Jan. 30, 1945. J. W. POULTER 2,368,568

MACHINE FOR HANDLING FLUID MATERIAL FOR TREATING PAVEMENT SUBGRADE MATERIALS

Filed Feb. 3, 1941 4 Sheets-Sheet 1

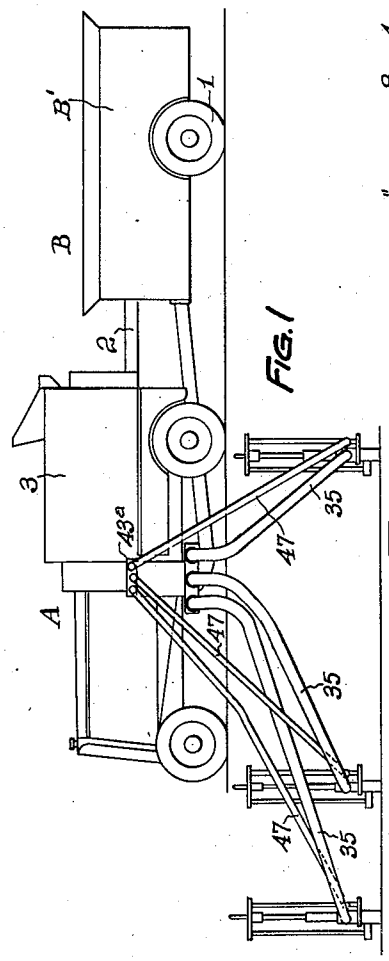


FIG. 1

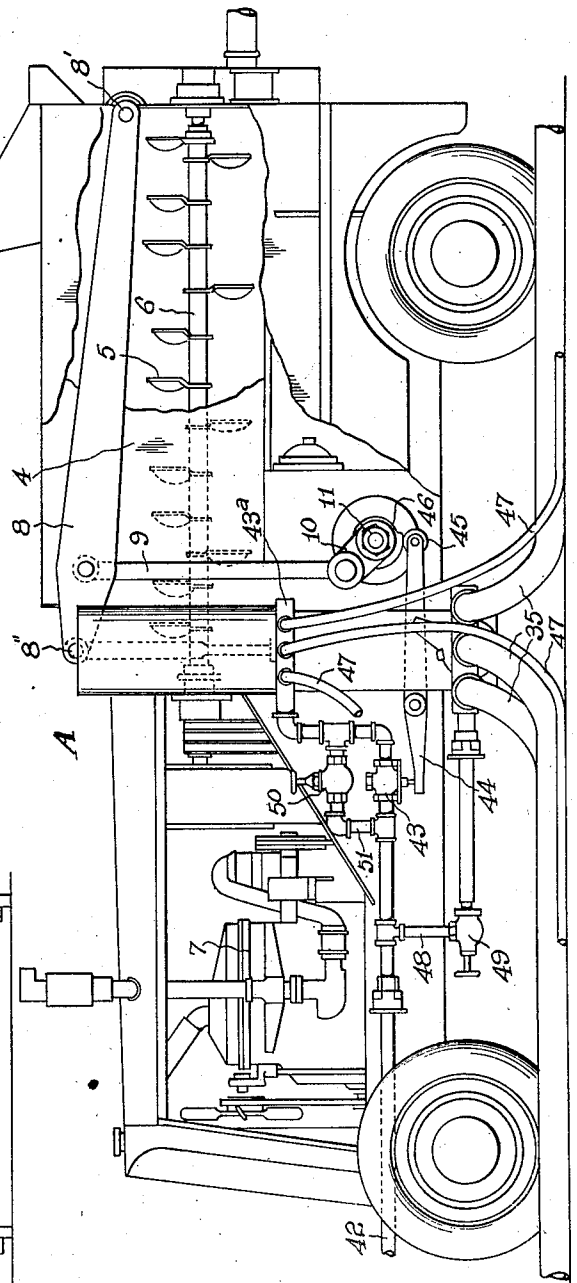


FIG. 2

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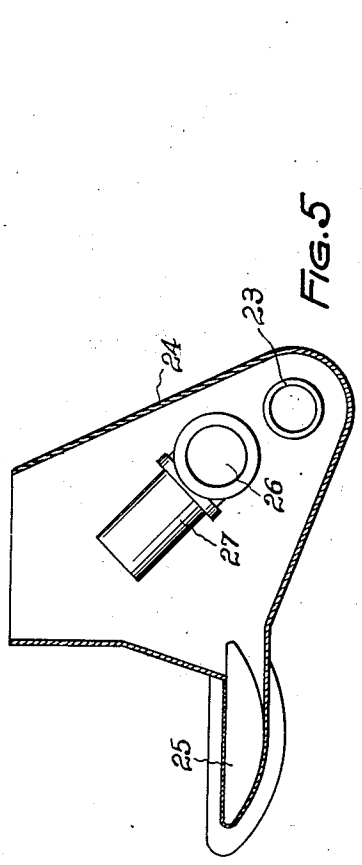


