April 30, 1935. S. M. MERCIER 1,999,419

CONVEYER APPARATUS

Filed Jan. 22, 1932 4 Sheets-Sheet 1

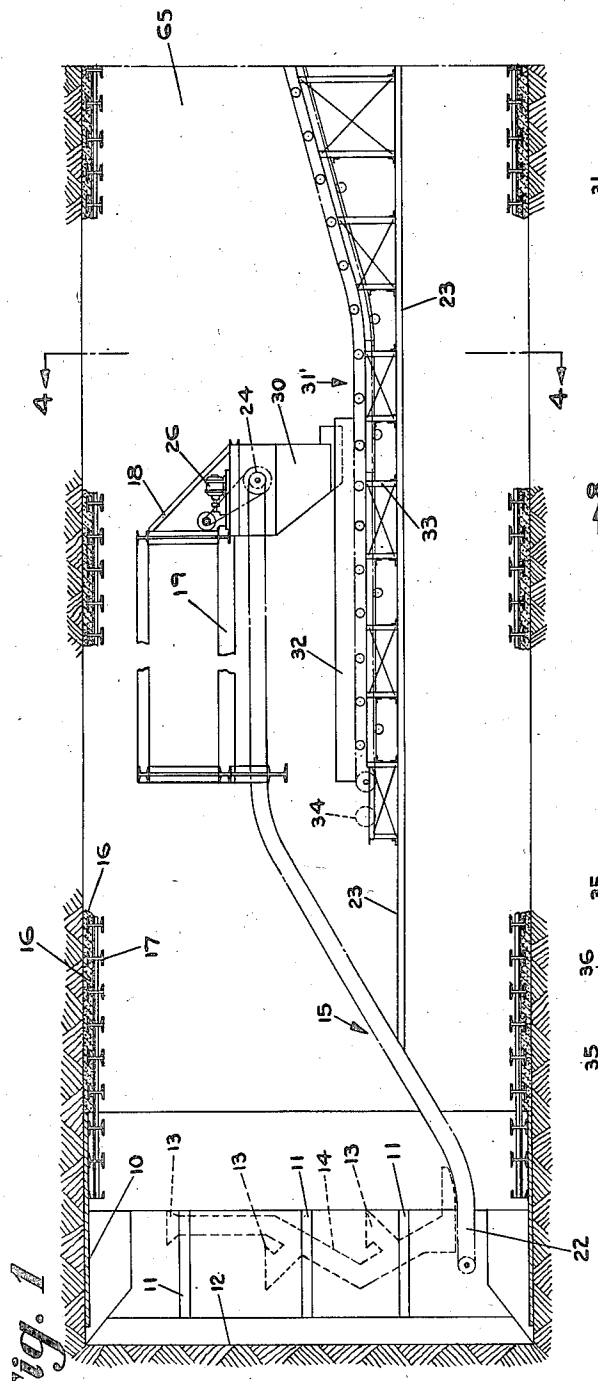


Fig. 1

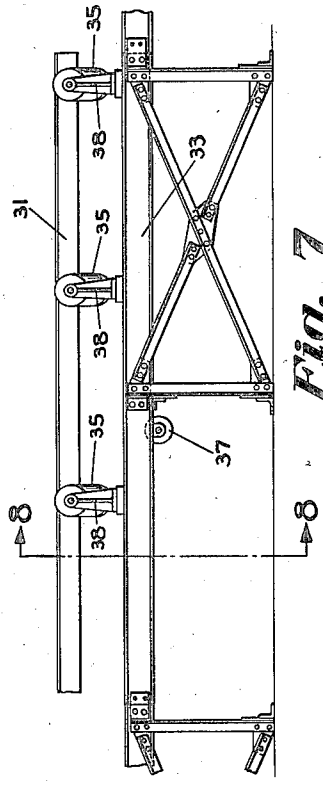


Fig. 7

