Oct. 4, 1955 A. L. BARRETT 2,719,642

HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

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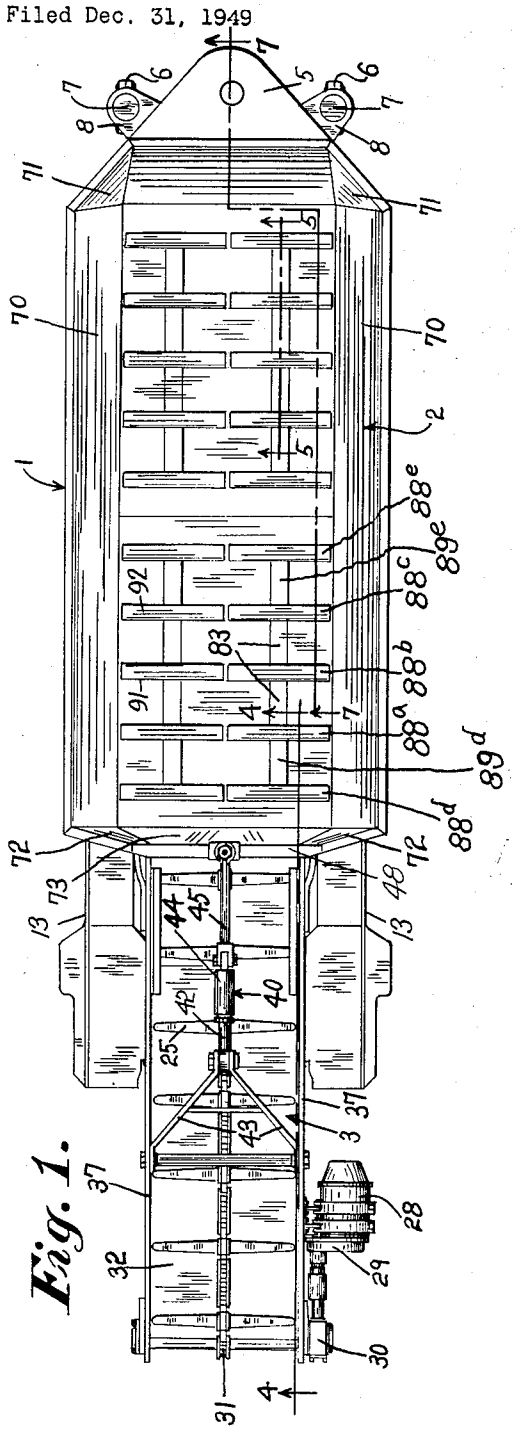


Fig. 1.

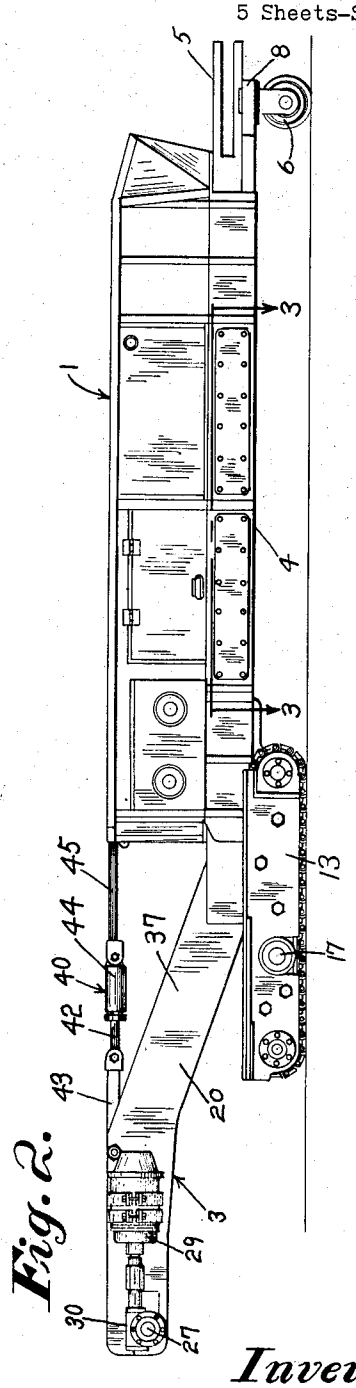


Fig. 2.

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HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