FIG. 5

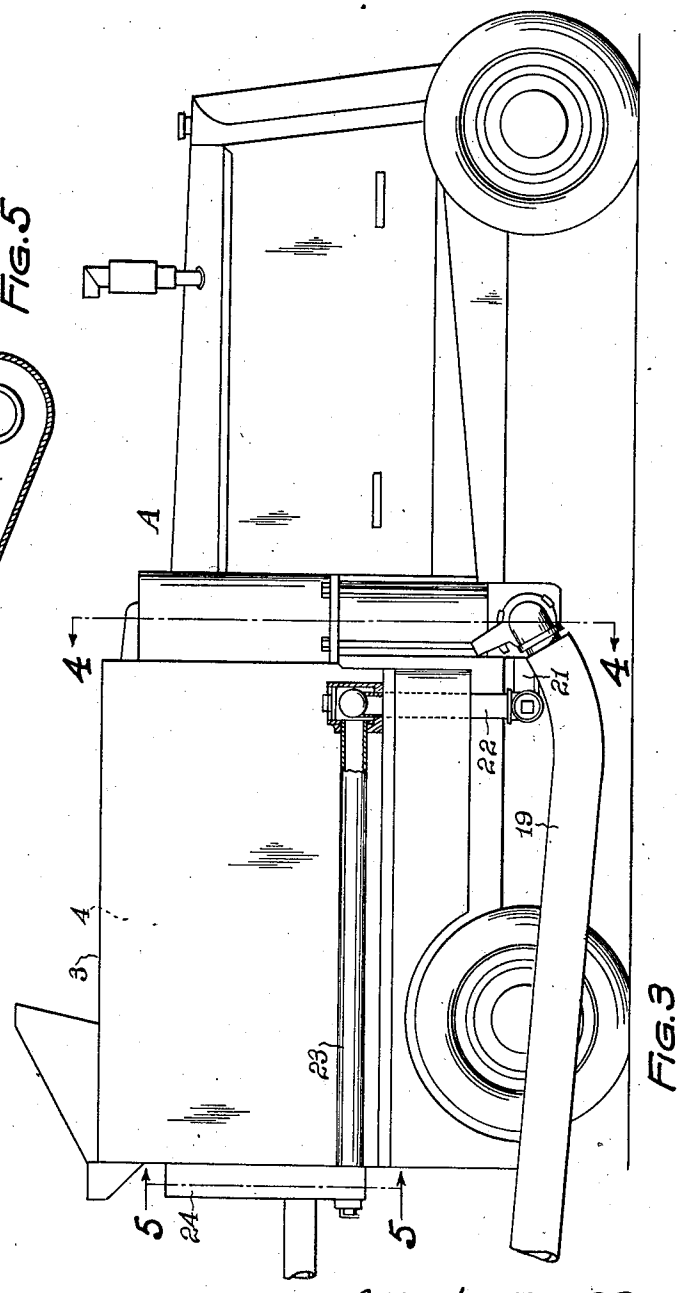


FIG. 3

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MACHINE FOR HANDLING FLUID MATERIAL FOR TREATING PAVEMENT SUBGRADE MATERIALS