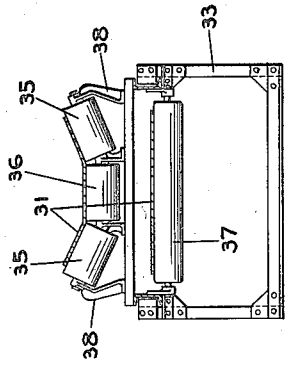


Fig. 8

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CONVEYER APPARATUS

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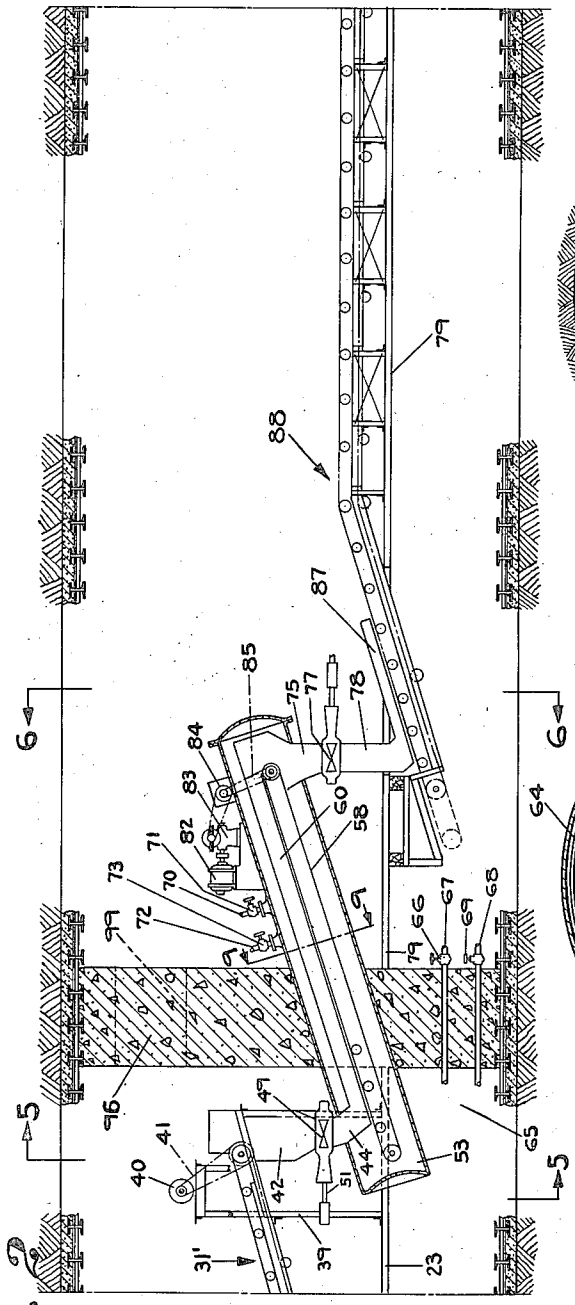