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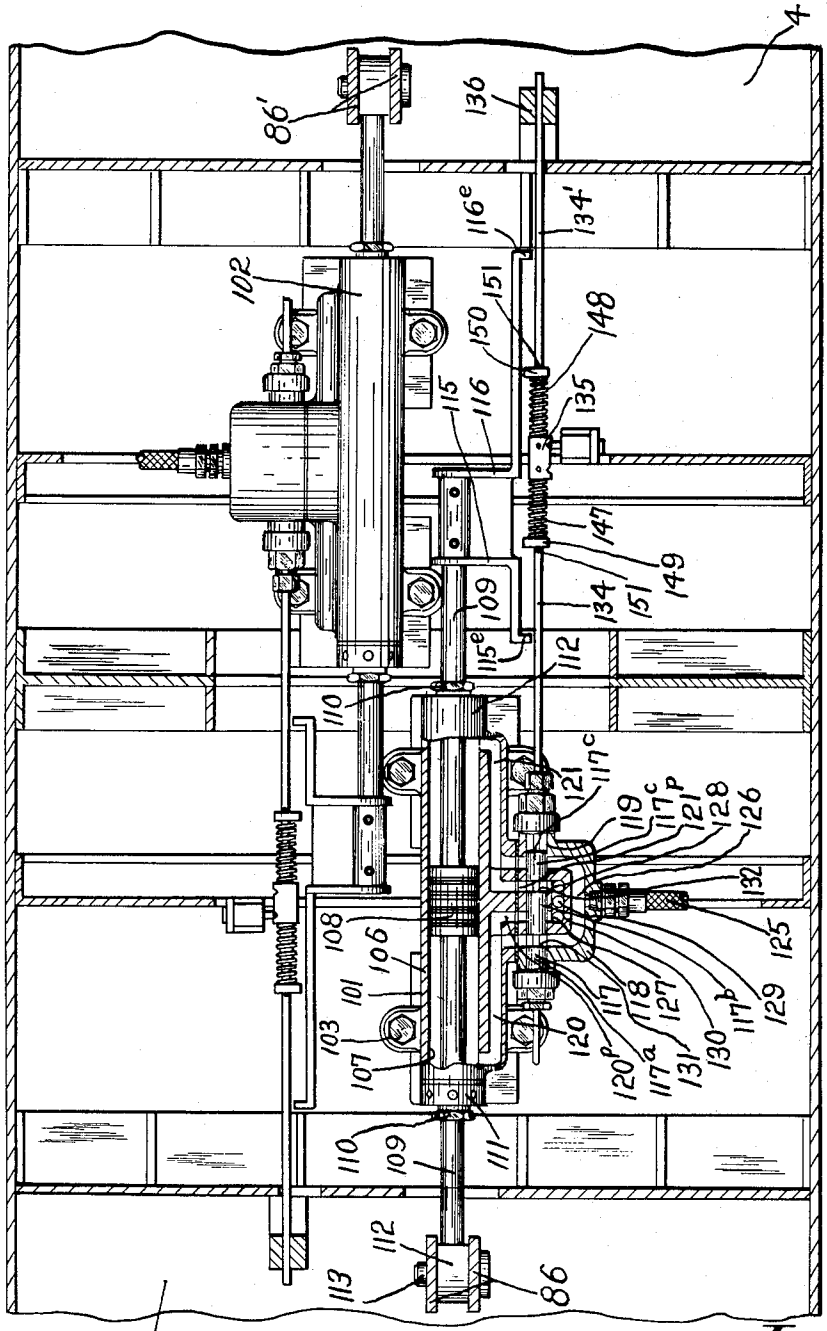


Fig. 3.

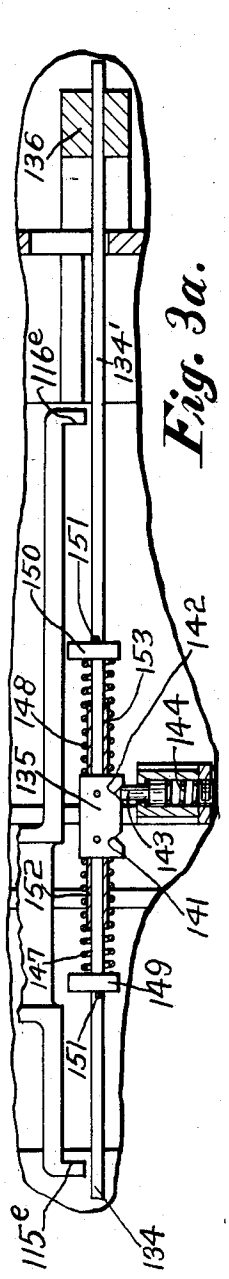


Fig. 3a.

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HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

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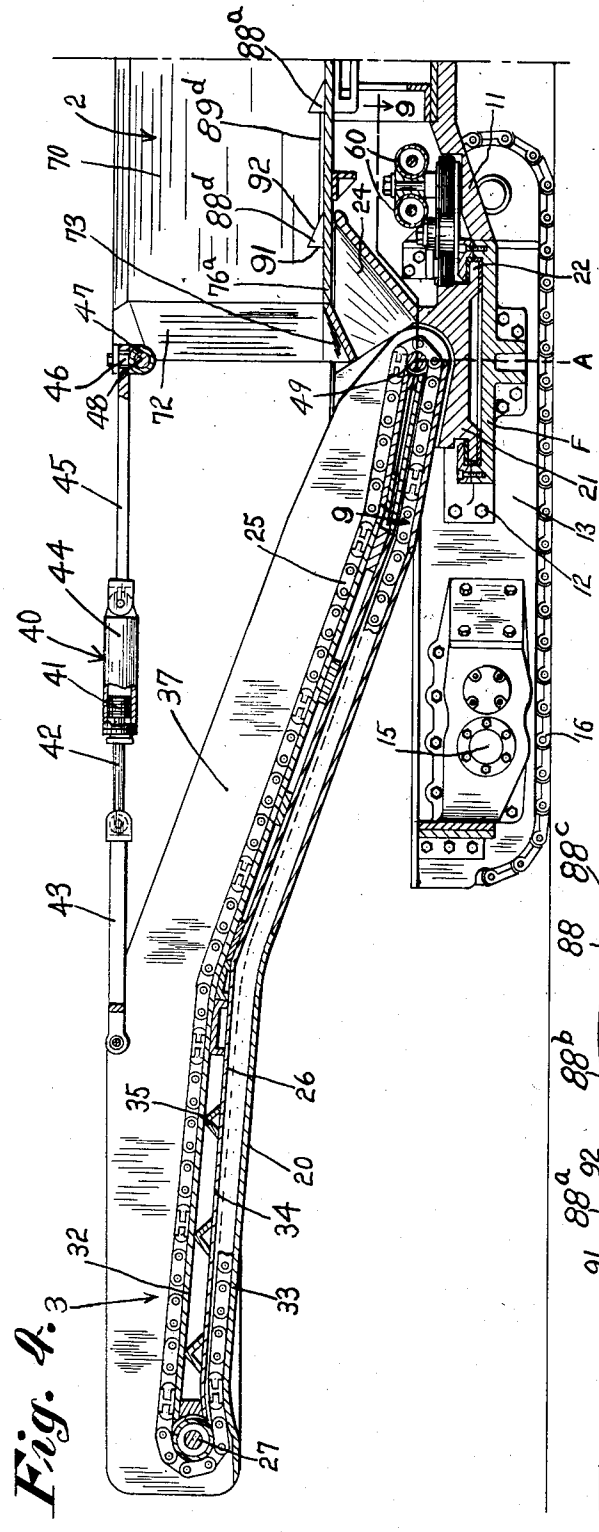