Filed Feb. 3, 1941 4 Sheets-Sheet 3

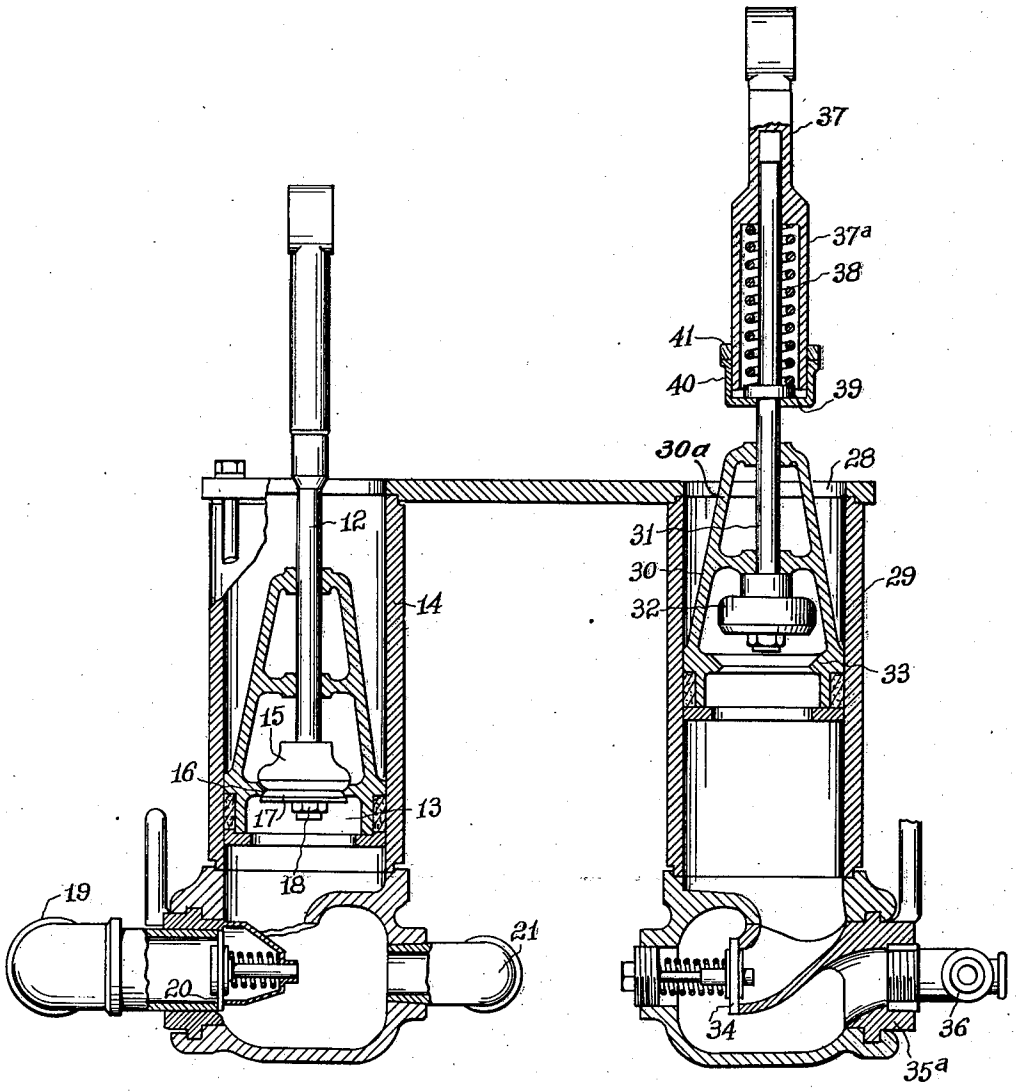


FIG. 4

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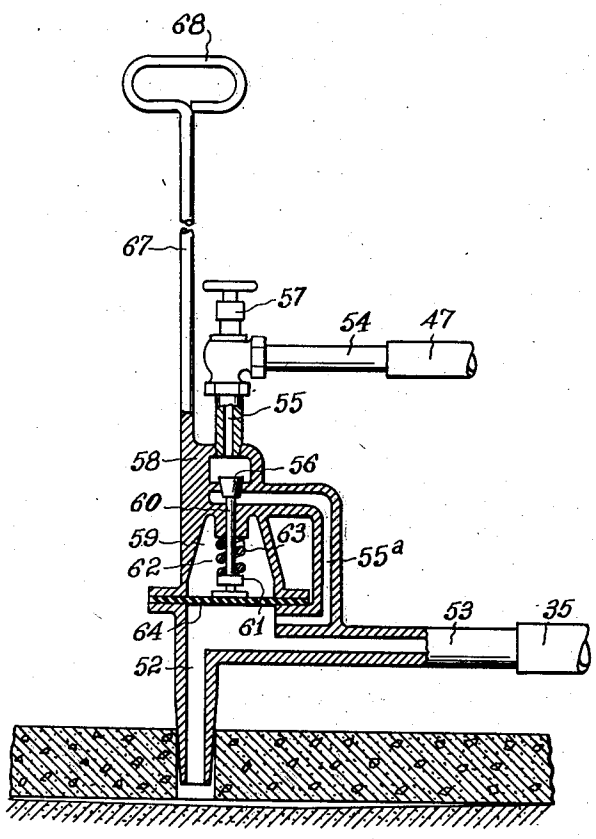