Fig. 2

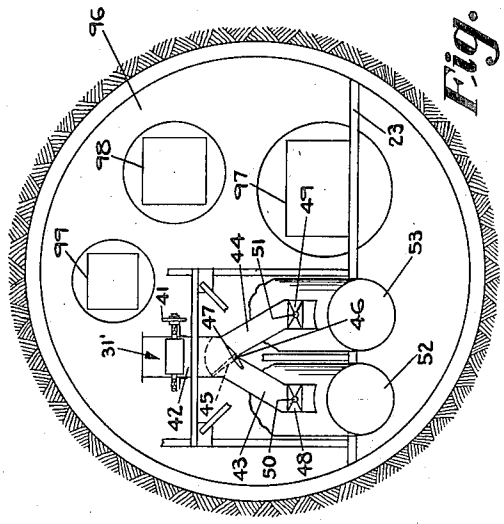


Fig. 5

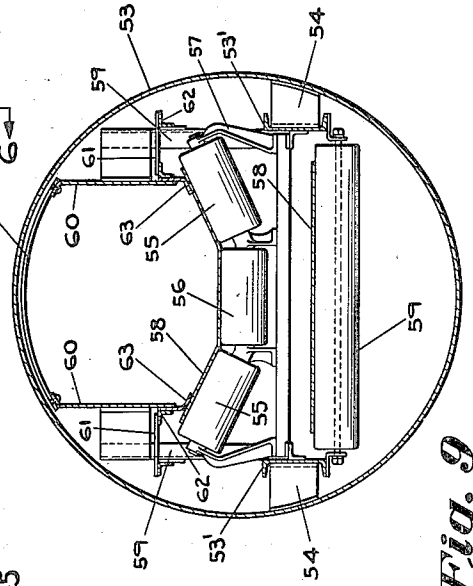


Fig. 9

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CONVEYER APPARATUS

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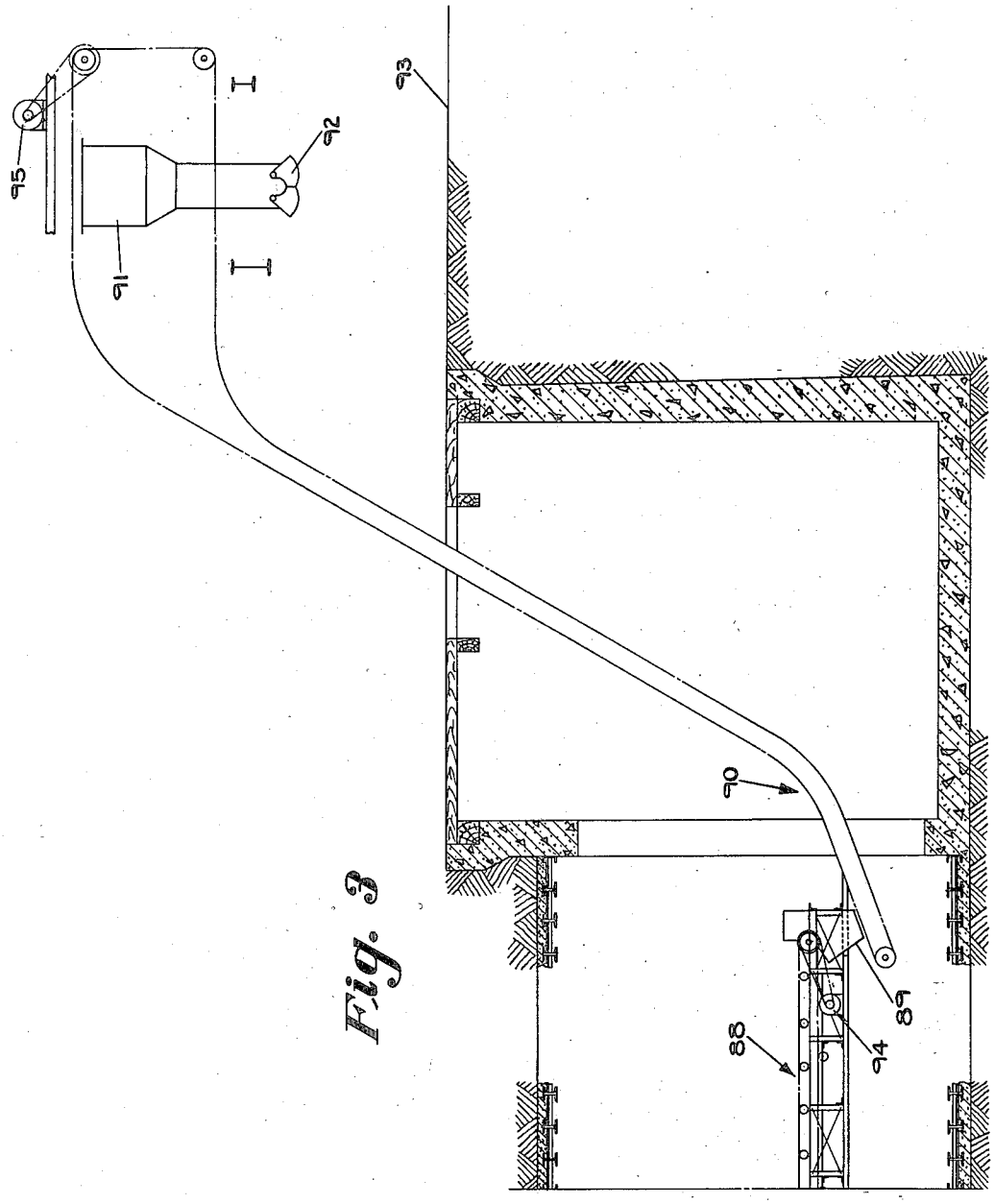