Fig. 4.

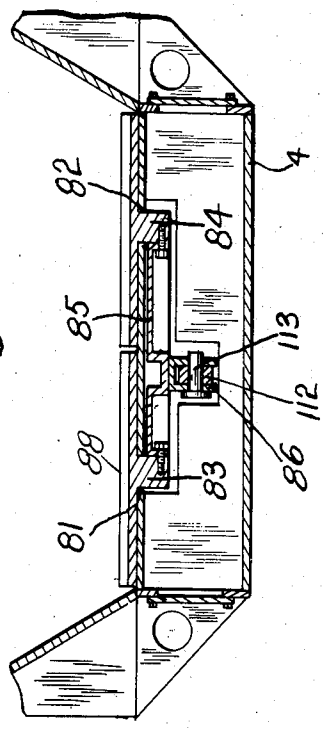


Fig. 6.

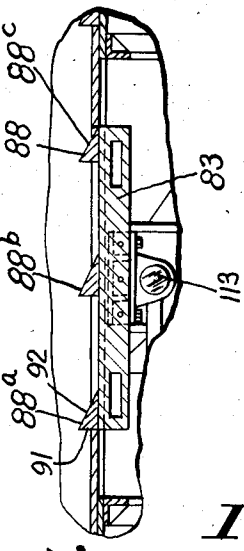


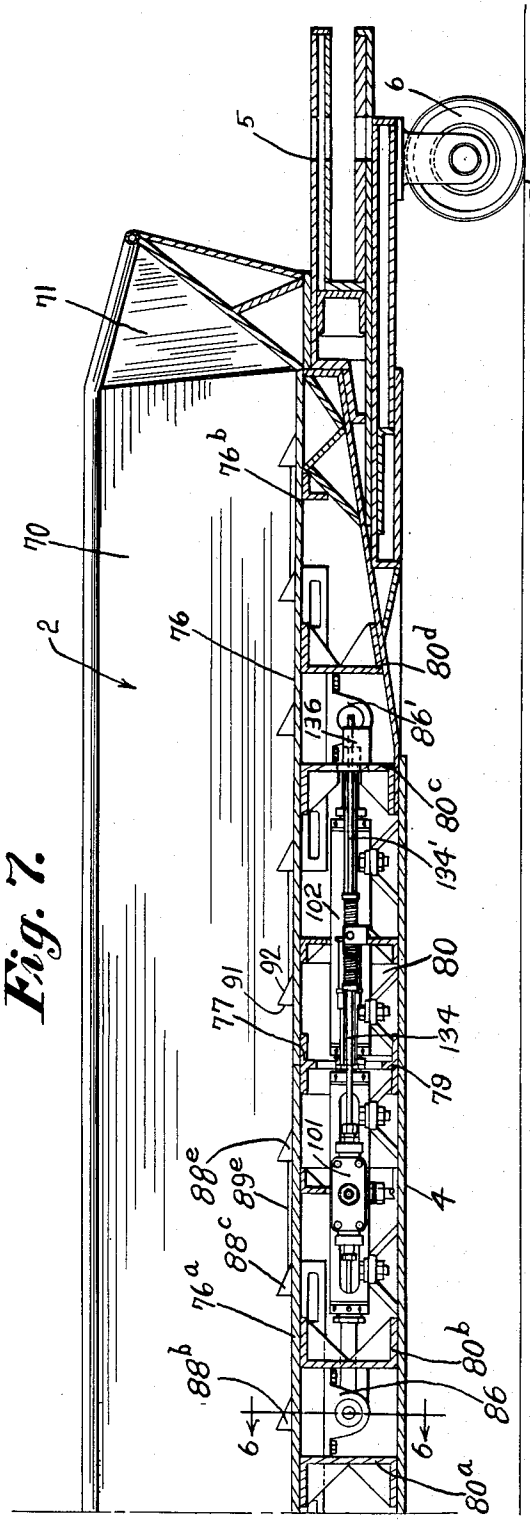
Fig. 5.

