impart incremental draft impulses to selected points of the continuous chain of tubular elements, whereby said chain will be bodily propelled round the two-way track. It will be noted that the resulting system bears an unmistakable resemblance to a large closed-loop fluid-circulation system along which the fluid is impelled by a number of pumping stations spaced along the system.

While the friction belt drive was above described with reference to the monorail embodiment illustrated in FIGS. 7 to 13, it will be understood that a similar drive system can be applied to the other embodiments described with reference to FIGS. 1–2 and FIG. 5. It may simply be noted that since in the latter embodiments the rollers or wheels such as **3** are somewhat tapered in shape, a cylindrical or grooved axial extension may be provided outwardly or inwardly of said wheels for engagement by the friction belt.

Another type of endless belt drive for a continuous conveyor system according to the invention is illustrated in FIGS. 16 and 17, wherein an endless drive belt acts directly on the axles **2** of the rollers. As shown a longitudinal pit **87** is provided between the rails **4** in which the lower leaf of the drive belt **88** extends. Projecting from the outer periphery of the belt are spaced drive lugs **89**, the spacing between which is substantially equal to the spacing between adjoining axles. The upper leaf of the belt extends in engagement with the upper sides of rollers **90** journalled on pivots **91** carried between pairs of brackets **92** resting along the sides of the pit and retained by pegs **93** or the like.

The endless drive belt at one end passes around a tension pulley **94** and at its other end around a drive pulley **95** rotated by motor **96**. To ensure satisfactory drive at least two of the drive lugs **89** should at any time be in engagement with a respective pair of roller axles. However, in cases where the spacing between the pulleys **94** and **95** is rather short, the lower leaf of the drive belt need not be supported at intermediate points but may hang freely in the pit, and the bottom of the latter may have an intermediate deepened portion as shown at **97**.

To distribute the drive force over a large number of axles in the case of chains of conveyer elements of great length, more than one drive belt such as **88** each with drive lugs **89** on it may be arranged in line. A common motor such as **96** in FIG. 17 may serve to drive both belts of an adjacent pair.

FIGS. 18 and 19 illustrate yet other power means for driving a conveyer system according to the invention. In this case there is a driving projection **98** projecting downwardly from the center of each axle **2** (or from another portion of the conveyer element depending on the embodiment thereof used). Projection **98** is generally of trapezoidal form and is preferably provided with side enlargements or bosses **98***a*. An endless drive belt **99** is again provided but the belt herein has a generally channel section which tends to close in transversely due to inherent resiliency. The belt is passed over end pulleys **100** and **101** one of which is motor driven as in the previous embodiments, and further passes around a pair of camming rollers **102** and **103** of relatively small diameter having a convex cross-sectional configuration. Thus, as shown in FIG. 18, the channel section of the belt is forced open by the leading one of the rollers, as at **99***a*, whereby the projecting member **98** is allowed to engage in between the sides of the channel section Beyond the leading roller **102** the members **98** are therefore clamped between the sides of belt **99** and are driven by the upper leaf of said belt, thereby propelling the system. On reaching the trailing roller **103** the belt is again forced open to release the members **98**. It will be noted in this case that the upper leaf of the drive belt **99** need not be supported by presser rollers since said belt is retained by its clamping engagement with the driving projections. Another advantage of this belt drive is that the axles **2** need not be uniformly spaced.

In a modified version of this embodiment the clamping relationship may be obtained by the use of two parallel drive belts bodily placed together, and guided by suitable camming means so as to be spaced apart at end portions but lie in close engagement over a relatively long intermediate portion, whereby the belts will close in around a driving projection of each successive truck similar to projection **98** in FIG. 18 and drive the truck and will then

release said projection towards the end of the belt. Instead of cooperating with a vertically depending projection as in FIG. 18, the drive belts may cooperate in a similar manner with a horizontal projection of the truck, such as a side extension of the axle **2** or a side extension of the pivot **70** in FIG. 12.

