No. 827,296. PATENTED JULY 31, 1906.

W. T. DONNELLY.

APPARATUS AND METHOD FOR TRANSPORTING SOLIDS.

APPLICATION FILED DEC. 28, 1904.

4 SHEETS—SHEET 1.

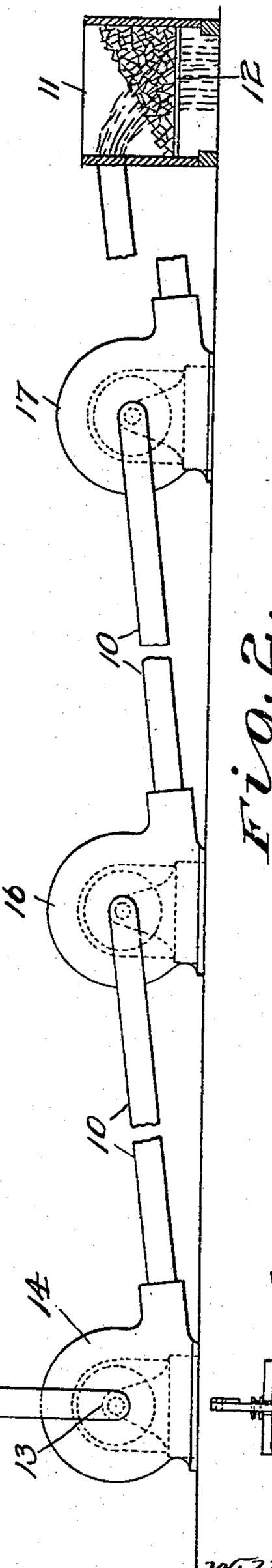


Fig. 1.

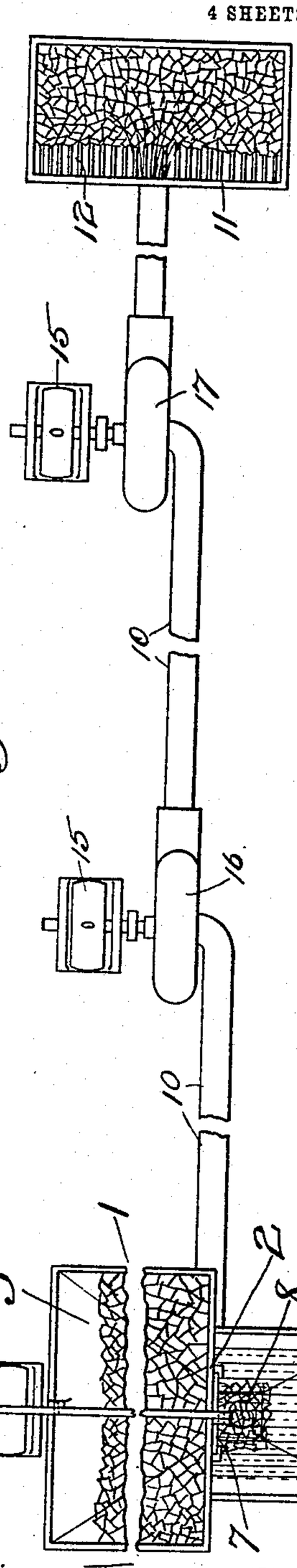
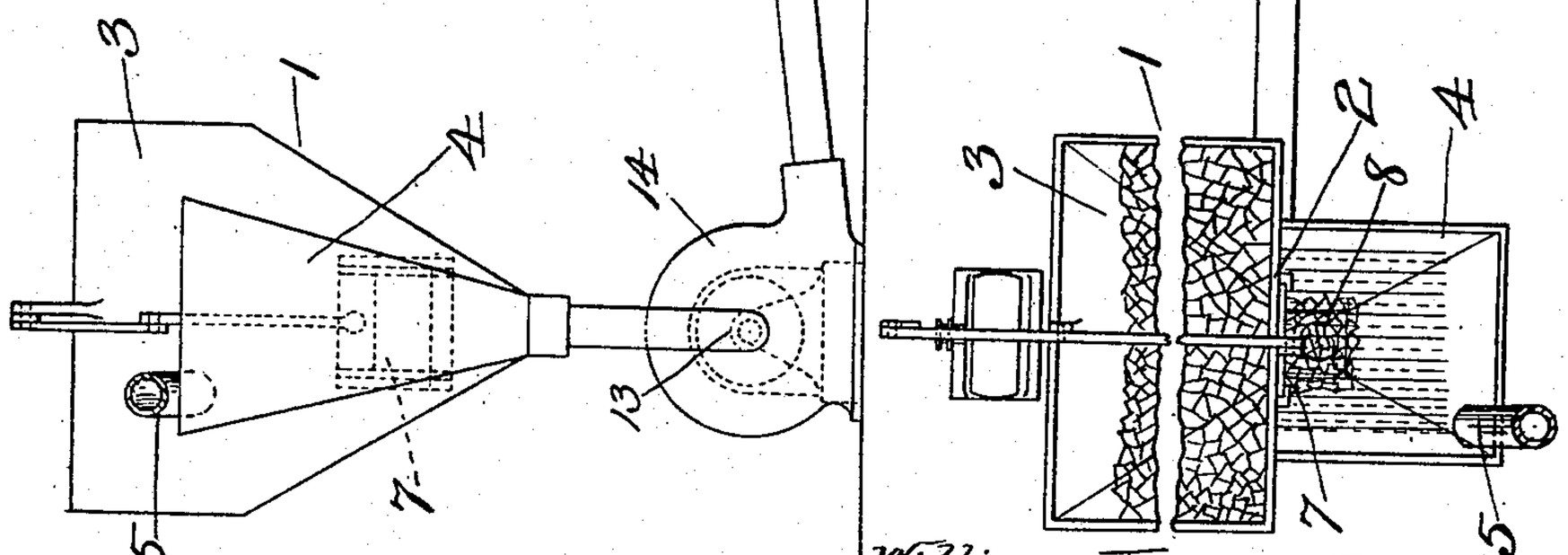