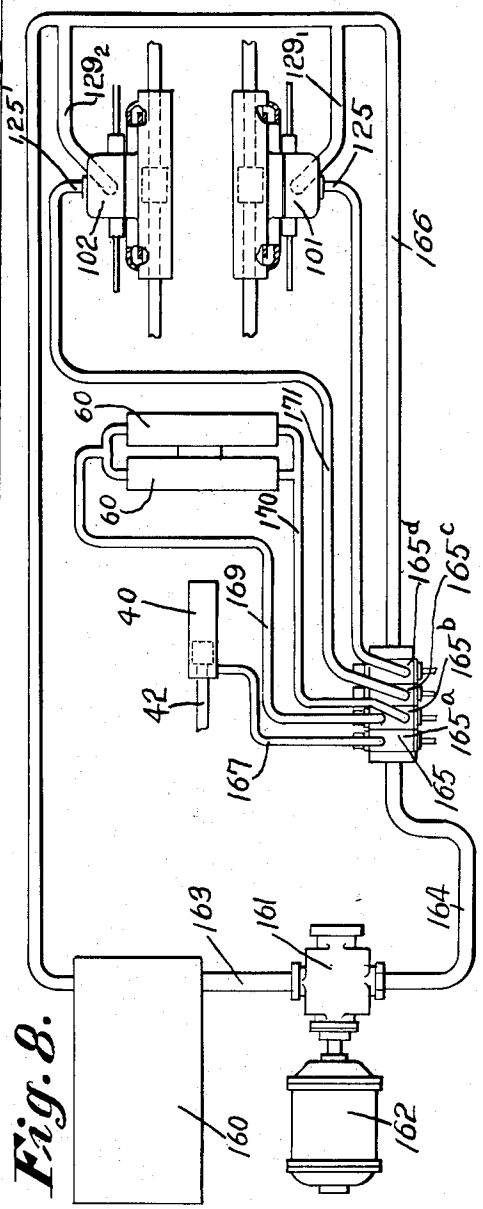
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HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

Filed Dec. 31, 1949 5 Sheets-Sheet 4





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HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

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Fig. 9.

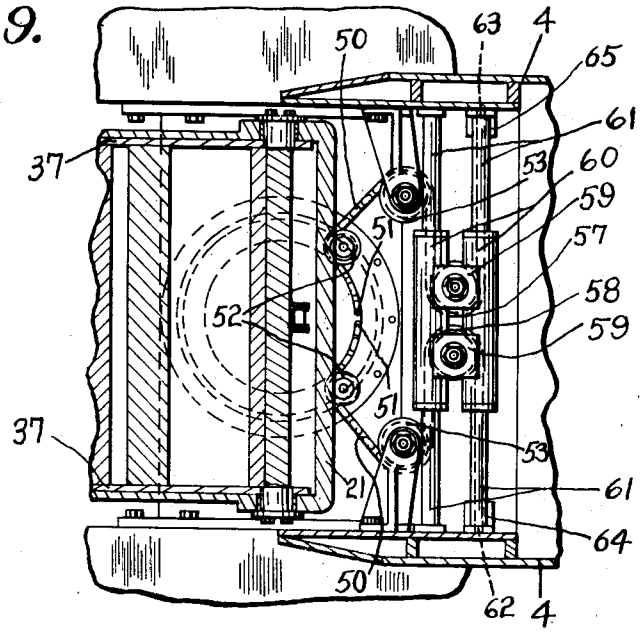
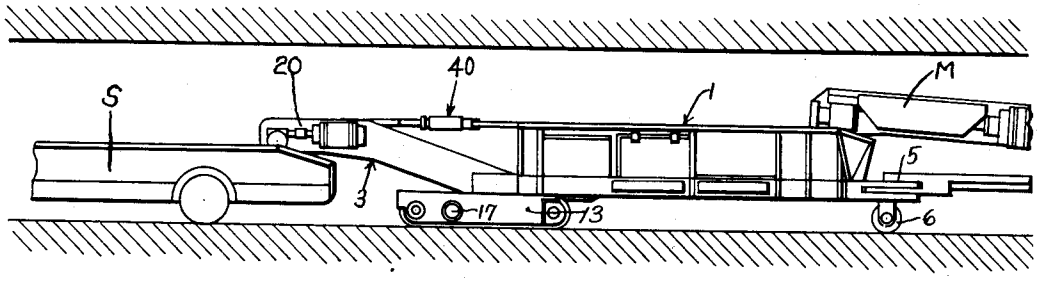


Fig. 10.



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United States Patent Office

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Patented Oct. 4, 1955

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HOPPER CAR WITH MULTIPLE RECIPROCATING CONVEYORS

Arthur L. Barrett, Franklin, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application December 31, 1949, Serial No. 136,317

1 Claim. (Cl. 214—521)

This invention relates to material storage and discharging apparatus, and more particularly to apparatus of the kind mentioned especially adapted for use in the temporary storage and subsequent delivery to material-handling apparatus of disintegrated material discharged by "continuous miners."

"Continuous miners" are adapted to disintegrate mineral veins, such as coal seams, at a relatively constant and high rate. There are brief interruptions, measured generally in seconds, with a well-known type of continuous miner, while the disintegrating apparatus is being shifted laterally between the completion of the disintegration of one upright band and the commencement of the attack on an adjacent band. There are slightly longer intervals, measured still in fractions of a minute, between the completion of the removal of one transverse upright section of the vein and the commencement of the attack on the next such section. Nevertheless, there are no intervals provided by the normal cycling of the apparatus sufficient to permit the transit of a shuttle car, after it has received a load of disintegrated material, from the point of reception of its load, to a point of discharge, and its return, after discharging its load, to a position for the reception of a new load. The provision of suitable storage means for the coal or other disintegrated material while the shuttle car is not in a position to receive a load, and the provision of suitable means for effecting loading of a shuttle car at a very rapid rate when one is available for the reception of a load is, therefore, an important problem, and various attacks upon this problem have been made. The problem is complicated by the fact that during the delivery of a full load of material to a shuttle car there will, unless special provision is made to avoid this condition, be a spreading of a thin layer—thin because of the relatively rapid movement, during the discharging of a load, of such conveying mechanism as is employed—through the material-receiving and material-discharging apparatus; and, when the shuttle car moves away and a full load is being received and stored, much, at least, of the material which forms the thin layer mentioned, will be discharged onto the mine floor. Different modes of avoiding this undesired happening have been developed; and my present invention provides another and advantageous mode of accomplishing this desired result through novel and improved apparatus.