FIG. 6

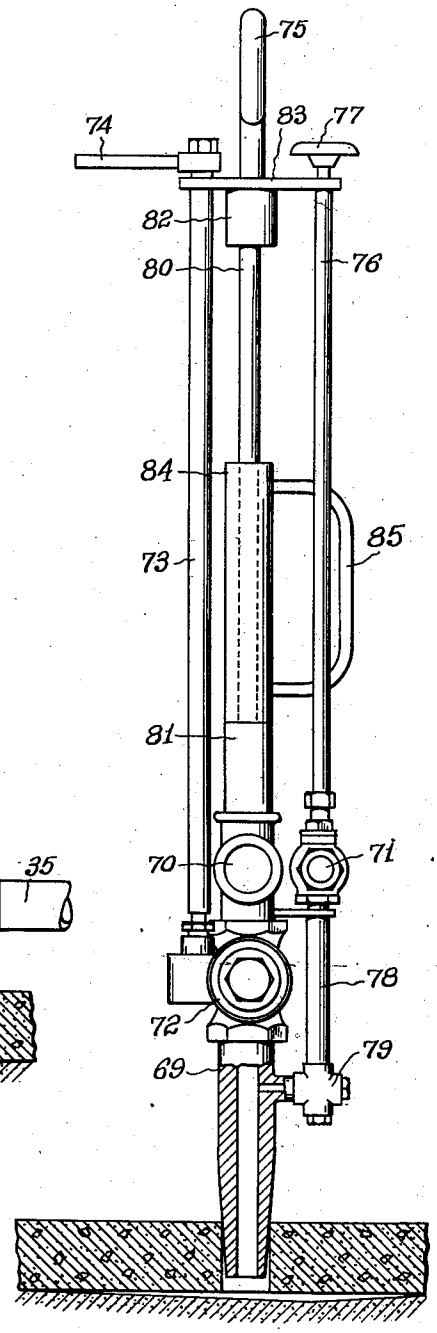


FIG. 7

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Patented Jan. 30, 1945

2,368,568

UNITED STATES PATENT OFFICE

2,368,568

MACHINE FOR HANDLING FLUID MATERIAL FOR TREATING PAVEMENT SUBGRADE MATERIALS

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Application February 3, 1941, Serial No. 377,270

18 Claims. (Cl. 94—39)

This invention has relation to the art of road maintenance, and correction of road surfacing, misalignment, and treatment of subgrade or soil conditions beneath and adjacent to road structures.

In certain respects the invention is a carrying forward of the inventions of my Patents Nos. 1,915,032, issued June 20, 1933; 1,969,324, issued August 7, 1934; 2,074,756, issued March 23, 1937; and 2,041,266, issued May 19, 1936. Particularly, this invention involves certain improvements and features increasing the adaptability of the machines such as proposed in the Patents Nos. 1,969,324 and 2,074,756 above mentioned, to enable the machines of this type to do additional work required for solving certain problems of road maintenance and grade correction such as have arisen in connection with modern concrete and similar roads, due to the increasing travel over such roads of heavy vehicles.

The present invention is an improved machine related most closely to the type of my previous Patent No. 1,969,324 in that the present invention utilizes many features of the design of the last mentioned patent in conjunction with the added improvements that enable the machine of the said patent to be employed with increased usefulness in the treatment of the soil and subgrade materials beneath road structures such as found all over the country today.

In the use of hard roads such as concrete, as well known, the road is made up usually of units comprising slabs arranged end for end and separated by what are called joints providing for expansion and contraction of the slabs and thus the whole road structure under different conditions of heat and cold.

It has been found in practice that the travel of heavy vehicles over roads of this type and over such roads where cracks appear from time to time due to settlement of non-uniform subgrade materials or other natural causes, the weight of the heavy vehicles will under normal conditions produce a certain amount of vertical movement of a slab and that this vertical movement is greater as the wheel of a vehicle carrying load approaches the point or points where the slabs come together, or where the edges of cracked portions come together. It is common for water to collect beneath the road and especially at joints, or beneath parts of the road where cracks appear, and while the actual vertical displacement of the slab or section of the road at these points is very slight at first, it will increase under heavy traffic and may become as much as ⅛" or even ¼". The results of such movement are very serious in the effects produced upon the subgrade or materials underneath as well as the road structure itself. As a matter of fact, since water will collect beneath the road, the greater vertical displacement of the slab at the cracks or joints under heavy vehicle travel is such as to produce what is known as "pumping," which means that the water adjacent the joint or crack is either forced forward or backward and out at the joint or crack or laterally, and out at the edge of the slab between it and the shoulder material or both. The comparatively high velocity of the water near a joint or crack caused by the greater displacement of the slab at these points washes away some of the grade material immediately adjacent the lower side of the slab and near the joints or cracks. This allows for a greater accumulation of water near the joint or crack, which results in a greater rate of washing and slab break-up because of loss of subgrade support.

I have discovered a new method and means for correcting the sometimes disastrous action of pumping, as above mentioned, which tends to break up or disintegrate the road structure, and I have invented a new composition of material that will be caused by the use of my method to penetrate and spread over and into the subgrade materials of the road so as to re-establish the integrity, so to speak, of the subgrade materials to cause them to fully support the road and correct the defects mentioned. This is done by replacing the displaced material as well as by re-establishing the firmness or stability of the subgrade material immediately adjacent the affected area and in this connection I employ the new filler composition which I have referred to above, emplacing it by use of air employed in a peculiar manner in conjunction therewith in the operation of the machine of this invention with its improvements contained therein, as compared with said machine as of the basic or general structure proposed in my Patents 1,969,324 and 2,074,756 hereinbefore referred to.