Fig. 2.



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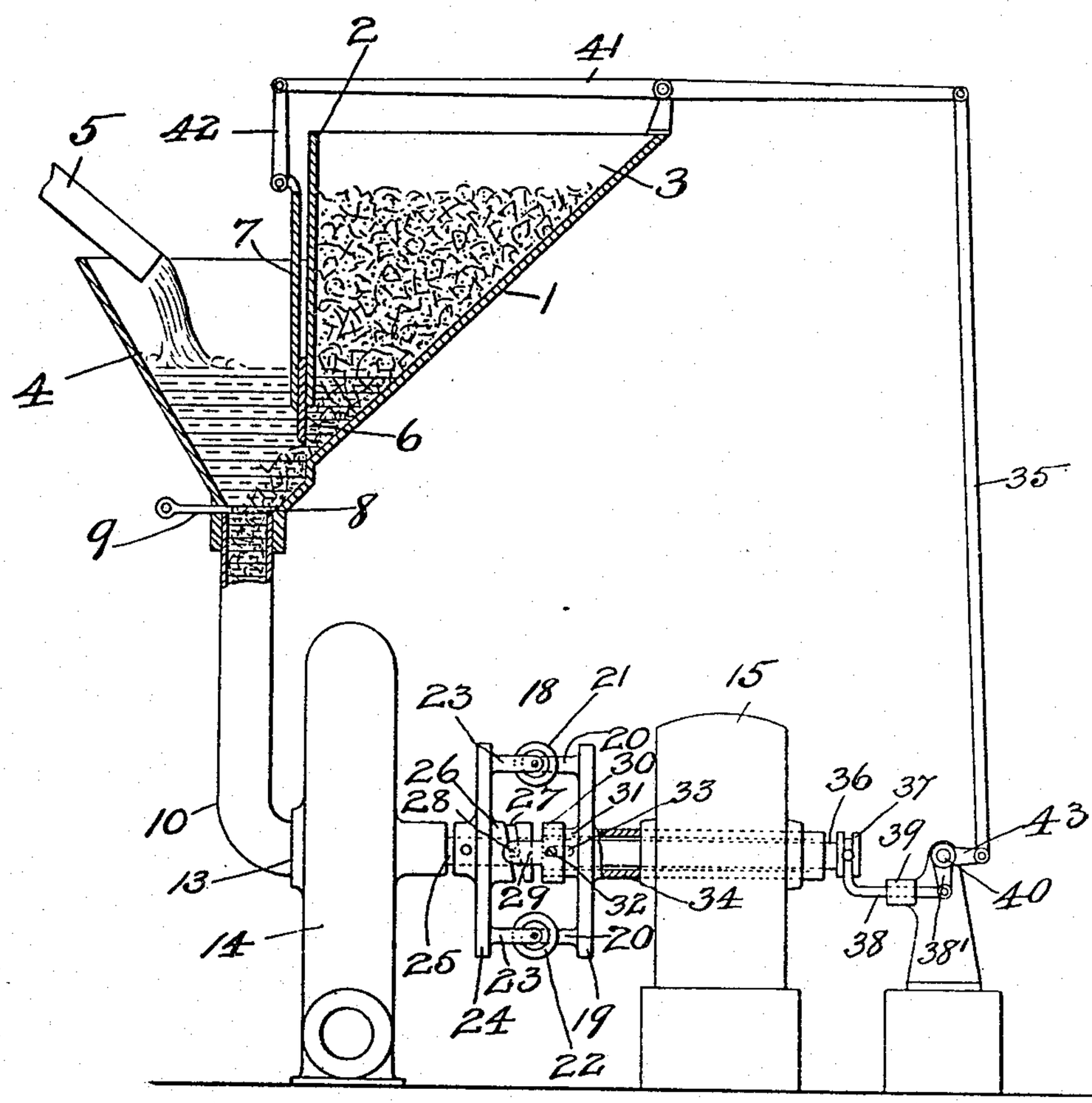
4 SHEETS—SHEET 2.