It is an object of my invention to provide an improved material-receiving, storing and discharging apparatus. It is another object of my invention to provide an improved material-receiving, storing and discharging apparatus, including a hopper and improved conveying means associated with said hopper, for receiving and distributing a load of material and for discharging such a load, and for preventing difficulty from arising through the presence of a thin layer of material distributed throughout the bottom of the hopper at the commencement of a period of reception at normal rate by the hopper of a load of material. It is still another object of my invention to provide an improved material-receiving, storing and discharging hopper having improved conveying means associated therewith providing optionally for the movement of material throughout the full length of the bottom of the hopper, or only throughout a portion of the bottom. It is still another object of the invention to provide an improved apparatus of the character mentioned, wherein, through the presence of improved conveying means associated with the hopper, in combination with a suitable material-discharging apparatus, an improved mode of handling material discharged from a continuous miner or the like may be provided. It is still another object of the invention to provide an improved material-distributing and discharging apparatus for a hoper car. Other objects and advantages of the invention will hereinafter more fully appear.

In the accompanying drawings, in which for purposes of illustration, one embodiment which the invention may assume in practice, is shown:

Fig. 1 is a plan view of the apparatus as a whole.

Fig. 2 is a side elevational view of the structure shown in Fig. 1.

Fig. 3 is a fragmentary, horizontal sectional view on an enlarged scale, the section being taken on the plane of the line 3—3 of Fig. 2, with some parts omitted.

Fig. 3*a* is a detail view on a further enlarged scale showing portions of a distributing valve actuating and controlling mechanism for a hydraulic motor.

Fig. 4 is an enlarged vertical sectional view through the discharge end of the apparatus of Figs. 1 and 2.

Fig. 5 is an enlarged fragmentary vertical sectional view on the plane of the line 5—5 of Fig. 1, showing a detail of the conveying mechanism.

Fig. 6 is a transverse vertical section, on an enlarged scale, on the plane of the line 6—6 of Fig. 7.

Fig. 7 is an enlarged vertical longitudinal sectional view on the planes of line 7—7 of Fig. 1.

Fig. 8 is a hydraulic diagram.

Fig. 9 is a transverse horizontal sectional view on the planes of the line 9—9 of Fig. 4, illustrtaing the construction of the swinging mechanism for the delivery conveyor.

Fig. 10 is a diagrammatic view showing the use of the apparatus.

Referring to the drawings, and first to Figs. 1 and 2, it will be observed that the invention is embodied in a vehicle generally designated **1** and including a material-receiving and storing receptacle generally designated **2** and a material-delivering apparatus generally designated **3**. The vehicle includes a generally box-like frame **4** terminating at its forward end in a hitch mechanism **5** and supported at that end by caster wheels **6** herein shown as rubber tired, there being a pair of these wheels, one swivelled on a vertical axis at 7 at either side of the frame by swivelled mountings and brackets **8**. The rear end of the frame **4** includes, adjacent the discharge end of the receptacle **2**, a downwardly sloping lower portion **11** supported on a cross-frame F which is secured as at **12** at its opposite ends to tread frames **13**. Each of these tread frames is provided with an independent, motor-driven variable speed, drive mechanism **15** for driving a tread chain **16**. As these drives are completely conventional and have been widely used in well-known commercial structures by applicant's assignee, they require no further illustration. It may be noted that one of the driving motors for these tread-driving devices is shown at **17** in Fig. 2.

A delivery or discharge conveyor **20** is mounted for swivelling about a vertical axis A by means of a turntable element **21** supported in appropriate guides **22** on the frame F. A hopper portion **24** upon the turntable **21** is positioned to receive material from the body **2**; and a flight conveyor **25** extends from a forward point in the bottom of the hopper **24** upwardly and rearwardly

along a frame 26 to a rear drive mechanism 27. This drive mechanism includes a motor 28 connected through a well-known form of speed-reducing mechanism (not shown, but enclosed in a housing 29) also conventional in various machines of my assignee, to a worm-driving mechanism of which only the casing 30 is illustrated in the drawings. This driving mechanism drives the conveyor 25 through a sprocket 31. Upper and lower deck plates 32 and 33 are provided to guide the active and return runs of the conveyor chain 25, and intermediate the deck plates 32 and 33 is a partition and reinforcing plate 34 secured by various cross braces 35 to the deck plate 32. Suitable side, material-guiding plates 37 are also provided for the delivery conveyor, these being suitably connected to the deck plates 32, 33, the partition and reinforcing plate 34 and the reinforcing means 35.

The height at which the conveyor 3 discharges is controllable by hydraulic cylinder and piston mechanism 40, the piston element 41 of which is connected by piston rod 42 and diverging links 43 to the side plates 37, while the cylinder element 44 is connected by a link 45 to a vertical pivot 46 mounted on a cross frame member 47 suitably secured, as by welding, to the rear end of the hopper 2. A horizontal pivot 48 provides for angling of the element 45 and associated parts relative to the body 2 as the delivery conveyor is raised and lowered. The delivery conveyor is suported for pivotal movement relative to the hopper 24 in any suitable manner, upon a horizontal, transverse pivot 49.