The necessity for use of air under pressure in conjunction with the emplacement of the new composition of materials caused to be introduced into the subgrade through the road structure itself or from the side thereof has required that means be employed in conjunction with the machines I have heretofore invented for handling the air phase of my process of correcting the grade conditions, and a machine embodying the improvements of the present described inven-

tion I have found will do this work very effectively.

The machine of my present invention comprises very generally the construction of my machine of Patent No. 1,969,324 wherein I utilize a mixer for the so-called "mud" which heretofore has been a cementitious material added to water and certain loamy soils of predetermined character. However, now I employ in my machine and mix thereby a treatment material of fluid nature as before, including water in large proportion admixed with approximately 10% cement and approximately 10% asphalt or asphaltic oil or like bituminous matter. The so-called "mud" or treatment material is fed to a mechanical moving means in the form of a cylinder and piston which forces the fluid treatment material to the point of introduction or application of the same to the sub-soil or subgrade materials beneath the road structure and I now provide with this machine the additional improvements of the air handling instrumentalities that conduct air under pressure to the fluid treatment material introducing nozzle and control the supply of this air under pressure so that it works intermittently or pulsatively in its direct action on the fluid treatment material. The surge effect produced by the air along with the slight rising and falling of the slab caused by the intermittent flow of both the air and mud give a much more complete filling of all voids beneath the slab than if the mud was used alone, or if the rate of flow was uniform. Reference in the above connection is made to my copending method application executed of even date herewith, filed February 17, 1941, Serial No. 379,365.

The machine of this invention will be understood as to its construction and operation upon reference to the following specification and accompanying drawings, in which—

Figure 1 is a diagrammatic view of my machine with its associated hopper vehicle that supplies the fluid treatment materials to the mixer and receives overflow of such materials from the mixer under certain conditions of service.

Figure 2 is an enlarged side view of the machine, a side of the hood of the engine being removed for disclosure of parts contained beneath the hood and illustrating the general arrangement of the conduits, both for air and for the fluid treatment material, and the nozzle units that are manually controlled and to which the several air and fluid material conduits lead for supply purposes.

Figure 3 is a view similar to Figure 2, but looking at my machine from the opposite side.

Figure 4 is a sectional view taken through the piston and cylinder units of the machine and about on the line 4—4 of Figure 3.

Figure 5 is a sectional view of a detail feature of the machine taken on the line 5—5 of Figure 3.

Figure 6 is a view partly in section showing one of the nozzle units with the control valves and operating means therefor such as may be employed in conjunction with my machine for directing the passage of the fluid treatment material through holes in the road structure.

Figure 7 is a view similar to Figure 6 but illustrating another type of nozzle unit adaptable for the purposes of the machine of this invention.

Describing my invention with specific reference to the drawings and particular reference to Figure 1 of the latter, I note that the machine of this invention is designated generally at A and may or may not be employed in conjunction with the hopper supply vehicle B. It is convenient to employ the vehicle B under certain working conditions, the latter being in the nature of a trailer construction including a hopper body B' mounted on rear wheels 1 and connected by any suitable trailer hitch 2 to the rear of my machine A. The purpose of the hopper vehicle B is to receive the aggregates of materials that are to be mixed in the mixer 3 of my machine in sufficiently large quantities to make sure that an ample supply of the treatment materials will be had to enable the machine A to carry on its work for a considerable period of time.

The machine A is more fully illustrated in Figures 2 and 3 of the drawings and comprises certain features of construction similar to those disclosed in my Patent 1,969,324 including a mixer comprising the mixing chamber 4, mixing blades 5 in said chamber carried by the operating shaft 6, a suitable engine 7 for supplying the power for driving the shaft through the intermediary of any suitable transmission mechanism, not material to the invention, and operating levers or beams 8. The operating levers or beams 8 are actuated by pitman rods or links 9 connected thereto and leading to cranks 10 on an operating shaft 11 so that the levers 8 will be moved upwardly and downwardly during the rotation of said shaft 11.

Similar to the manner presented in my last mentioned patent, the levers 8 are pivotally supported upon the body of the mixer 3 at one end as shown at 8' and at the other end at 8''. Said levers are pivotally connected to the upper ends of piston rods 12 and 31, seen best in Figure 4. The piston rod 12 is immovably connected to the piston 13 in a cylinder 14 by anchoring the valve 15 at the lower end of the rod 12 to the valve seat 16 by means of a clamp plate 17 held in place by nuts 18.