Fig. 3

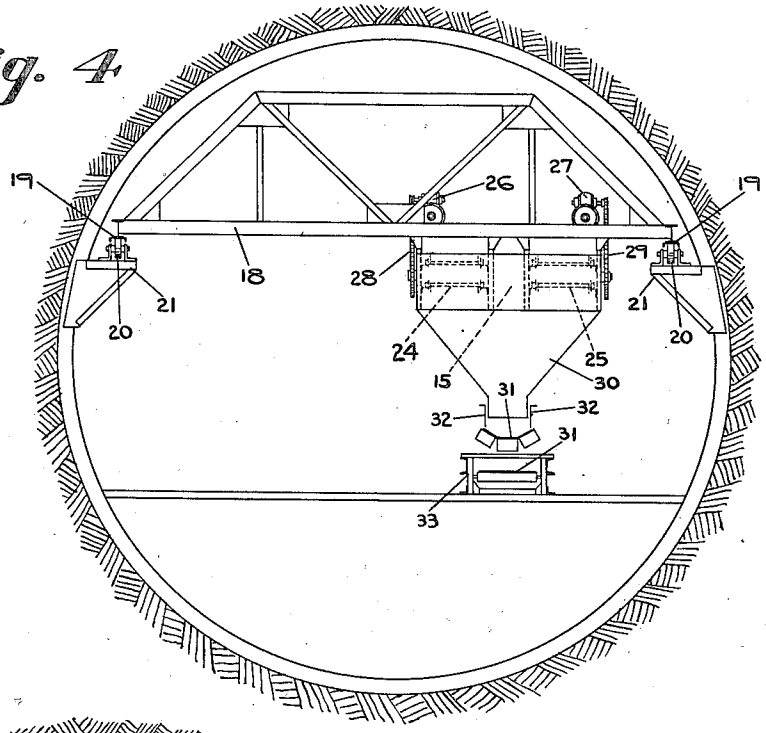
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CONVEYER APPARATUS

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Fig. 4.



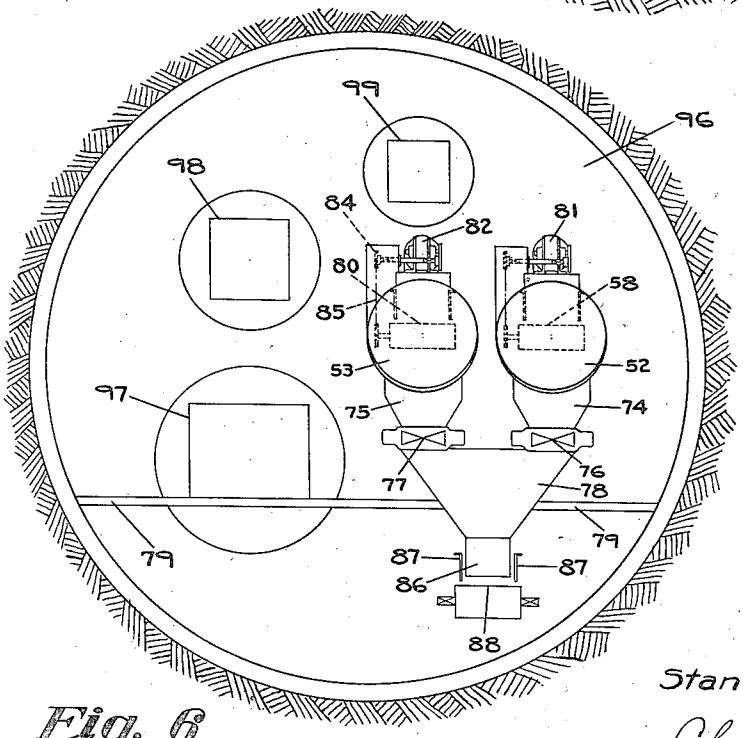


Fig. 6

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UNITED STATES PATENT OFFICE

1,999,419

CONVEYER APPARATUS

Stanley M. Mercier, Boston, Mass., assignor, by mesne assignments, to Silas Mason Company, Inc., a corporation of Delaware

Application January 22, 1932, Serial No. 588,162

3 Claims. (Cl. 61—84)

My invention relates to conveyer apparatus particularly adapted for use in connection with underground excavations.

One of the objects of my invention is the provision of a continuously operable conveyer system between a tunnel heading underground to an unloading station above ground.

Another object of the invention is the provision of improved and efficient mechanism for conveying material through a partition from a compressed air chamber.

A further object of the invention is the method of removing excavated material from a compressed air chamber through an auxiliary air-locked auxiliary chamber to avoid disturbance of the air in the compressed air chamber.