The delivery conveyor may be swung laterally by flexible members, herein chains 50 (see Fig. 9), secured as at 51 to the turntable element 21. The chains 50 pass around pairs of stationary idler sprockets 52 and 53, one pair located adjacent either side of the turntable element 21. The chains then extend around sheaves 57 and 58 rotatably supported by blocks 59 fixed to parallel feed cylinders 60. The feed cylinders have pistons, not shown, connected with oppositely extending piston rods 61, whose opposite ends are secured to the side frames of the box-like frame 4. The opposite ends 62 and 63 of the chains 50 are connected to yielding abutment devices 64 and 65 mounted on the box-like frame 4, and it will be apparent that by admitting fluid to one end or the other of the cylinders 60 the sheaves 57 and 58 will be moved simultaneously toward the one or towards the other side of the apparatus, thereby effecting swinging of the turntable element 21 and the delivery conveyor 20. The swinging mechanism for the delivery conveyor is essentially the same, except in size, as is disclosed in the John R. Sibley application, Serial No. 102,996, filed July 5, 1949, Apparatus for Continuous Mining.

The material-receiving and storing receptacle 2 is supported by the box-like frame 4 and includes sloping side walls 70, sloping end walls 71 at the end remote from the discharge conveyor, and converging end wall portions 72 adjacent the discharge conveyor providing an opening 73 through which material received by the material-receiving and storing receptacle 2 may be discharged to the hopper 24. The material-receiving and storing receptacle is provided with a bottom wall 76 made of two parts, 76^a and 76^b, abutting each other and supported at their adjacent ends on a transverse support member 77 to which the plates 76^a and 76^b are welded or otherwise suitably attached. The material-receiving and storing receptacle, as noted, overlies the box-like frame 4, of which the plates 76^a and 76^b form upper portions, and there is a lower plate 79 also forming a part of the box-like frame 4 and suitably secured to other parts of the frame 4 by various transverse spacer and reinforcing members 80^a, 80^b, 80^c, 80^d, etc. Between the plates 76^a, 76^b, and 79 there is provided a chamber or space 80 in which actuating means for material-handling devices at the bottom of the material-receiving and storing receptacle 2 are arranged.

As the general construction of the plates 76^a and 76^b are quite similar, the construction of the plate 76^a alone will be described in detail. It will be observed that this plate is traversed by a pair of longitudinally extending slots or openings 81 and 82. Through these slots there extend elongated guide blocks 83 and 84 respectively. These guide blocks are connected by a cross frame 85 to which a depending drive connection 86 is suitably secured. The guide blocks 83 and 84 each have connected rigidly to them three material-moving elements 88, these being numbered respectively, for identification, 88^a, 88^b and 88^c. Two other material-engaging and moving elements, 88^d and 88^e, are secured by plate portions, 89^d and 89^e respectively, to the elements 88^a and 88^c. The plate portions are wide enough to prevent escape of material through the slots, and long enough so that the ends of the slots are never uncovered. The material-moving elements 88 may be constructed in any suitable manner to provide relatively large forwardly facing material moving surfaces which exert relatively large thrusts on the material to be moved, and are at the same time so constructed as, as by the presentation of wedge or V-like rearward surfaces to the material during their opposite movements, to move relatively easily, and with much diminished coal-moving tendency, in the opposite direction. Herein they have, as shown, upright faces 91 facing towards the delivery conveyor, and inclined faces 92 which slope away from the vertical faces toward the plate 76^b and the receiving end of the material-receiving and storing receptacle.

It will now be understood that within the bottom of the material-receiving and storing receptacle 2 and movable over the flat bottom of the material-receiving and storing receptacle provided by the plates 76^a and 76^b there are arranged two pairs of sets of material-moving elements, each set including, as shown, five material-moving elements at either side of the longitudinal center line of the material-receiving and storing receptacle, and ten material-moving elements—two banks of five each—being arranged at either end of the hopper section. The spacing of the material-moving elements is essentially such that when all of them are moving in synchronism the effect is to convey all of the material on the bottom of the material-receiving and storing receptacle at a suitably controlled rate toward the discharge conveyor; and, as will shortly be explained, the two banks of material-engaging and moving elements adjacent the discharge conveyor can be moved while the other two are idle, or vice versa, or all twenty of the elements may be moved at once. The advantage of these operating arrangements will be appreciated when the structure by which they are made possible has been described.

It has been noted that the two sets of material-engaging and moving elements which lie near the discharge conveyor are moved by guide blocks 83 and 84, and that both of these guide blocks are simultaneously moved in like directions because they are connected together by the frame 85 to which the single drive connection 86 is attached. The other two series of material-engaging and moving elements are similarly arranged and have a drive connection designated 86'.

Any suitable means may be provided for transmitting reciprocatory motion independently to driving connections 86 and 86'. Such driving connections need to be powerful, and need to be controllable at the will of an attendant, both to vary their speeds individually and to enable either to have its movement interrupted while the other continues to operate. As one simple and appropriate means for accomplishing these functions suitable valved and controlled hydraulic operating mechanisms 101 and 102 are provided, the mechanism 101 being associated operatively with the banks of material-moving elements nearer the discharge conveyor, and the mechanism 102 with the banks of material-moving elements more remote from the discharge conveyor. As straight line reciprocation is all that is involved, the mechanisms 101 and 102 may be rigidly

