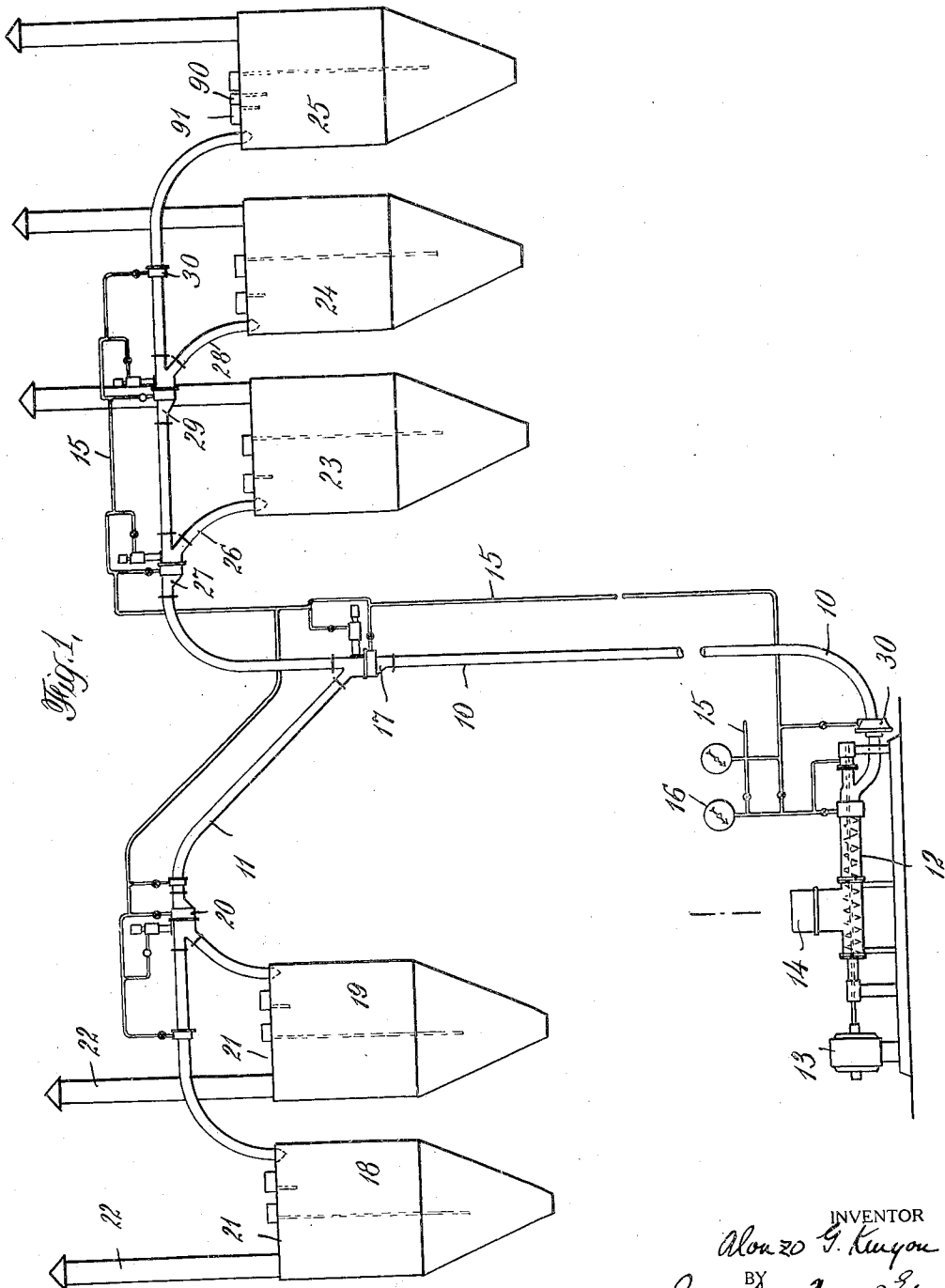


May 10, 1932.

A. G. KINYON
CONVEYING SYSTEM
Filed March 8, 1924

1,857,643

4 Sheets-Sheet 1



INVENTOR
Alonzo G. Kinyon
BY
Reuben Davis Marston & Edmonds
ATTORNEYS

May 10, 1932.