At its lower end the cylinder 14 is connected by a relatively large conduit or flexible hose 19 that leads to the lower portion of the hopper vehicle B so that the fluid treatment material in the latter may be supplied to the lower end of the cylinder moving thereinto past a suitable valve 20 spring actuated to remain normally seated until unseated by the upward suction stroke of the piston 13. When the fluid treatment material which is referred to hereinafter as "mud," being so termed in the art of use of my machines, is drawn into the lower end of the suction cylinder 14 by the up-stroke of the piston 13, it is forced out of the cylinder 14 upon the down stroke of said piston and when so forced passes through a conduit 21 connected with a vertical pipe 22, in turn connected to a horizontal pipe 23 which leads to a casing 24 at the rear end of the mixing chamber 4. From the casing 24 the "mud" under the pumping action of the piston 13 passes through an opening 25 into the mixing chamber. An overflow pipe 26 leads from the mixing chamber through the casing 24 back to the interior of the hopper vehicle B. The level of the "mud" or fluid conduits of the mixer is governed by employing a pivoted pipe section 27 shiftable about its point of connection with the overflow pipe 26, as seen in Figure 5, and, by raising and lowering the upper open end of the pipe section 27, the level of the fluid material in the mixer may be increased and decreased, respectively.

It will be understood, of course, that the con-

duit 19 may lead from any suitable source of supply of "mud" and likewise the overflow pipe 26 might be connected to any suitable receptacle to which the excess "mud" or fluid material in the mixer may be desired to be led.

The front end of the mixing chamber 4 is in communication, by an opening 28, with a pressure cylinder 29 arranged alongside and spaced from the cylinder 14, see Figure 4. In the cylinder 29 is arranged the piston 30 operated by the relatively movable piston rod 31 carrying the correspondingly movable valve 32 adapted to be seated and unseated relative to the valve seat 33. The valve 32 and piston 30 operate in a manner similar to corresponding parts as illustrated in Figure 3 of my Patent 1,969,324. A relatively narrow member of substantially a U-shape is mounted, and has its ends fixed to the piston head forming a ball member 30a. This member 30a serves as a guide for the relatively movable piston rod 31, and permits the "mud" to flow from the mixing chamber through the valve seat 33. In other words, when the valve 32 closes down upon its seat 33 upon the down stroke of the piston 30, the "mud" which has previously passed downwardly from the mixing chamber 4 through the piston 30 to the lower end of the cylinder 29 will be forced past a valve 34 at the bottom of cylinder 29 out of the cylinder into one or more of the "mud" hoses or conduits 35 that are coupled to the lower end of the cylinder 29 by suitable couplings 36. The intake valve 32 of the piston 30 is spring loaded in order to make provision for by-passing action of the fluid material or "mud" and to provide a safety means for purposes more fully to be understood upon description of other parts made hereinafter. The valve 32 is carried by the piston rod section 31, as previously stated, and this piston rod section is free to move in the upper rod section 37, the latter having a hollow portion 37a that forms a spring barrel in which the spring 38 is seated, said spring bearing at its lower end against a collar 39 fixed to the rod section 31 adapted to abut with the lower closed end of a cap 40 which screws onto the lower extremity of the spring barrel portion 37a of the rod section 37. The cap 40 is prevented from displacement by a lock nut 41. The upper end of the spring 38 has a bearing against the upper extremity of the hollow portion or barrel section 37a of the member 37.

The distance between the lower side of the cap 40 and the top portion of the piston 30 is slightly greater than the travel necessary to cause the valve 32 to contact its seat 33 in the piston 30. In view of the foregoing, the full force required to operate the piston up to the amount necessary to compress the spring 38 is carried by the spring. When this pressure is sufficient to compress the spring 38, the lower portion of the cap 40 will come in contact with the upper end of the piston 30 and move the piston so that the pressure in the cylinder will continue to build up until the pressure against the valve 32 is sufficient to compress the spring 38 still further. This permits the valve 32 to open and the piston to complete its stroke without any further building up of the pressure in the cylinder 29 even though the discharge or discharges leading from the cylinder may be closed, it being understood that these discharges comprise the flexible hose or conduits 35 by which the "mud" or fluid treatment material is carried from the cylinder 29 to the place or places of use thereof.

As shown in Figure 2, there are three "mud" lines 35 that lead from the "mud" manifold 35a at the bottom of the cylinder 29, each of these "mud" lines or conduits 35 leading to a nozzle unit, one type of which is illustrated in Figure 7 of the drawings and another type illustrated in Figure 6.

It is contemplated, according to the improvements of this invention, as largely distinguished from the machine of the construction of my Patent 1,969,324, to make provisions for the supply of air to the nozzle units at the ends of the conduits 35, said supply to be effected intermittently or by pulsations, as will appear more fully hereinafter.