Fig. 3.



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4 SHEETS—SHEET 3.

Fig. 7.

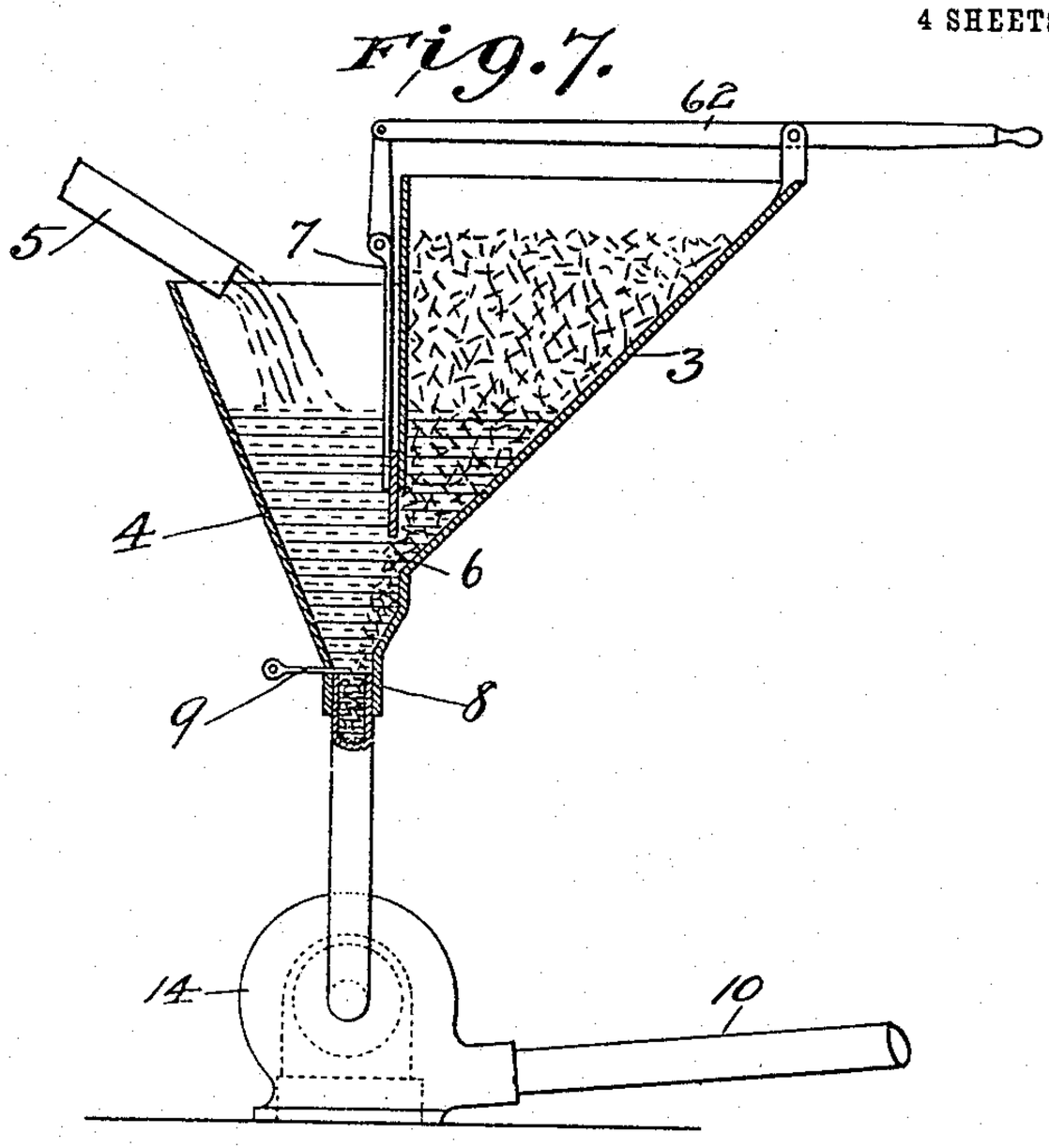