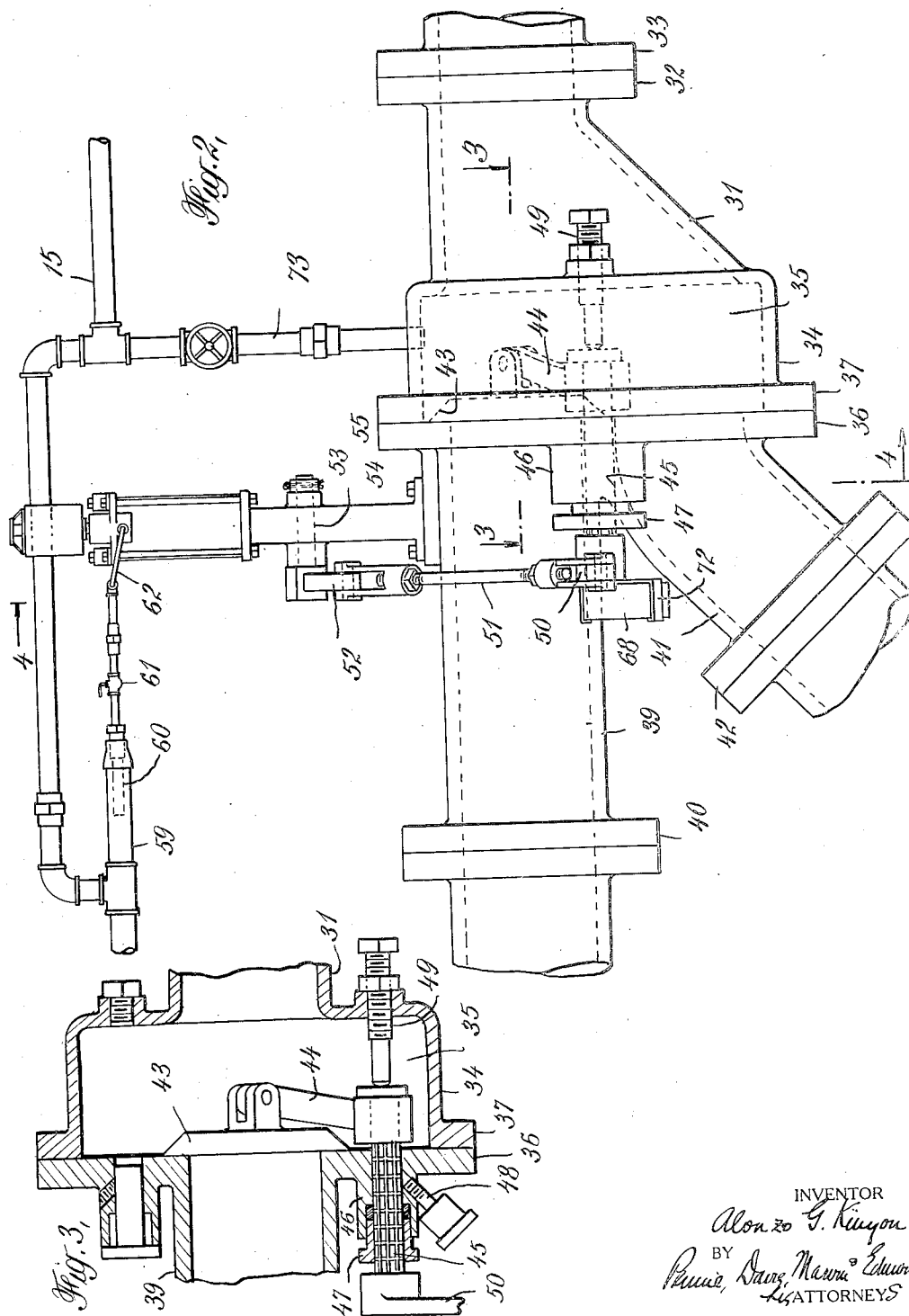
A. G. KINYON

1,857,643

CONVEYING SYSTEM

Filed March 8, 1924

4 Sheets-Sheet 2



INVENTOR

Alonzo G. Kinyon

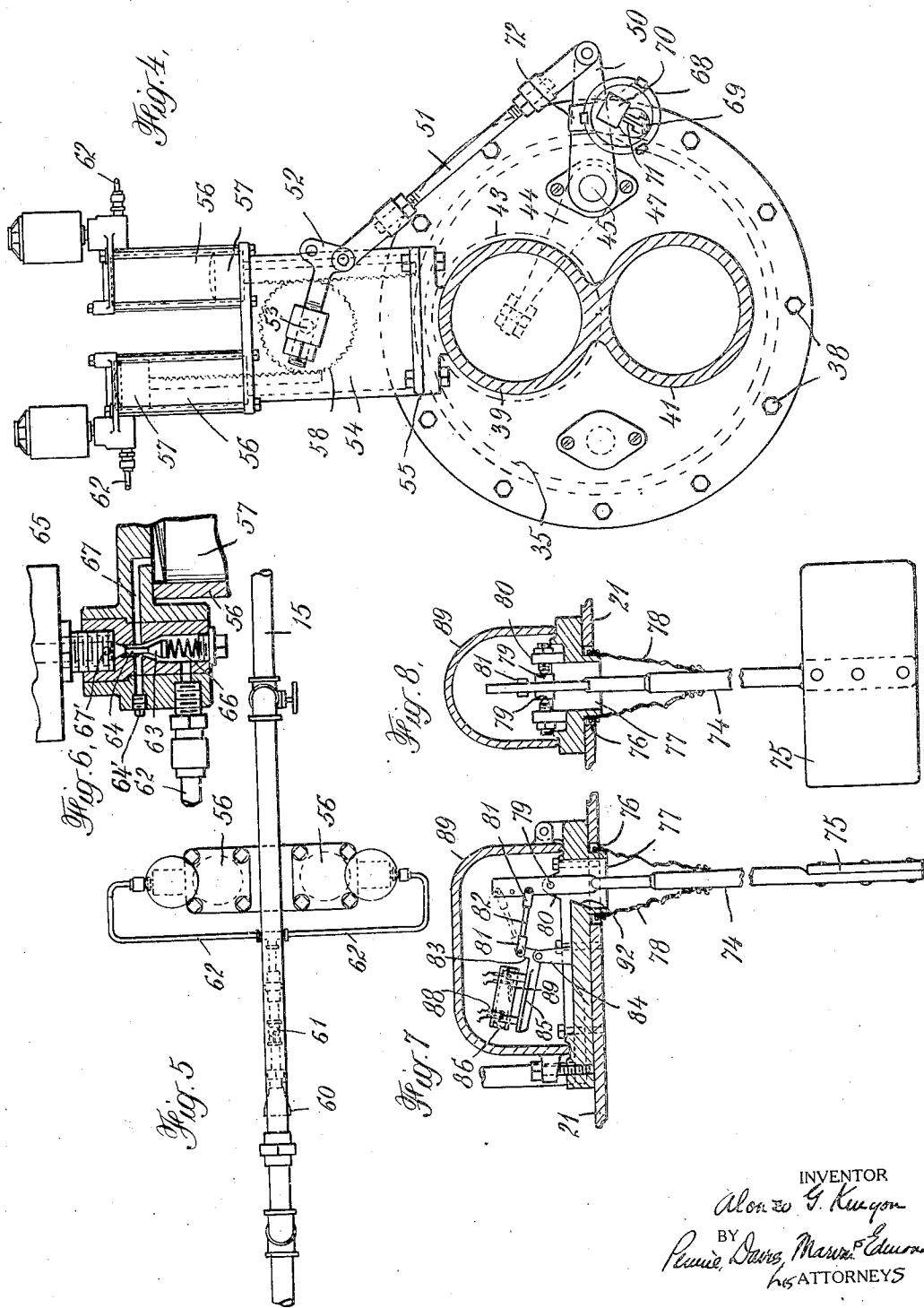
BY

Russell, Davis, Mearns & Edwards