held as by bolts **103** to mounting brackets **104** supported on the bottom plate **79** of the box-like frame section **4**. The structures of the two mechanisms **101** and **102** are the same, there simply being a reversed disposition of these mechanisms on the frame of the apparatus, and accordingly mechanism **101** alone needs to be described. These mechanisms are hydraulic motors with automatically controlled distributing valves, and may be of any suitable form. As illustrated, the motor mechanism **101** includes a cylinder **106** having a bore **107** in which a piston **108** is reciprocable. This piston is connected to a piston rod **109**, which extends through suitable glands **110** in each of the heads **111** and **112** of the cylinder **106**. One end of the piston rod **109** is connected to a block **112** which is pivotally secured, by a pivot pin **113**, to the drive connection **86**. The other end of the piston rod **109** carries arms **115** and **116**, having ends **115^e** and **116^e** respectively, which constitute actuating elements for the distributing valve **117** of the motor mechanism **101**. It will be noted that this distributing valve is enclosed in a valve chest **118**, and is reciprocable in a bore **119** in the chest. Fluid distributing passages **120** and **121** extend from the bore **119** at points relatively near the opposite ends of the latter to the opposite ends of the cylinder bore **107**. Associated with each of the distributing passages **120** and **121** are what may be called parallel passages **120^p** and **121^p**. These open into the bore **119** at points between the points of connection of the main passages **120** and **121** with that bore, and relatively close to each other. A fluid supply connection **125** opens into a U-shaped passage **126**, whose branches are in line with the points of communication of the passages **120** and **121** with the bore **119**. Opposite the points of communication of the passages **120^p** and **121^p** with the bore **119** are passages **127** and **128** which communicate with an exhaust connection **129** through a longitudinal passage **130** in the valve chest.

The distributing valve **117** is of the three-spool type and includes spools **117^a**, **117^b** and **117^c**, and there are grooves formed in the distributing valve as at **131** and **132**, the groove **131** separating the spools **117^a** and **117^b** and the groove **132** separating the spool **117^b** from the spool **117^c**. In the mid-position of the valve the distributing passages are all cut off from communication from both fluid supply and exhaust. The valve **117** is provided with an operating rod **134** which carries a block **135**, and which is guided at a point beyond the block **135** by an extension of the stem **134** numbered **134'**, as indicated at **136**. Referring, before describing the actuating means for the valve, again briefly to Fig. 3, it will be noted that the valve **117** is at the left-hand end of its travel in the valve chest **118**, and that it is supplying fluid from the U-shaped passage **126** via the distributing passage **120** to the left-hand end of the cylinder bore **107**, while simultaneously the right-hand end of the cylinder bore is being vented to the exhaust line **129** through a portion of the distributing passage **121** and the auxiliary distributing passage **121^p**.

The extremities or ends **115^e** and **116^e** on the arms **115** and **116** are adapted to move the block **135** and thereby the distributing valve in opposite directions. Since the mechanisms **101** and **102** are hydraulic motors, there is provided a special valve-actuating mechanism which will insure complete and timely shiftings of the distribution valve. Many other arrangements could be used, such as electrical controls, pilot valve devices with dwells, etc., but a simple mechanism effective for the purpose consists simply of forming a couple of notches **141** and **142** in one side of the block **135** (though these may be circumferential grooves) and associating with them a spring held detent **143** with a spring **144** by which it is yieldingly held in engagement with one or the other of the notches, and these providing resilient throwing means for the valve. The resistance to movement of the block **135** is substantial with these detent arrangements, and to provide sufficient thrust upon the block to effect its movements, the rod **134** is surrounded at opposite sides of the

block with suitable springs **147** and **148** engaging the block at one end and having their other ends engaging slidable collars **149** and **150** which surround the rod and are normally forced by the springs **147** and **148** against suitable stop pins **151**. In order to provide for positive starting movement of the valve stem, sleeves **152** and **153** may be arranged around the valve stem and be made enough shorter than the distance between the collars and the blocks so that only after the requisite energy has been stored in the springs will there be any positive movement imparted to the blocks by the engagement of the collars with the sleeves. The movement of the block necessary to free it from the action of the detent **143** will be made less than the movement of the valve rod necessary to effect interruption of communication between the ends of the cylinder bore **107** and the supply and exhaust connections.

The mode of operation may be understood by noting that, with fluid supply that is hereinabove described, the piston **108** is moving toward the right in Fig. 3. Accordingly the arm **115** is moving toward the right. Shortly before the piston reaches the end of its stroke the end **115^e** will engage the collar **149** and continued movement of the piston will result in compression of the spring **147** and the storing of energy in this spring. Reliance could be placed wholly on the stored energy in the spring, or on the engagement of the spring coils with each other, to start the positive movement of the valve rod and its release from the holding action of the detent **143**, but, as illustrated, the collar **149** will engage the sleeve **152** and positively start movement of the valve rod **134** just before the piston **108** reaches the desired right-hand position in the cylinder bore **107**. When the holding action of the detent has been interrupted, the movement of the valve rod will be quickly completed by the expansion of the pre-compressed spring **147**.