Fig. 4.

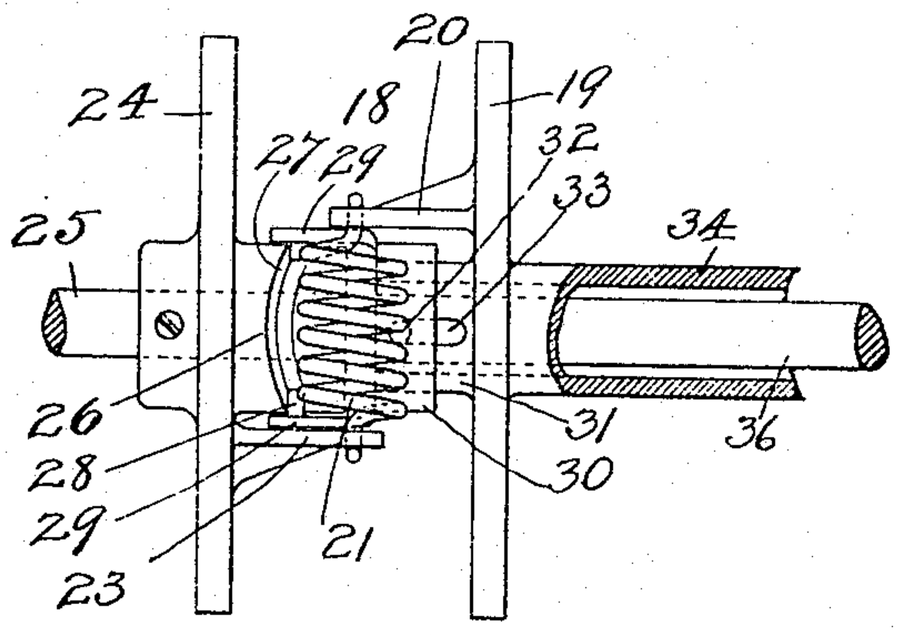
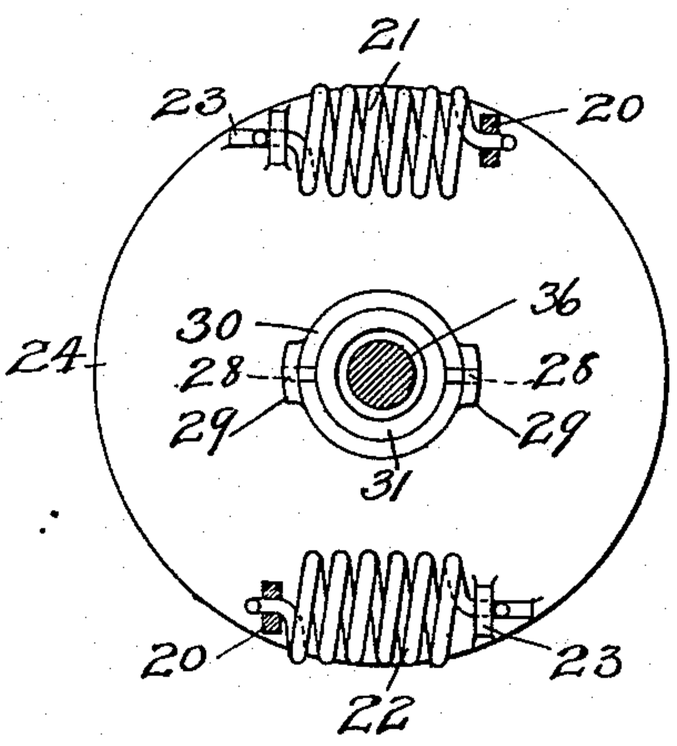