ATTORNEYS

May 10, 1932.

A. G. KINYON
CONVEYING SYSTEM
Filed March 8, 1924

1,857,643
4 Sheets-Sheet 3

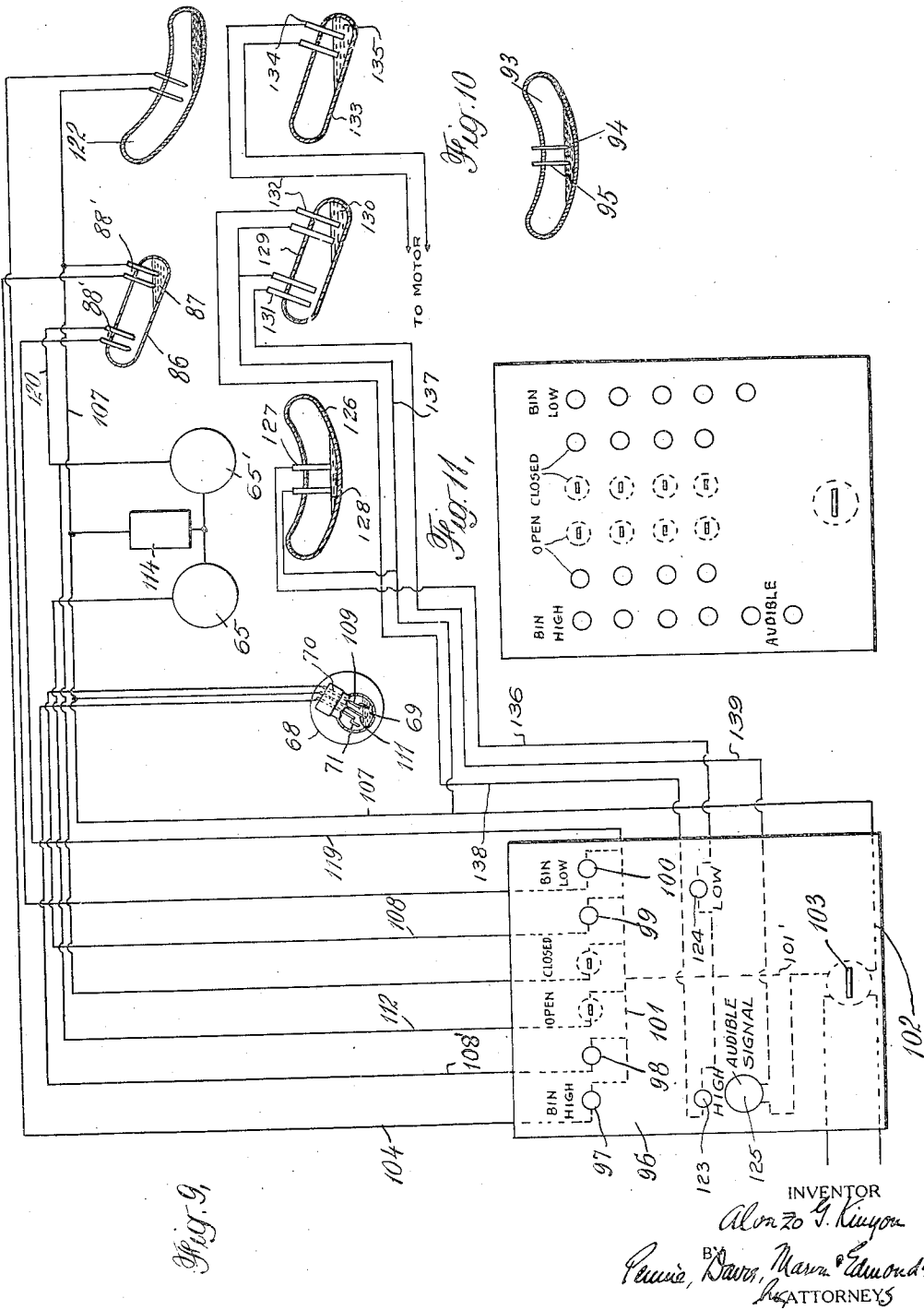


INVENTOR
Alonzo G. Kinyon
BY *Reinic, Davis, Marvin, Edwards*
ATTORNEYS

May 10, 1932.