The hydraulic system of the apparatus may now be briefly described. A tank or reservoir **160** is provided for a suitable hydraulic fluid. A pump **161** driven by any suitable motor **162** mounted on the apparatus is adapted to draw fluid from the tank through a conduit **163** and discharge it through a conduit **164** to a suitable multiple-unit valve box **165**. This valve box may provide for a free flow-through of fluid when its several valves are in neutral position, and may be equipped with a suitable relief valve for preventing the building up of excessive pressures, this type of valve being well-known and widely used in the products of my assignee. The other end of the valve box **165** is connected by a return line **166** with the tank or reservoir **160**. One unit **165^a** of the valve box controls the supply and venting of fluid via a conduit **167** relative to the cylinder and piston mechanism **40** which controls the elevation of the discharge end of the discharge conveyor **3**. The next unit, with the parts arranged as shown, is numbered **165^b**, and it effects the supply and discharge of fluid via conduits **169** and **170** to the opposite ends of turntable swing cylinders **60**. The third valve box unit, **165^c**, controls the supply of fluid through a conduit **171** to the connection **125'** of the motor **102** and the valve unit **165^d** controls the flow of fluid through the conduit **125** to the motor **101**. The exhaust conduits from the mechanisms **102** and **101** are designated **129$_2$** and **129$_1$** and lead to the return line **166**. Evidently the valve unit **165^a** may be manipulated to change the elevation and to hold at the desired elevation the delivery conveyor discharge end. The valve unit **165^b** can effect lateral swinging of the delivery conveyor in either direction from central position, or return it to central position after displacement in either direction. The operation of the motors **102** and **101** can be controlled respectively by the valve units **165^c** and **165^d**. Either of these motors can be run alone or both together. The motor **28** can operate the delivery conveyor either when the motors **101** and **102** are operating or when either or both of the latter are idle.

One more point remains to be mentioned. The material-engaging elements will evidently move in a direction away from the delivery conveyor, due to their tapered construction, with minimum movement of the coal in the material-receiving and storing receptacle 2. In the opposite direction they will positively move the coal in front of them and thus tend to move, and effect the delivery to the discharge conveyor of the entire contents of the material-receiving and storing receptacle. While the material-moving elements are herein shown as generally wedge-shaped in construction and as relatively rigid with respect to the devices which effect their reciprocation, it will be understood that they are as shown but illustrative of any type of material-moving apparatus in which the material-engaging elements move with relatively small resistance through the coal or other material while traveling in one direction and exert a much augmented material-thrusting force when traveling in the other direction.

Referring now to Fig. 10 the mode of operation of the apparatus which has been described may be readily understood. A "continuous miner," M, is shown in Fig. 10 as discharging to the material-receiving end of the apparatus 1, that is, to the right-hand end of that apparatus in Figs. 1 and 2. The "miner" is shown as connected by the hitch mechanism 5 to the apparatus 1, so that the material-receiving and storing receptacle 2 will be maintained in the desired underlying relation to the discharge of the "continuous miner."

Assuming that the receptacle 2 has no material in it, as might be the case after a period of substantial shutdown of the "miner," and that the "miner" commences to disintegrate a portion of the mineral vein, it will be appreciated that the "miner" will discharge material onto the plate 76[b] and that, by appropriate operation of the motors 102 and 101 with resultant actuation of the conveying devices which these motors actuate, a load of material can be received and properly stored in the receptacle 2, and, if necessary, some of this material may even be stored in the discharge conveyor 20.

When it is desired to discharge the load from the receptacle 2 to a shuttle car S arranged beneath the discharge conveyor 20, as shown in Fig. 10, the speed of operation of the motors 102 and 101 may be increased and the motor 28 may drive the discharge conveyor at such a relative rate as will effect, ordinarily in a fraction of a minute, the complete delivery of the initial stored load from the apparatus 1.

As the "miner" will be continuing to disintegrate the vein and to discharge the disintegrated mineral into the receptacle 2, it will be clear that, during the fraction of a minute which may be required for the discharge of the full load, there will still be being delivered into the right-hand end of the receptacle 2 material at the normal rate of delivery by the "miner" M. Because the conveyors in the bottom of the receptacle are operating at a much higher speed than during normal load reception, this material will be distributed, as the main load moves out, over the bottom of the receptacle in a much thinner layer, and, if special arrangements were not made to dispose of at least a large part of this layer before the shuttle car left the apparatus 1, this material might be discharged onto the mine bottom and have to be shoveled.

A very desirable way of handling this material to prevent the undesirable result just mentioned is to stop—or substantially stop—the motor 102 and let the discharge from the "miner" simply continue onto the plate 76[b] while all the material on the plate 76[a] and in the delivery conveyor is loaded into the shuttle car before the latter leaves to deliver its load. When this procedure is adopted it will be evident that after the left-hand conveyor sections and the discharge conveyor have been emptied, the material on the plate 76[b] may be moved over toward the left—toward the discharge conveyor—and a complete load stored in the receptacle 2, any material which tends to pass beyond the left-hand end of the plate 76[a] being stored in the delivery conveyor by appropriate actuation of the latter.

Instead of storing the material on the plate 76[b], the motor 101 may be stopped, or preferably be operated very slowly, while the motor 102 is operated more rapidly, but still relatively slowly, and the material which would otherwise form the layer will be stored principaly on the plate 76[a] after the delivery conveyor has been cleared of material. The motor 101 may be maintained inactive while the motor 102 operates, if desired, as above noted, but it is thought that better results may be obtained if the motor 101 is slowly operated. After the material that would have formed a layer has been stored on the plate 76[a], a complete load may be received by the receptacle 2 and, in part by the delivery conveyor, if necessary.

The ability to operate the motors 101 and 102 separately or together, and at widely varying rates, and the ability to operate the flight chain of the discharge conveyor independently by its motor 28, provide a very flexible mode of operation.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claim.

What I claim as new and desire to secure by Letters Patent is:

In an apparatus of the character described, a receptacle for receiving and storing material, material-conveying means extending along the bottom thereof, a delivery conveyor supported to receive material from said receptacle, and supporting and transport means for said apparatus including caster wheels at opposite sides of the center line thereof at its forward end and mutually independently driven tractor devices underlying the other end of said receptacle, said tractor devices having a transverse frame connecting them and underlying the rear end of said receptacle and said delivery conveyor having a receiving hopper from which it is adapted to draw material pivotally supported on said transverse frame.

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