More particularly it is the object of the present invention to provide for conveyer apparatus in a tunnel auxiliary compressed air chambers and mechanism to control the pressure of the air therein and the passage of excavated material therethrough so that without interruption such material may be effectively transferred through a bulkhead in a tunnel from the compressed air chamber where workmen are excavating at the tunnel heading.

Other objects of the invention will appear hereinafter, the novel features and combinations being set forth in the appended claims.

In the accompanying drawings

Figs. 1, 2 and 3 placed end to end represent more or less diagrammatically my improved method and apparatus for removing excavated material from a compressed air chamber at a tunnel heading.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 1 looking in the direction of the arrows.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 2 looking in the direction of the arrows toward the bulkhead in the tunnel;

Fig. 6 is a sectional view on the line 6—6 of Fig. 2 looking in the direction of the arrows toward the bulkhead in the tunnel;

Fig. 7 is an enlarged side view of a portion of the conveyer shown in Fig. 1;

Fig. 8 is a sectional view on the line 8—8 of Fig. 7 looking in the direction of the arrows; and

Fig. 9 is an enlarged sectional view taken on the line 9—9 of Fig. 2 looking in the direction of the arrows.

Referring to Fig. 1, 10 designates a cylindrical shield having transverse horizontal platforms 11 on which the workmen may stand while manually excavating the material from the working face 12 of the cylindrical tunnel. Hoppers shown diagrammatically at 13 may be located in convenient position at the various platforms 11 to receive excavated material for passage into the chute 14 and then into the receiving end of the endless conveyer 15.

Back of the cylindrical shield 10 the cylindrical wall of the tunnel may be composed of concrete 16 reinforced by the metal structure illustrated at 17 in the usual manner of lining such tunnels to withstand enormous external pressures particularly when the tunneling is being carried on through earth beneath a body of water.

As the excavation from the working face or tunnel heading 12 proceeds and the tunnel is thereby lengthened the shield 10 is moved forward from time to time and the tunnel lining 16, 17 extended accordingly.

I therefore prefer to mount the conveyer 15 on a carriage 18 the lateral ends of which are provided with longitudinal guide shoes 19, 19 adapted to engage the upper sides of two series of rollers 20, 20 mounted on the brackets 21, 21 which are located on opposite walls of the tunnel at the elevation illustrated in Figs. 1 and 4. It should be particularly understood that the frame 18 serves to support the conveyer structure 15 for movement forwardly along the brackets 21, 21 so that as the shield 10 is stepped forward to the working face or tunnel heading from time to time and the tunnel lining is extended accordingly the frame 18 is moved along the brackets 21, 21 to maintain the receiving end 22 of the conveyer 15 under the chute 14.

The frame of the conveyer structure 15 is secured rigidly at its rear end to the carriage frame 18 so as to move bodily therewith at all times. The forward inclined portion of the conveyer 15 and the receiving end 22 thereof are therefore suspended in a space which is free and unobstructed, thereby facilitating loading excavated material onto the conveyer and the operations necessary to move the shield 10 forwardly and to extend the tunnel walls. If desired the floor 23 may be extended forwardly under the conveyer 15 so as to lend support to the inclined portion thereof as shown in Fig. 1.

The conveyer apparatus 15 may be composed of two sections 24, 25 each operable independently of the other by separate motors 26, 27 connected by the chains 28, 29 to the sprockets which drive the chains of the conveyer sections.

Either conveyer 24 or 25 may be operated or

both may be simultaneously operated to deliver material to the hopper 30 for passage to the belt conveyer. Lateral spaced-apart vertical guides 32, 32 may be mounted on the supporting frame 33 of the conveyer 31' to prevent the material delivered to the belt 31 from spilling off the sides. The vertical guide walls 32 may extend rearwardly to the rear end of the conveyer 31' as shown in Fig. 1 so that as the carriage 18 moves forward step by step toward the tunnel heading the lower delivery mouth of the hopper 30 will remain in delivery communication with the conveyer belt 31.

When the rear end of the conveyer 31' is reached by the step by step movements of the conveyer 15 toward the tunnel heading the conveyer 31' and the frame 33 may be extended by having sections added thereto and a section of belt 31 may be inserted and the apparatus reassembled in its extended position. The walls 32 may be moved forwardly accordingly. Such extensions of the conveyer 31' may be repeated until the tendency for water to seep into the tunnel through the working face becomes so great that the compressed air is unable to prevent it, whereupon the building of another bulkhead or partition in the tunnel, to the right of the conveyer 31' as viewed in Fig. 1, will become necessary.