Fig. 5.



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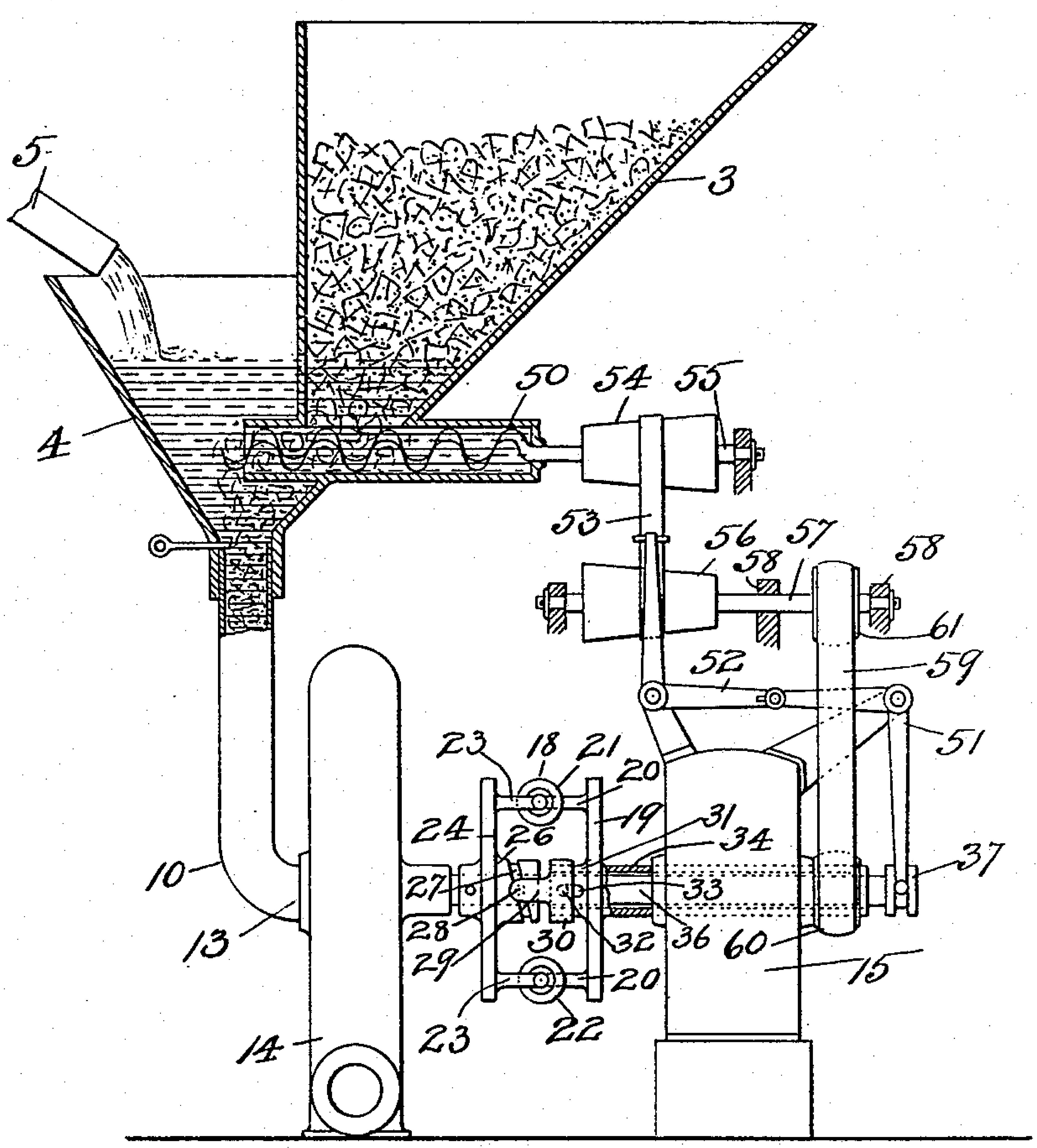
4 SHEETS—SHEET 4.