Referring to FIG. 11, the lay-out in plan of the loading end of a conveyor line according to the inventions is illustrated in one form it may conveniently assume. The outgoing track for the loaded conveyer units, illustrated at 1_1, 1_2, and 1_3, is shown at *4b*, while the incoming track for empty units is shown at *4a*, the two tracks being interconnected by a loop *4c*. As shown, the track section ahead of the outgoing portion *4b* is subdivided into two or more parallel branches such as *4d*, *4e*, providing as many loading stations. Each such loading station may include, in the case of solids being conveyed, a device **35** for opening the tubular elements and a loading device **36** provided with feeder chutes **37** or the like overhanging the opened tubular elements. Any suitable vibratory or other means can be used in assisting the feed motion through the chutes. Beyond the loading device is a vibrator device **38** acting on the still-open container elements to compact their contents, and beyond that is a closing device **39** which acts to close the elements as previously described. Shunt lines **40** are provided beyond the loading stations for storing loaded container units prior to departure.

It will be understood that the character of the devices provided at the loading stations may differ from that just indicated and will depend on the type of goods being conveyed. Thus in the case of many kinds of solid materials the compacting means **38** may be superfluous and, also, the closing means **39** would be superfluous in the case of materials which may satisfactorily be conveyed in open condition. In the case of liquids being conveyed, the loading stations may obviously comprise the filling means described in connection with FIGS. 3 and 4.

The other delivery end of the line may be laid out in a generally analogous manner. For the discharge of materials at the delivery end, the horizontal rails may be gradually bent up in a vertical plane so that the opened tubular elements will simply dump their contents while in motion. The empty tubular containers may then be loaded with some other materials, thereby providing for two-way transportation. Thus after the dumping step just described the elements may be moved past a washing station where the open elements are washed and then past a loading station, where they may be filled with liquid fuel, for example, or some other commodity required at the other end of the line.

The ensuing exemplary data are given by way of illustration to highlight the remarkable advantages of a conveying system according to the invention over more conventional conveying means.

A mine with an extraction yield of one million tons of ore per year, can be served by a novel conveyer system including tubular container elements 10 to 15 cm. in diameter and 25 meters long propelled at a linear speed of from 1 to 2 meters per second. The two-way track for such a system would require about 20 kg. steel per linear meter, which represents only about one tenth the amount of steel required per linear meter of a standard railway track. A corresponding economy is obviously also achieved on the sleepers, ballast and any earth-moving and building work required along the line.

Where the elements are provided in the form of a continuous chain displaced in the manner shown in FIGS. 14 to 19 by drive stations spaced along the line, the spacing between adjacent drive stations will of course depend on the cross-section profile of the line, the weight of conveyer chain per kilometer and the permissible draft forces in said chain. Assuming a rolling friction coefficient of 3%, a weight of conveyer element per meter equal to 50 kg. and a draft resistance of 1500 kg. in the chain, it is found that on the flat the spacing between adjacent drive stations can be about 10 kilometers long, such distance of course being increased in the case of down-grades and decreased for up-grades.

It will be understood that various modifications may be made in the specific embodiments illustrated and described within the scope of the appended claims.

What I claim is:

1. In a conveyer system for liquids comprising a track forming a closed loop, roller-mounted trucks riding said track and means for propelling said trucks along said loop, at least one elongated tubular container made of a semi-rigid yielding sheet-material, supported on a plurality of said trucks and further comprising a flexible filling pipe projecting from its top and having a downwardly and forwardly directed inlet portion adapted for insertion into a charging tank to scoop liquid therefrom into said container.

2. In a conveyer system for liquids according to claim 1, an elongated liquid charging tank mounted alongside the track at a section thereof and guide means positioned ahead of said tank and adapted to coact with said filling pipe to guide the latter upwardly to enable it to dip into the charging tank to scoop liquid therefrom into said container, while passing along said charging tank.

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