With the foregoing in view, as seen in Figure 2, there is provided an air supply line 42 which extends to the air manifold 43a mounted adjacent to the top of the cylinder 29. In the length of the air line or conduit 42 is located an automatic air control valve 43 which is intermittently tripped to open and closed positions by an actuating lever 44. The lever 44 is pivoted intermediate its ends and engages the stem of the valve 43 at one end of the lever. The opposite end of the lever 44 carries a roller 45 operating on a cam 46 carried by the shaft 11 that supports and operates the cranks 10 which produce the desired movements of the pistons in the two cylinders previously described. Therefore, at predetermined times in the rotation of the shaft 11, the air valve 43 will be opened, thus to supply air under pressure intermittently from the pressure supply line 42 to the manifold 43a, and from the manifold 43a to the three air conduits or hoses 47 by which the air is conducted from the manifold 43a to the three nozzle units previously referred to.

A by-pass or branch pipe 48 leads downwardly from the main air supply pipe 42 and into the "mud" manifold 35a. This by-pass pipe is controlled by a valve 49 normally closed in the operation of the machine but adapted to be opened in order to carry pressure air to the manifold 35a for blowing out the manifold and the "mud" conduits 35 leading therefrom as well as the nozzle units that are connected with said conduits 35.

Provision is made by a valve 50 in a second by-pass pipe 51 for supplying a continuous flow of pressure air to the air manifold 43a, if, under certain conditions, such air is desired in the operation of the machine.

At the ends of each associated pair of "mud" and air conduits 35 and 47, respectively, as stated before, there is located one of the nozzle units employed for the purposes of introducing the fluid treatment material beneath the pavement. Figure 6 illustrates one of these units which comprises the nozzle proper 52 having the tubular extension 53 to connect with one of the conduits 35 and having a valve pipe extension 54 to connect with one of the air conduits 47. In the present instance, the pipe extension 54 communicates with a valved conduit 55 having the automatic valve 56 therein to control the passage of air therethrough to the pipe extension 53 and conduit 35. A manually controlled cut-off valve 57 is connected with the pipe 54 and enables the entire cutting off of the supply of air from the air conduit 47 or the regulating of the amount of air supplied to the conduit 55 according to the requirements of the particular work being performed. The air conduit 55 that is controlled by the automatic valve 56 leads to the pipe extension 53 by a passage 55a communicating both

with the pipe extension 53 and hose conduit 35 and with the nozzle 52. The body 58 of the nozzle unit is provided with a chamber 59 into which the stem 60 of valve 56 extends, the said stem having a collar 61 engaged by one end of a spring 62, the spring at the opposite end engaging a shoulder 63. The action of the spring 62 is to hold the automatic valve 56 closed until the pressure of the "mud" or liquid treatment material in the nozzle 52 below the chamber 59 builds up sufficiently to raise a diaphragm 64 at the bottom of the chamber 59, thereby causing the diaphragm to engage a stem 66 of the valve 56 to move the valve to its upward open position and thereby permit the air supplied from the conduit 47 to enter the nozzle below the diaphragm 64 by way of the passage 55a.

Under the foregoing conditions, the operation of the nozzle unit, so far as the supply of air to the "mud" or liquid treatment material, is concerned, as it is received in the nozzle 52, is automatic. In other words, when the pressure force causing the "mud" to pass through the nozzle 52 is relieved, the air supply from the conduit 47 will be cut off automatically through the action of the valve 56 and the diaphragm 64. For convenience in handling the nozzle unit just described, a suitable vertical handle 67 is employed having the hand piece 68 at its upper end. It will be understood that by manipulation of the handle 67 the nozzle 52 may be forced downwardly and wedged into the opening in the pavement through which the liquid treatment material or "mud" is to be introduced into voids or into the soil of the subgrade of said pavement.

In Figure 7 there is illustrated another type of nozzle unit which may be described as comprising the nozzle proper 69 having a suitable coupling pipe 70 for attaching one of the "mud" hoses or conduits 35 to supply the liquid treatment material to the nozzle 69. There is provided on pipe 70 a coupling connection for attachment of one of the air lines or conduits 47. A valve 72 between the point of the coupling 70 and the nozzle proper 69 controls the passage of the "mud" to the nozzle under the actuation of the valve by means of a shaft 73 and handle 74 at the upper end of the shaft adjacent to the handle 75 of the unit. In like manner the valve 71 is adapted to be opened and closed by means of a handle rod 76, at the upper end of which is a hand piece 77 for manipulation purposes. From the valve 71 the air line leads, by pipe section 78 and union 79, to the nozzle 69 where the air enters from one side. The nozzle unit includes the handle rod 80 that leads up to the handle 75 from the coupling member 70, and around this handle rod or standard, at its lower end, is a sleeve 81. Near the upper end of the member 80 is a hollow boss 82 surrounding said member and carrying the supporting plate 83 which coacts with the parts 76 and 73 to support and guide same.