Fig. 6.



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UNITED STATES PATENT OFFICE.

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APPARATUS AND METHOD FOR TRANSPORTING SOLIDS.

No. 827,296. Specification of Letters Patent. Patented July 31, 1906.

Application filed December 28, 1904. Serial No. 238,669.

To all whom it may concern:

Be it known that I, WILLIAM THOMAS DONNELLY, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Apparatus and Methods for Transporting Solids, of which the following is a specification.

My invention relates to an improved apparatus and method for transporting solids, particularly for transporting coal.

By the means now available for transporting coal from mines to a convenient or desired point for shipment the cost is so great that the mine operator or owner is compelled to charge a large price for it in order to make a fair profit, and especially is this the case when it has to be transported for a long distance, and it often occurs that mines are rendered absolutely worthless to the owners on account of the conditions of the country, which render it practically impossible to transport the coal or, if possible, the cost of transportation is thereby rendered so great that the coal cannot be transported and sold at market price.

My invention, therefore, has for its object to obviate these difficulties by providing a pipe-line through which solid material in a more or less divided state can be transported by means of water forced therethrough, by providing relay devices along the pipe-line for forcing the water and solid material in a mixed condition therethrough, by providing means for controlling the relative quantities of water and solid material entering the pipe-line, said means being preferably automatic and controlled by the specific gravity of the mixture in its passage through one of the relay of water-forcing devices, preferably the initial water-forcing device, and by providing a device of the character set forth adapted to be operated and controlled below the surface of the water, so as to exclude the entrance of air with the mixture.

In the drawings, Figure 1 is a side view of my device; Fig. 2, a plan view thereof; Fig. 3, an end view, partly in section; Figs. 4 and 5, detail views of the governor; Fig. 6, an end view, partly in section, of a modification; Fig. 7, an end view, partly in section, of another modification.

Corresponding parts in all the figures are denoted by the same reference characters.

Referring to the drawings, 1 designates the hopper or bin adapted to contain the solid material to be transported in a more or less comminuted state mixed with water.

The hopper is divided by a partition or wall 2 into a compartment 3 for the solid material and a compartment 4, into which the water for transporting the solid material is introduced by a pipe 5. The partition 2 extends short of the bottom of the hopper, so as to leave an opening 6, through which the solid material can be discharged, and a vertically-slidable gate or valve 7 is provided to open and close the opening 6, and thereby regulate the feed of the solid material from the compartment 3.

An outlet-opening 8 is provided at the bottom of the hopper and is opened or closed by a slidable gate or valve 9 to regulate the feed of the mixture of water and solid material from the hopper into the pipe-line 10, one terminal of which is connected with said outlet and the other terminal leads into the bin 11, having a grated bottom 12, through which the water runs off, leaving the solid material in said bin in condition for use.