While various types of conveyer apparatus may be mounted on the floor 23 in the manner shown in Figs. 1 and 2 I prefer to use an endless belt conveyer for use in tunnels. The belt 31 is shown in Figs. 7 and 8 mounted on the rollers 35, 36 in trough-shaped formation so far as the upper run is concerned while the lower run is guided along the cross rollers 37 journaled in the framework 33. The rollers 35, 36 are shown supported by means of the standards 38 secured to the framework.

The rear end of the conveyer 31' is supported in an upwardly inclined position as shown at the left-hand end of Fig. 2. The belt 31 is arranged to be driven by the motor 40 and sprocket chain 41.

The rear end of the conveyer 31' is arranged to deliver material into the hopper 42 as shown in Figs. 2 and 5. From the hopper 42 the material may pass into one of the branches 43 or 44 of a bifurcated chute. The entrance of the material into one of the branches 43, 44 is controlled by the deflector valve 45 hinged at 46 as shown in Fig. 5. This valve may be operated by applying proper power to one of the arms 47. When the valve 45 is in the position shown in Fig. 5 the material will pass from the conveyer 31' through the hopper 42 into the branch chute 44.

Near the lower ends of the chutes 43, 44 are slide valves 48, 49 which may be operated by means of the exterior rods 50, 51. When the deflector valve 45 is in the position shown in Fig. 5 so as to establish communication between the hopper 42 and the chute 44 the valve 49 should be open and the valve 50 closed.

Extending through the bulkhead or partition 96 in the tunnel are two tanks 52, 53 each preferably of metal and each preferably cylindrical and capable of withstanding an internal air pressure equal to that used in the chamber at the tunnel heading to the left of the bulkhead 96 as viewed in Figs. 1 and 2. The auxiliary chambers afforded by these tanks are each entirely closed. The chute 43 communicates through an airtight connection with the tank 52 and the chute 44 communicates through another air tight connection with the tank 53.

Each tank is provided with an endless belt conveyer a cross-section of which is shown in Fig. 9. The conveyer frame 53' is secured by means of brackets 54, 54 to opposite walls of the tank and guide rollers 55, 56 are mounted on standards 57 to support the upper run of the endless belt 58 in trough formation while the lower run of the belt is guided on the lower rollers 59 journaled in supports on the under side of the framework 53'.

Also mounted on the framework 53' are the standards 59, 59 which serve as supports for the vertical walls 60, 60 at the sides of the belt conveyer. The lower ends of these walls connect with the longitudinal plates 61, 61 and angle bars 62, 62 to support the angular sealing plates 63, 63 which engage the upper surface of the upper run of the belt. While an arcuate crosspiece 64 extends between the upper ends of the walls 60, 60 it should be understood that the longitudinal chute formed by the walls 60 is in free communication with other portions of the tank so far as air pressure is concerned.

The pressure of the air in the working chamber 65 may be controlled by the valve 66 in the supply pipe 67 which extends through the bulkhead 96 as shown in Fig. 2 while exhaust may be effected through the exhaust pipe 68 under the control of the valve 69.

Likewise the air pressure in each tank may be controlled by means of valves in supply and exhaust pipes. Each tank is provided with a supply pipe and an exhaust pipe each pipe having a control valve therein. For the tank 53 a supply pipe is shown at 70 with a control valve 71 therefor and an exhaust pipe is shown at 72 with a control valve 73 therefor.

Extending through openings in the lower sides of the rear elevated ends of the tanks 52 and 53 are chutes 74, 75 each of which makes an air tight fit with the walls of the tank to which it is connected. Slide valves 76, 77 are relied on to control the passage of the material from the chutes 74, 75 into the hopper 78 which extends through the floor 79 as shown in Fig. 6.

The conveyers 58 and 80 in the tanks 52 and 53 are operable individually and independently of each other as shown in Fig. 6 which is a view taken on the line 6—6 looking in the direction of the arrows or to the left toward the bulkhead 52. Electric motors 81 and 82 may be connected through self-locking worm gearing 83, sprockets 84 and sprocket chains 85 to the conveyers 58 and 80 to drive the same alternately.