A. G. KINYON
CONVEYING SYSTEM
Filed March 8, 1924

1,857,643
4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

ALONZO G. KINYON, OF ALLENTOWN, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE ESTATE OF JAMES W. FULLER, DECEASED, OF CATASAUQUA, PENNSYLVANIA

CONVEYING SYSTEM

Application filed March 8, 1924. Serial No. 697,723.

This invention relates to conveying systems and more particularly to a system which is intended to be used for the conveying and distribution of material in a finely divided state. It offers numerous peculiar advantages in connection with the handling of pulverulent material which is stored at a central point and then distributed to various remote points to be used; for instance, the system of this invention is particularly adapted for use in the handling of pulverized fuel. The details of the invention will therefore be described in that adaptation although it is to be understood that the utility of the principles of the invention is not limited to any particular pulverulent material and the use of the term "pulverized fuel" is intended to include other similar materials which may be handled by this system with equal facility.

It is customary in connection with the use of pulverized fuel to carry on the grinding and pulverizing operations in some central location, from which the pulverized material is distributed either directly from the pulverizers, weigh bins or storage bins, to the bins from which the material is conveyed to the burners. Frequently the latter bins are located at points which are spaced apart considerable distances and it is therefore desirable to provide a system of conveying the material to these bins by which the operator, stationed at the central station, may control the distribution of the material to the bins where it is required, and may also be advised by suitable indicating devices as to the condition of such bins at all times. The present invention is intended to provide such a system and it involves the use of a pump or other similar device which propels the material through a system of transport lines which are of a size appropriate to the quantity of material which is to be distributed. These lines extend to the several bins in which the material is to be deposited and each bin is connected with the main line. Located at each bin is a valve arranged so that the operator may shut off the flow of material beyond this bin and cause the entire flow to pass into the bin. These valves are operated by mechanism under the control of the operator and devices located at the operator's station indicate the positions of the several valves. At each bin devices are provided which are brought into action when the material level in the bin reaches certain predetermined points and these devices cause indicators at the central station to give a signal. Each bin may have a device to show the operator when it is full, and another device which shows when the contents of the bin has reached a certain low level. Also, the device in each of the bins except the last brought into action when the material has reached the high level operates to close the valve so that when the level of the material in that bin has brought the device into operation, the valve for that bin is closed and the material then flows along the main line to the next bin in the series. The last bin in the series; that is, the one which is last filled under normal conditions, is provided with two such devices, one of which operates when the bin is nearly full to actuate a warning signal, preferably audible, calling the operator's attention to the condition of the bin. Should the operator, for any reason, however, fail to observe this signal, then, when the material has reached a still higher level, a second device is brought into action which shuts down the pump so as to stop the flow of material in the system.

As will be seen from the brief description of the invention above set forth, it involves the provision of transport lines by which material is distributed from a central location to a series of bins, means for propelling the material through these lines, means by which the flow of material to each of these bins is manually controlled, means automatically operating when the material has reached a certain level in the bin for shutting off the flow of material to that particular bin and causing the material to pass beyond to the next bin in the group, and means in the last bin of the series by which the entire system may be automatically shut down whenever the material in that bin reaches a predetermined height. The invention also involves the provision of improved remotely controlled valves, preferably electro-pneumatic-

cally operated, devices in the bins which cause the valves to be closed when the level of the material in the bin reaches certain predetermined points, and various other elements and combinations of elements which will presently be set forth in detail.

One embodiment of the invention is illustrated in the accompanying drawings, in connection with the conveying and distribution of pulverized fuel, and in these drawings,

Fig. 1 is a diagrammatic layout of such a conveying system in which five bins are used, three located on the main line, with two located on a branch line,

Fig. 2 is a view in side elevation of the electro-pneumatically operated two-way valve for controlling the flow of material from the transport line to the bin,

Fig. 3 is a sectional view of this valve on the line 3—3 of Fig. 2,

Fig. 4 is an end view partially in section, on the line 4—4 of Fig. 2,

Fig. 5 is a top plan view of the devices shown in Fig. 4, illustrated in the piping connections.

Fig. 6 is a sectional view of a detail of the air connection for the valve,

Fig. 7 is a longitudinal, sectional view of one of the devices by which the indicators are actuated,

Fig. 8 is a cross-sectional view of the same,

Fig. 9 is a diagram of electrical circuits which may be employed in the system shown in Fig. 1,

Fig. 10 is a detail of a modified form of switch which may be used with the mechanism shown in Fig. 7, and

Fig. 11 is a diagrammatic view of a switchboard showing indicating lamps and control buttons.

Referring now to these drawings, and particularly to Fig. 1, the system is shown to include a main transport line 10 along which three bins are located, and a branch line 11, on which two bins are located. The material is forced into the line 10 by means of a pump 12 of the screw conveyor type directly connected with a motor or other source of power 13. The intake 14 of the pump is connected with a storage bin or weigh bin, or may receive the material directly from the pulverizer, as may be desired. Associated with the transport line is an air line 15 connected with an air reservoir or other source of supply. In this air line are suitable gauges 16, located at the operator's station near the pump, and also various branch connections and control valves therefor, by which air is led to the pump. The pump which I prefer to use in this connection is that illustrated in my co-pending application, Ser. No. 329,209, filed October 8, 1919, Patent No. 1,553,539, September 15, 1925, in which the pulverized material is mixed with air under such conditions that it takes on the mobility of a liquid and

may consequently be readily conveyed to considerable distances without great expenditures of power. The main air line beyond the gauges and the pump connections extends along the transport line and is used to actuate the electro-pneumatic mechanism which operates the valves.