The pipe-line is preferably constructed of sections of pipe and is of a length proportioned to the pressure and velocity of the entering solids and water. As shown, the first section of pipe leads from the outlet of the hopper to the inlet 13 of the centrifugal pump 14, of which there are a number along the pipe-line for forcing the mixture under pressure and velocity therethrough, and each pump is driven by an independent source of power, as an electric motor 15, the second section leads from the outlet of the pump 14 to the inlet of the second pump 16, the third section leads from the outlet of the pump 16 to the inlet of the third pump 17, and the fourth section leads from the outlet of the pump 17 into the bin 11 at the end of the pipe-line. For the purpose of regulating the relative quantities of water and solid material entering the pipe-line the pump 14 is driven by its motor through the flexible coupling 18. This coupling consists of the disk 19, having lugs 20, to the ends of which are attached one end of the coil-springs 21 and 22, the other ends of said springs being attached to lugs 23 on the disk 24, which is secured rigidly to the shaft 25 of the pump. The disk 24 is provided with a hub 26, having an angular groove 27, which is engaged by the pins 28 on the ends of the arms 29, extending from the collar 30, mounted on the hub 31 of the disk 19. The pin 32 passes through elon-

gated slots 33 in the tubular motor-shaft 34 and also through a hole in the reciprocable operating-rod 36, on the outer end of which is a grooved pulley 37, engaged by the inner end of a reciprocable arm 38, mounted in a bearing 39, the outer end of the arm 38 being pivotally connected to the arm 38′ of the bell-crank lever 40.

The lever 41 is pivotally supported on the hopper, and one end is pivotally connected to the gate 7 by a link 42 and the other end pivotally connected to the arm 43 of the bell-crank lever 40 by a rod 35.

It will be understood that owing to the difference in specific gravity of the material to be conveyed and the water the disks 19 and 24 will change their relative position under the varying load due to imparting velocity and pressure to the differing mixture entering the pump, this change in position being utilized to regulate the quantity of solid entering the pump and is effected as follows: If an over amount of solids is being fed to the pump 14, this will result in a change in the position of the disks 19 and 24 and cause the groove 27 to act upon the pins 28 of the collar 30 to move that collar and its attached parts in such a manner as to slide the operating-rod 36 and close or partly close the gate 7, and thereby reduce the quantity of solids entering the pump 14, and if the amount of solids being fed to the pump 14 fall short of that required it will result in a reverse change of the position of the disks 19 and 24, and cause the groove 27 to act upon the pins 28 of the collar 30 to move that collar and its attached parts in such a manner as to slide the operating-rod 36 and open or partly open the gate 7, and thereby increase the quantity of solids entering the pump.

Referring now to the modification Fig. 6, this form of my invention only differs from that of Figs. 1 to 3 in the following particulars: A spiral feeding device 50 is employed to deliver the solids from the compartment 3 of the hopper 14. A bell-crank lever 51 is pivotally mounted on the casing of the motor 15, one end engaging the groove in the pulley 37 and the other end pivotally connected to one end of a second bell-crank lever 52, also mounted on the casing of the motor 15 and having on its other end a fork which engages and shifts a belt 53, running over a conical pulley 54 on the shaft 55 of the spiral feeding device 50 and a pulley 56 on a shaft 57, mounted in bearings 58. For transporting power from the motor 15 to the shaft 55 a belt 59 runs over a pulley 60 on the motor-shaft and over a pulley 61 on the shaft 57. It will be understood that when the operating-rod is shifted by the action of the flexible connection or governor the bell-crank levers will shift the belt 53 of the spiral feeding device, and thereby regulate the feed of the solid material.

Referring now to the modification Fig. 7, this form of my invention only differs from that of Figs. 1 to 3 in that the automatic feature of the device is dispensed with and a hand-lever 60 is pivotally supported on the hopper and one end is pivotally connected to the gate 7, so that the feed of the solid material may be manually controlled.

My process, which is conveniently carried out by means of the above-described apparatus, consists, essentially, in establishing a flow of water through the line from the receiving to the delivering terminal, introducing the solids to be transported into the stream of flowing water, limiting the introduction of the solids, preferably automatically, by the change in the specific gravity of the mixture of water and solids entering the line, and finally separating the water from the solids at the delivering-terminal of the line.