When material passes into the hopper 78 it is discharged therefrom through the mouth or spout 86 between the protecting walls 87, 87 onto the extensible conveyer. This conveyer may be the same in construction as that shown in Figs. 7 and 8, but on account of the inclined receiving end adjacent the hopper 78 the conveyer 88 is extended by inserting sections intermediate its ends and extending the endless belt likewise. Such extension is effected from time to time when a tunnel underground is started and is discontinued after the position is reached where a bulkhead is necessary.

The delivery end of the conveyer 88 is provided with a delivery chute 89 through which the material passes onto the receiving end of the conveyer 90. The latter is diagrammatically shown in Fig. 3 in position to take the material from the entrance to the tunnel and deliver it to the hopper 91 from which it may be discharged through the control valve 92 into wagons on the street level 93.

The conveyers 88 and 90 are individually and

separately operable. The conveyer 38 is operable by means of the motor 94 geared thereto and the conveyer 90 is operable by the motor 95 geared thereto. Each of the six conveyers between the tunnel heading and the street level is independently and separately operable so that any one of them may be controlled to start, stop or operate at any desired speed.

In the conveying system disclosed the closed compressed air tanks 52, 53 forming the auxiliary chambers are prefebaly inclined upwardly as shown in Fig. 2 so as to afford sufficient room or space for the receiving hopper and the discharge hopper and the chutes connected to these hoppers.

In operating the system disclosed it is desirable to convey the excavated material from the tunnel heading to the street above ground without interruption. That is to say, the excavated material is conveyed from the compressed air working chamber at the tunnel heading through the bulkhead and thence above ground in one continuous operation without disturbing the compressed air chamber.

The chutes 43, 44 leading downwardly from the hopper 42 have an air tight fit with the tanks 52, 53 and the slide valves 48 and 49 when closed are also air tight. Likewise the chutes 74, 75 have an air tight fit with the elevated ends of the tanks 52, 53 and the slide valves 76 and 77 when closed are also air tight.

After the air in the working chamber 65 has been brought up to the desired pressure, such as a pressure of between twenty and thirty-five pounds per square inch or more, by manipulating the valves 66 and 69 the pressures in the tanks 52, 53 may be regulated by means of the valves 71, 73. During such operations care must be exercised to keep the valves 48, 49 and 76, 77 closed.

When excavated material is directed to the hopper 42 the latter may act as a storage hopper of material whenever desired. Either or both conveyers 24, 25 may therefore be operated continuously while a change is being made from one tank to another. When the valve 45 is in the position shown in Fig. 5 the material will be directed into the chute 44 but so long as the valve 49 is closed the hopper 42 continues to act as a storage hopper.

When all the valves 48, 49 and 76, 77 are closed the air in either tank may be exhausted or compressed. If the material is to be directed into the tank 53 the exhaust valve 73 is kept closed and the supply valve 71 opened. The valve 77 should also be kept closed. Compressed air enters the tank through the supply pipe 70 until the air in the tank 53 is at the same pressure as that in the working chamber 65, whereupon the valve 71 is closed. Then by opening the valve 49 the material may be discharged from the hopper 42 through the chute 44 to the conveyer 58. This will be accomplished readily since the air pressure is the same on both sides of the valve 49, that is, the air pressure in the tank 53 is the same as the air pressure in the working chamber 65. Consequently there will be no disturbance of the compressed air in the working chamber 65 when the valve 49 is opened.

Now by starting the motor 82 the conveyer 58 may be operated to fill with material the trough formed by the walls 60, 60 and the upper run of the belt 53 until the hopper 75 is filled while the valve 77 is still closed. The conveyer 58 should then be stopped. When the hopper 42 and chute 44 are emptied or nearly so the valve 49 is again closed and the motor 82 stopped. The valve 49 must be closed before the valve 77 can be opened. But before the valve 77 is opened after the valve 49 is closed the compressed air in the tank 53 should be bled by opening the exhaust valve 73. When the air in the tank 53 is at atmospheric pressure the valve 77 may be opened and the motor 82 restarted whereupon the material in the tank 53 and the hopper 75 will be discharged through the hopper 78 and spout 86 onto the conveyer 88 for delivery by the latter to the street hopper 91.

While the compressed air is being bled from one tank, the other tank may have its interior pressure brought up to that of the working chamber. The conveyers in the tanks may therefore be alternately operated so that there need be no interruption of the excavating operations at the tunnel heading.