In the system illustrated which is simply representative of one layout, a branch line 11 is connected to the main transport line 10 through an electro-pneumatically operated valve 17, and in this branch line are two bins 18 and 19. The bin 19 is connected with the branch line through a valve 20 similar to the valve 17, while the bin 18 is directly connected with the end of the branch line without the interposition of a valve. The bins may be of any desired form having closed tops 21 provided with vent stacks 22. On the top of each bin is located the mechanism by which the signals at the central station are brought into action when the level of the material in the bin has reached a predetermined point. Beyond the valve 17 the main line continues for the purpose of supplying bins 23, 24, and 25. The bin 23 is supplied through a branch 26, which connects with the main line through a valve 27, and the bin 24 is supplied through a branch 28 connected to the main line through a valve 29. The bin 25 which is the last bin of the series, is directly connected to the end of the transport line. In addition to the control valves by which the material is diverted into the bins, the main line is provided with blow-out valves 30 at different points along its length, these blow-out valves being connected with the main air line through suitable branch connections having control valves therein.

The two-way valves 17, 20, 27, and 29, by which the branch lines leading to the bins are controlled are illustrated in Figs. 2, 3, 4, and 5. Each valve consists of a main body portion 31 having a flange 32 at one end, provided with the flange 33 on the transport line, a union by which the valve is connected in the line. The main body portion 31 is hollow and has an enlarged end 34 forming a housing 35 in which the valve disc is to operate. Associated with the valve body is a valve discharge branch which carries at one end a plate 36 which is adapted to be secured to a peripheral flange 37 located on the rim of the casing 35 by bolts 38. Extending from the plate 36 is a pipe 39 which provides a continuation of the main line, being connected to this line by means of a flange union 40. Also extending from the plate 36 is a pipe or elbow 41 which is connected with the branch line by a flange union 42. The ports through which the main and branch lines are connected will be seen to be placed one above the other and these ports are controlled by means of a valve disc 43 located within the housing 35. This disc is carried on the end of an arm 130

44 which is, in turn, mounted on a shaft 45 which is supported in a bearing 46 forming a part of the plate 36. A gland 47 is also provided in connection with this bearing and the shaft 45 has longitudinal and circumferential grooves for a lubricant which is supplied thereto by means of a grease cup 48. Extending through the wall of the housing opposite the end of the valve disc arm shaft 45 is an adjusting bolt 49 by which the position of the shaft and the bearing of the disc against its seat may be adjusted. On the outer end of the shaft 45 is a crank 50 which is connected by a link 51 to another crank 52, mounted on a shaft 53. The shaft is mounted in a framework 54 secured to the pad 55 on the upper surface of the main line pipe 39. The link 51 is so constructed that its length may be varied as desired, and the crank 52 is provided with a plurality of apertures in its outer end so that the point of connection of the crank and link may be varied. This permits of varying the throw of the valve disc so that this throw may be given the proper length according to the size of the orifices of the main line and branch line pipes. The shaft 45 may be placed in either side of the valve, according to local conditions. Also the crank 52 is adapted to project from either side of the shaft 53 so that connection thereto can be made to crank 50 at either side of the valve.

Secured to the upper end of the framework 54 are cylinders 56, as shown in Fig. 4, in each of which moves a piston 57. Each piston has a rack instead of a piston rod, which rack engages the teeth of a pinion 58 mounted on the shaft 53. With this arrangement when one piston is forced downwardly by compressed air the other one is raised so as to be in operative position. In Figs. 2 and 4 the various parts are in their proper relation to permit the pulverized material to flow from the main transport line into the branch. Accordingly, the disc 43 is in its uppermost position and the appropriate piston is raised so that when air is admitted to the cylinder shown to the left in Fig. 4, the valve disc will be moved downwardly to close the branch line connection and permit the material to flow on through the main line.

Air is admitted to the cylinders 56 from the main air line 15 through a branch connection 59 in which is an air strainer 60, together with a cut-out valve 61. As shown in Fig. 5, the branch air line 59 terminates in lateral branches 62, each of which supplies air to one cylinder of the material valve operating mechanism, and also permits the escape of air from this cylinder. One of these valves is illustrated in Fig. 6, and located in the body of the valve is a small pin valve 63 which is located directly beneath the core 64 of a solenoid 65. The branch air line 62 connects with a passage through the body of

the valve which is normally closed by the pin valve being forced against its seat by a spring 66, the passage extending beyond the pin valve into the upper part of the cylinder. When the solenoid 65 is energized its core moves downwardly and unseats the pin valve thus permitting air to be introduced into the cylinder and so causing the valve disc 43 to be moved from one port to the other. In order that this movement may be complete the operator must depress a switch button on a control board and keep the button depressed until such time as the piston has moved to the end of its path of travel. When the button is released and the solenoid de-energized, the spring 66 together with the air pressure forces the spring valve 63 against its seat while the air within the cylinder returns through the passage 67 and escapes through the port 67' to the atmosphere. The plug 64' closes the aperture necessarily made in drilling the aperture 67. The piston, however, remains in its lowermost position until the piston in the other cylinder is operated. A similar action of corresponding parts of the solenoid 65' and pin valve on the other cylinder occurs when the device brought into action when the level of the material reaches a predetermined point closes the circuit to the other solenoid, closing the valve to the bin as explained more fully hereinafter.