I do not wish to be understood as limiting myself to the details of construction and arrangement as herein described and illustrated, as it is manifest that variations and modifications may be made in the features of construction and arrangement in the adaptation of the device to various conditions of use without departing from the spirit and scope of my invention and improvements. I therefore reserve the right to all such variations and modifications as properly fall within the scope of my invention and the terms of the following claims.

What I claim is—

1. A transporting device consisting of a pipe-line, means for introducing solid material to be conveyed mixed with water, automatic means for controlling the relative quantities of water and solid material entering the pipe-line and means at intermediate points for imparting pressure and velocity to the mixture, substantially as described.

2. A transporting device consisting of a pipe-line, a bin or hopper containing the solid material to be conveyed mixed with water, means acting below the surface of the water for controlling the admission of the mixture, automatic means for controlling the relative quantities of water and solid material entering the pipe-line and means at intermediate points along the pipe-line for imparting pressure and velocity to the mixture, substantially as described.

3. A transporting device comprising a hopper or bin for containing solid material to be conveyed and water, a pipe-line connected with the outlet from the hopper for transporting said mixture, relay-pumps along said line for forcing said mixture under pressure and velocity therethrough and means for automatically controlling the relative quantities of water and solid material entering the pipe-line, substantially as described.

4. A transporting device consisting of a pipe-line, means at the starting-point for per-

mitting the entrance of water, automatic means for delivering solid material into the pipe, means to impart velocity and pressure to the mixture, operative connection between the means for delivering the solid material into the pipe and the means for imparting velocity to the mixture, acting to maintain constant relation between the amount of water and solids entering the pipe-line, substantially as described.

5. A transporting device comprising a hopper or bin for containing solid material to be conveyed and water, a pipe-line connected with the outlet from the hopper for transporting said mixture, relay-pumps along said line for forcing said mixture under pressure and velocity therethrough, means for operating said pumps and means for automatically controlling the relative quantities of water and solid material entering the pipe-line, substantially as described.

6. A transporting device comprising a hopper or bin for containing solid material to be conveyed and water, a pipe-line connected with the outlet from the hopper for transporting said mixture, relay-pumps along said line for forcing said mixture under pressure and velocity therethrough, means for operating said pumps and means for controlling the relative quantities of water and solid material entering the pipe-line controlled by the specific gravity of said mixture in its passage through one of said pumps, substantially as described.

7. A transportation device consisting of a pipe-line, means at the starting-point for permitting the entrance of water, automatic means for delivering solid material into the pipe, means for imparting pressure and velocity to the mixture and means to automatically vary the relation between the velocity imparted to the water and the amount of solids introduced for the purpose of maintaining an approximately constant relation between the amount of water and solids passing through the pipe.

8. A transporting device consisting of a divided hopper or bin for containing solid material to be conveyed and water, a pipe-line connected with the outlet from the hopper for transporting said mixture, relay-pumps along said line for forcing said mixture under pressure and velocity therethrough, means for operating said pumps and means for automatically controlling the relative quantities of water and solid material entering the pipe-line, substantially as described.

9. A transporting device consisting of a divided hopper or bin for containing solid material to be conveyed and water, a pipe-line connected with the outlet from the hopper for transporting said mixture, relay-pumps along said line for forcing said mixture under pressure and velocity therethrough, means for operating said pumps and means for controlling the relative quantities of water and solid material entering said pipe-line controlled by the specific gravity of said mixture in its passage through one of said pumps, substantially as described.

10. A transporting device consisting of a source of water-supply, a hopper or bin containing the material to be transported in a comminuted condition, means for delivering the water and comminuted material in measured quantities to a pump, automatic means for controlling the relative proportions of liquid and solid entering the pump and means for forcing the mixture under pressure and velocity to any desired point consisting of a pipe-line and relay-pumps, substantially as described.

11. A method of transporting solid material which consists of establishing a flow of water from the receiving to the delivering terminal of the line, introducing the solid material to be transported into the stream of flowing water, limiting the introduction of the solid material by the change in specific gravity of the mixture and finally separating the solid material from the water at the delivering-terminal of the line, substantially as described.

Intestimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM THOMAS DONNELLY.

Witnesses:

GEORGE W. EISENBAUM

W. BAKER.