After the conveyer in the tank 53 has been filled with material and the valve 49 closed the deflector valve 45 shown in Fig. 5 may be thrown to its opposite position so as to direct material from the hopper 42 into the chute 43. As soon as it is certain the air pressure in the tank 52 is equal to that in the working chamber 65 the valve 48 may be opened and the motor 81 started until the hopper 42 and chute 43 are emptied or nearly so. Then after closing the valve 48, stopping the motor 81, and bleeding the compressed air from the tank 52 the material may be discharged to the conveyer 88.

The motors 81 and 82 may be provided with the usual and well known starting, stopping and controlling devices; the motors may be operated at varying speeds. For instance, in order to obtain a substantially continuous discharge of material through the hopper 78 onto the conveyer 88 the motors 81, 82 may be operated and controlled so that as soon as one conveyer 58 stops delivering material the other may be started to discharge material to the hopper 78. This may be accomplished by operating one of the motors at two speeds and the other always at the same speed. The two speed motor is operated at its higher speed while its conveyer is being loaded and is operated at its lower speed while discharging. The distribution of transfer of material through the bulkhead is therefore regulated by timing the starting, stopping and operation of the motors 81, 82 in accordance with the desired distribution along the constantly moving conveyer 88. Consequently a continuous transfer of material from the tunnel heading to the unloading position above ground may be assured.

It can readily be seen that by having two tanks to afford two air locked auxiliary chambers the material may be delivered alternately to these chambers while having the air pressure therein equal to that in the working chamber. Furthermore, the material may be alternately discharged from these air-locked chambers while at atmospheric pressures. The air pressures on opposite sides of the valves 48, 49 being equal there will be no tendency for the air to flow into or out of the working chamber 65 and these valves can be operated very freely. The valves 76, 77 are also freely operable since they are opened only when atmospheric pressure is present on both sides of the same.

In Figs. 5 and 6 I have illustrated diagrammatically at 97, 98 and 99 the usual air tight doors in the bulkhead 96. The door 97 is preferably at the level of the floors 23 and 79 shown in Fig. 2.

The door 98 may be used for ingress and egress of the workmen relative to the working chamber 65, while the opening for the door 99 serves preferably as an emergency exit from the compressed air chamber 65.

Obviously those skilled in the art may make various changes in the details and arrangements of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended, and I wish therefore not to be restricted to the precise construction herein disclosed.

Having thus described and shown an embodiment of my invention what I desire to secure by Letters Patent of the United States is:—

1. In conveyer apparatus, the combination with a tunnel bulk-head, of two air pressure cylinders extending through said bulk-head, a hopper, conveying mechanism for delivering material to said hopper, means for delivering material from said hopper to either of said cylinders, two valves one for each of said delivering means to cut off communication between said cylinders and said hopper when material is not being delivered to said cylinders, conveyers one in each of said cylinders, means for directing discharge of material from said cylinders, valves in said discharge means to close communication between said cylinders and the atmosphere, and means for controlling the air pressure in said cylinders to effect maximum air pressure therein when receiving material from said hopper and minimum air pressure when discharging material.

2. In conveyer apparatus, the combination with a bulkhead, of means comprising an upwardly inclined compressed air chamber extending through said bulkhead, means comprising traveling conveyer mechanism and a chute for effecting the introduction of material into said chamber at one side of said bulkhead, means comprising a chute and traveling conveyer mechanism for transferring the material away from the other side of said bulkhead, a traveling conveyer within said chamber for transferring the material from the first-named chute along the upward incline to the second-named chute, inlet and outlet valves for the passage of material into and out of said chamber, and means for controlling the air pressure in said chamber.

3. In conveyer apparatus in combination with a tunnel bulkhead of two air pressure cylinders extending through said bulkhead, a hopper, means for delivering material from said hopper to either of said two cylinders, two valves, one for each of said delivery means to cut off communication between either of said cylinders and the hopper when material is not being delivered to said cylinder, conveyers, one in each of said cylinders, means for directing discharge of material from said cylinders, valves in said discharge means to close said cylinders at the discharge ends thereof, and means for controlling the air pressure of said cylinders to effect maximum air pressure therein when receiving material from said hopper and minimum air pressure when discharging material.

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