In order to indicate at the central station when the piston has moved to its limit of travel, thus indicating that the valve disc has moved to close the desired port, there may be employed electric indicating lamps in a circuit which is controlled by a switch 68 mounted on the crank 50 and consisting of a casing within which is a quantity of mercury 69. Disposed above the mercury is a terminal member 70 from which depend three contact points, one of which is designated by the numeral 71. These contact members are arranged so that when the switch is moved to the right or left the mercury establishes a contact between the central point and one or the other of the outer points. Appropriate circuits are thus established through the mercury to light lamps at the central station, one of which indicates the open, the other the closed position of the valve. Consequently in operating the valve from the central station the operator will close the circuit which actuates the appropriate pin valve, thus causing air to be introduced into the proper cylinder. This circuit will be kept closed until such time as one or the other of the circuits through the contacts and the mercury has been closed, whereupon the lamp will indicate that the valve disc has moved to the desired position. The switch casing 68 is mounted in a clamp 72, secured on the crank 50 and provided with a plurality of jaws, each of which has set screws and jam nuts so that the casing is not only firmly held in position,

but may also be given the desired exact adjustment necessary to cause the indicating mechanism to function properly.

In addition to the connections previously described the main body of the valve is connected to the main air line through a branch 73 having a cutoff valve located in it. This branch connection provides an emergency blow-out valve for introducing air into the valve in case the material becomes clogged therein, and to clear the line to the next forward station.

As previously mentioned, each of the bins contains a device brought into action when the level of the material reaches a predetermined point which operates, in the case of each bin except the last, to cause the valve controlling the flow of material from the main line into that bin to be closed when a predetermined level has been reached. In the last bin of the series there are provided two such devices, one of which causes a preliminary warning signal to be operated and the other of which causes the pump mechanism to be shut down. In addition to the devices which operate when the material has reached a predetermined level, the bins may also have devices which cause signals to be given, showing when the material has fallen below a certain level in the bin. In each case the mechanical construction of the mechanism is substantially the same, the connections with the signals being varied to produce the desired results.

Each device consists of a pendulum 74 which is suspended from the top of the bin and which carries a paddle 75 at its lower end. This paddle is mounted in such a location that it is moved from its vertical position by the flow of material over the top of the pile in the bin as the latter is being filled. The pendulum 74 extends upwardly through a slot 76 in the top of the bin and a registering slot formed in the base 77. A canvas sleeve 78 is secured to the pendulum and to the base around the slot so that the entrance of dust from the bin into the casing may be prevented. The pendulum is pivoted between hardened steel points 79 formed on the end of threaded members which are secured in suitable lugs 80, these threaded members being capable of adjustment as may be desired, and being held in adjusted position by suitable jam nuts. The upper end of the pendulum which is flattened in order that it may project through the slot and also provide a suitable bearing surface for the points, is connected by suitable links 81, 81, which are, in turn, connected by a turn buckle 82 to one arm of a bell crank 83 pivotally mounted in a lug 84 extending upwardly from the base of the device for use in connection with electric signals. The other arm 85 of this bell crank carries a mercury switch which consists of a sealed glass tube

86 having a quantity of mercury 87 within it. Sealed in the opposite ends of the tube are contacts 88 which are so arranged that when the tube is tilted to permit the mercury to lie either in one end or the other, a circuit will be closed between the adjacent contacts and the mercury. The contacts at one end of the tube are properly connected with a suitable lamp at the switchboard, and the contacts at the other end of the tube function to close the circuit to the solenoids which operate to close the valve to the bin, so that as the material piles up in the bin the pendulum 74 will be swung out of the vertical and this will cause the bell crank to tilt so that the mercury runs to one end or the other of the tube to close the proper circuit. The entire operating mechanism is enclosed within a cover 89 so as to protect it from dust.

The device just described may be used for indicating either the high or low level of the material in the bin by a suitable arrangement of the electrical circuits. Also, in bin 25, which is the last bin of the series, there are provided two high level indicating devices, one of which has a pendulum somewhat longer than the other. The device 90 which has the longer pendulum is arranged to establish a circuit which operates a warning signal at the board. This warning signal is preferably an audible signal, such as an electric horn or bell, and is intended to attract the operator's attention to the condition of the bin. The device 91 which has the shorter pendulum operates when the material has reached a somewhat higher level, and is arranged so that upon its movement circuits are established which shut down the pump motor.

While the devices which have just been described are in general satisfactory for operating signals for indicating both the high and low levels of the material in the bin, it has been found that the device which indicates the low level is likely, under certain conditions, to give a wrong indication unless provision is made to permit the pendulum to swing in both directions away from a vertical axis. This is due to a tendency of the pulverized material to "rathole" directly over the point where it is being withdrawn at the bottom of the bin and as the material continues to feed out of the bin slides occur which fill up the rathole. Sometimes as a result of these slides the signal pendulum is carried back to its vertical position, although when the sliding material has reached a condition of repose its level may be considerably above that of the paddle. This would cause the signal to give the wrong indication. This difficulty, however, has been overcome by slight modifications in the construction of the device. For this purpose the base of the device is cut away slightly as at 92 so as to permit the pendulum arm to move to either side of its vertical position, and the mercury switch

is given the modified form illustrated in Fig. 10. In this figure it will be noted that the glass tube 93 has a depression 94 mid-way of its ends and the contact members 95 sealed through the tube are so located that when the tube is exactly in its horizontal position the mercury will lie in the depression and will electrically connect both contacts. However, if the tube is tilted slightly one way or the other the mercury will travel to the lower end of the tube and but a slight movement is necessary in order to throw the mercury away from the contacts and thus break the circuit. These contacts are connected with a lamp at the central station so that when the tube is in horizontal position the lamp is lighted, thus indicating that the material is at or below the height of the paddle associated with this indicator. When the tube is moved to either side of its horizontal position, the lamp goes out and in the case of a slide the pendulum will ordinarily move from an inclined position at one side of the vertical, to an inclined position on the other side. In this case the lamp at the central station would simply make a flash, but would not continue lighted unless the pendulum came to rest exactly vertical. The probabilities of this occurring upon a slide taking place are so slight that the signal has been found to work satisfactorily under normal operating conditions.

In Fig. 9 there is shown a switch board 96 used in connection with an electric signaling system, this switch board being located at the central station where the operator stands. In this diagram there are shown the connections from the central station to the actuating device in two of the bins, one being an intermediate bin, while the other is the last bin in the line. It will be understood that when additional intermediate bins are employed, similar circuits to those which will presently be described are made use of. A switch board of a form appropriate for the system illustrated in Fig. 1 is shown in Fig. 11. The first lamp 97 at the left of the switch board is in a circuit which is controlled by mechanism actuated when the material in the intermediate bin reaches a certain predetermined high level. Next to this lamp is a lamp 98 which is lighted when the valve associated with the bin is in the open position. Next to the lamp 98 are two buttons designated as "open" and "closed", one of which, when depressed, establishes the circuit opening the valve, the other the circuit by means of which the valve is closed. Beyond the buttons designated "open" and "closed" is a lamp 99 which is lighted when the valve is in the closed position. Beyond the lamp 99 is another lamp 100 which is lighted whenever the material in the bin has fallen below the level of the low level paddle. Beneath the lamps and buttons just described is a lamp 123 connected in a circuit controlled

by a device in the last bin, this lamp being lighted when the material in that bin reaches a predetermined high level. Also the board contains a lamp 124, controlled by a device in the last bin, and lighted when the material in the bin reaches a certain predetermined low level. Diagrammatically indicated at 125 is an audible signal which is in a circuit actuated by a control device in the last bin. Mounted on the board are bus-bars indicated by the lines 101 and 102, which are in turn connected to a source of current at a suitable voltage. The entire system is controlled by a main switch 103 located between the bus-bars and the line.

In the circuits illustrated the valve for controlling the material flow is in the closed position while the actuating device is in that position which it would assume when the material is below the level of the paddle. It will now be seen that there is a circuit through the lamp 97 as follows: Through the line 104, contacts 88', mercury 87, the contacts and mercury being located on the arm associated with the bin signal, thence through the return line 107 to the bus-bar 102. The lamp 97 is lighted, indicating that the material has fallen below the level of the pendulum. Since the valve controlling the flow to that bin is closed, the lamp 98 is out, while the lamp 99 which indicates that the valve is in the closed position, is lighted. The circuit through the lamp 99 is as follows: from the bus-bar 101 through the line 108, to the contact 109, mercury 69, central contact 111, thence to the return line 107. When the operator depresses the switch button marked "Open", this establishes a circuit through the line 112, solenoid 65, and to the current resistor 114, and return line 107. So long as the switch button "Open" is depressed current will flow through the circuit just described, and when the admission of air to the cylinder associated with the solenoid 65 has forced the piston within that cylinder to its lower limit of travel, the switch 68 will have tilted to the opposite inclined position, whereupon the mercury will break the circuit through the lamp 99 and establish a circuit through the lamp 98 by contacting with the points 111 and 71. This circuit through the lamp 98 is as follows: from bus-bar 101 through the line 108', through contact points 71 and 111 to the return line 107.

When sufficient material has been discharged into the bin to cause the high level indicating device to swing, the switch 86 will have taken the opposite inclined position so that the mercury 87 closes the contacts 88. This establishes a circuit as follows: from the bus-bar 101 through line 119 across contacts 88, through mercury 87, thence through the line 120 and through the solenoid 65' and current resistor 114 to the return line 107. Upon the establishment of this circuit by the

tilting of the switch 86, the solenoid 65' is energized, admits air into the cylinder which causes the valve to close and no further material is then discharged into the bin. The low level indicating device in the bin is provided with a switch 122 actuated by means of a pendulum and paddle as previously described. When the material reaches the lower level the switch will be placed in such position that the mercury closes the circuit through its contacts, whereupon a circuit will be established as follows: from the main bus bar 101 through lamp 100, thence through the line 123, through the contacts in the switch 122 to the return line 107.

The last bin in the series is directly connected to the transport line, and no valve is interposed in the connection. This bin is provided with a device having a pendulum which extends down into the bin to a point near the bottom thereof. This pendulum is of the construction previously described, and actuates a switch 126 provided with contacts 127, and a quantity of mercury 128. A second pendulum in this bin carries a switch 129, provided with mercury 130, and pairs of contacts 131 and 132 mounted in the ends of the tube in which the mercury is contained. A third pendulum mounted in this bin carries a switch 133, provided with a pair of contacts 134 in one end of the switch tube which also contains a quantity of mercury 135.

It will be recalled that when the level of the material in the last bin reaches a certain predetermined lower limit, an indication is given at the main control station. When the level of the material being fed to this bin reaches a certain high level an audible signal is operated, and when the material reaches a still higher level the motor which drives the pump propelling the material through the system is stopped. The circuits by which these results are brought about electrically are as follows: When the material in the bin reaches the low level, the switch 128 is in the position shown in the drawings, at which time a circuit is established as follows: from the bus-bar 101' which leads from the main bus-bar 101 to the switch 103, through the lamp 124, line 136, one of the terminals 127, through the mercury 128, and the other terminal 127 to the return line 137. The lamp being lighted shows the operator that a sufficient quantity of material is not present in the bin, and he may close the valves in the system so that the transport line will deliver into this bin. In the illustration, the switch 126 is in the position that it would occupy while the bin is being filled.

The switch 129 shown in the drawings, operates in one position to maintain a lamp lighted at the central station, when the material in the bin is below the level of the pendulum by which the switch is operated. When the switch is in the position shown,

the lamp 123 is in a circuit as follows: From bus-bar 101' to lamp 123, line 138, to one of the contacts 132, through the mercury 130 to the other contact 132, and back to the return line 137. When the material entering the bin reaches a level such that the pendulum is swung and the switch 129 is tilted, the mercury runs away from the contacts 132, when the circuit above described is broken and the lamp goes out, thus visually indicating that the material has reached the level of the pendulum. This switch 129 is provided with an additional pair of contacts 131 in the opposite end so that when the pendulum reaches the inclined position and the mercury has run to the opposite end of the tube, the contacts 131 are closed when an audible signal is actuated. The circuit through the contacts 131 is as follows: From the bus-bar 101' through the audible signal 125, the line 139, to one of the contacts 131, thence across the mercury 130 to the other contact 131, to the return line 37. The audible signal now operates to notify the attendant that the material has reached a certain high level in the bin. Should the attendant fail to cut off the flow of material to the bin, the third pendulum in the bin is swung when the material reaches a somewhat higher level. This pendulum carries a switch 133, with contacts 134. As shown in the drawings, the switch is in the position that it would occupy when the material has reached the high level, and the switch is closed. In this position the switch closes a circuit only a part of which is shown. The circuit leads, however, to the motor and contains mechanism of the usual type for stopping the motor, as, for instance, by means of a relay which throws the main motor switch.

It will be seen that with the connections above described, the condition of the valves is shown to the operator at all times, and he is also informed as to the level of the material in the last bin. As soon as the material in any bin reaches either a high or a low level, a lamp is lighted and continues lighted so long as the condition exists. Also, when the material reaches a high level in the intermediate bins, a circuit is established which causes the solenoid at that bin to operate the valve to shut off the further flow of the material to the bin. When the material reaches the low level in the bin the operator is warned of the condition by the lighting of a lamp on the board. As to the last bin in the line, the signal actuating devices show when the level of the material has fallen below a selected lower limit, causing a lamp at the switch board to be lighted. Also, when the material has reached a predetermined high level, an audible warning signal is first actuated and if the condition is not corrected and more material is discharged into the bin, a third device is moved so as to close a circuit

which causes the motor driving the pump to be shut down.

It will be seen that with the system above described it is possible for a single attendant to operate the system and to control the condition of the bins at all times. The control mechanism may be placed at any desired point in the plant and may be as near to or as remote from the bins themselves as the layout of the plant may require. The attendant is promptly warned whenever the material in the bins falls below a predetermined low level and, in the case of each bin except the last, whenever the material being discharged into the bin reaches a high level the valve by which the flow of this material is controlled is automatically shut off, thus requiring no attention on the part of the operator. The supply of the material to the individual bins is under direct control and the distributing valves may be actuated from the switch panel whenever desired. For instance, should the material in two or more bins simultaneously reach the lower level, it would be desirable to permit a small supply to be introduced into one bin without completely filling the bin so that there would be no danger of the supply in the other bin entirely failing. The operator may exercise such control by opening the appropriate valve and permitting a certain quantity of material to be discharged into the bin which would be less than enough to actuate the high level indicator. By means of the switch which closes the valve he may voluntarily shut off this supply and cause the discharge to commence into another bin. In this way less than a capacity quantity may be discharged into a number of bins without the necessity of waiting until one bin after another is filled. At the same time the position of the bin valves is always shown on the panel so that there is no likelihood of the operator becoming confused.

Furthermore, while the system has been shown as arranged for distributing material to five bins, two of which are located on a branch line, it will be understood that it is applicable to any number of bins arranged in any desired manner. Also its use is not limited to the distribution of pulverized fuel, since it will be clear that the character of the material conveyed does not affect the operation of the several devices of which the system is composed. The means by which the material is moved through the system has been referred to as comprising a motor driven pump, preferably of the type illustrated in my co-pending application previously referred to. As disclosed in that application, this pump is so arranged that air is injected into the material being propelled, the aeration being such as to permit the transportation of the material through extended lines. The use of a propelling

pump in which the material is transported in an aerated condition also improves the action of the indicating devices, since the fluid mixture of air and the pulverized fuel may be given an increased velocity. Also the transportation in this condition improves the action of the indicating mechanism since the material discharged in the bin flows laterally more readily and this lateral movement actuates the signal pendulum with greater certainty.

I claim:

A conveying system of the class described which comprises the combination of a main transport line, means for propelling material therethrough, a plurality of bins located along the main line, branch connections between each of the bins except the last and the main line, the last bin being directly connected to the main line, a two-way valve for controlling each branch connection, the said valve being alternately operable to open the branch and close the main line beyond the branch, and to close the branch and open the main line beyond the branch, a central control station, means remotely controlled at the central station for opening and closing said valves, means for indicating the condition of said valves, means associated with each bin except the last operable when the material in said bin has reached said predetermined high level to actuate the operating means of the valve associated with said bin to close the branch line feeding that bin, and means associated with the last bin only and operable when the material in said bin has reached said predetermined high level to shut down the propelling means.

In testimony whereof I affix my signature.

ALONZO G. KINYON.