On the standard or rod 80 is mounted a driving sleeve 84 which slides up and down the member 80 and at its lower end is adapted to impinge against the sleeve 81 while at its upper end it is adapted to impinge against the boss 82. A handle 85 is attached to the driving sleeve 84, and, by manipulation of this handle and up and down movement of the sleeve 84, a hammering action of the sleeve against the lower sleeve 81 may be produced so as to drive the nozzle 69 into the opening of the pavement through which the "mud" is to pass beneath the pavement structure. In like manner, by up and down movements of the driving sleeve 84 to impinge it against the boss 82, an upward driving effect of the sleeve to act upon the upper portion of the nozzle unit may be produced for facilitating the removal of the nozzle 69 from the opening in the pavement into which it is wedged when the nozzle unit is being employed in the operation of my machine.

Description of operation of machine

The liquid treatment material is supplied to the mixer with the ingredients thereof combined and largely composed of water, 60 to 80%, cement about 10%, and asphalt or asphaltic oil or like bituminous material, about 10%, through the conduit 19 that leads to the lower end of the cylinder 14. The action of the piston 13 upwardly draws the "mud" into the cylinder 14 and the action of said piston 13 downwardly forces the "mud," by way of conduit 21 and pipe 22 and pipe 23, into the mixing chamber 4 through the casing 24. The turning blades 5 on the shaft 6 in the mixer agitate the said liquid treatment materials and combine them into a uniform mixture ready to be dispensed or ejected from the machine.

Operation of the pressure piston 33, as previously described, will force "mud" received in the pressure cylinder 29 directly from the mixing chamber 4, out of the cylinder 29 through the various "mud" conduits 35, which are shown but any suitable number of which may be employed. The "mud" passes through the conduits 35 to the nozzle units at the outer end of the conduits, and the conduits 35 are sufficiently long that the nozzle units may be located many feet from the machine for the purpose of causing the introduction of the "mud" into different openings formed in the pavement structure to enter the voids or sub-soil under the pavement. As pressure is produced through the conduits 35 by the pressure action of the piston 33, forcing the "mud" through these conduits to the nozzles 52 for the type of unit illustrated in Figure 6, or to the nozzle 69 for the type of unit illustrated in Figure 7, air is intermittently supplied to the nozzle of the construction of Figure 6 by the automatic valve 56 actuated by the diaphragm 64. It will be observed that only when the pressure force of the piston 33 is acting upon the "mud" will the valve 56 of the unit of Figure 6 be opened to supply air to the "mud" to act thereon and therewith in order to spread the "mud" and cause thorough penetration of the same into the space of the void beneath the pavement, or into the sub-soil materials beneath the pavement if there are no large voids.

When the nozzle unit of Figure 7 is employed, the air is admitted to the nozzle 69, opening the valve 71 by means of the handle 76. Of course, it is to be understood that in the use of the Figure 7 nozzle unit described, air is supplied intermittently only, or by pulsations, so to speak, in the operation of the machine because the main air control valve 43 is an automatic actuating valve and is operated at predetermined times under the control of the cam 46 and the lever 44. The air flow through the air manifold 43a and the hose lines 35 out to the "mud" nozzles starts just after and stops just before the "mud" flow, the latter being compelled of course by the pressure stroke of the piston 33 in the cylinder 29.

The cam 46 is timed in its action on the roller 45 to accomplish the foregoing.

By reason of the provision of the spring loaded valve 32 of the pressure piston 30 and the action of this valve in opening and closing the passage through the piston for the "mud" that comes from the mixing chamber 4, the nozzles of the nozzle units employed at the ends of the "mud" conduits 35 and air conduits 47 may be shut off at will. Because of the size of the opening in each nozzle of the respective nozzle units, the resistance to flow is such that with all nozzles open, the pressure is substantially maximum. Under these conditions, each nozzle will be worked independently, as regards the valve means, to shut off the same, and move from one hole in the pavement to another hole, as necessary, without interfering with the other nozzles or the operation of the machine. Thus, if one or two nozzles of their respective nozzle units are closed, the tendency of the pressure piston 30 to feed too much material to the conduits 35 and all of the nozzles is compensated for by the action of the spring 38 in permitting yielding of the valve 32 to open position so that stoppage or shutting off of any one of the "mud" lines 35 will merely cause the surplus material that is not being fed from the shut off nozzles to pass backwardly or upwardly through the passage in the piston 30, by the valve 32, and into the upper portion of the cylinder 29 or back into the chamber 4. Thus, it will be seen that the mixing chamber 4 discharges directly into the pressure cylinder and the piston in the latter forces the fluid mixture through the hose lines 35 to the nozzles thereof on the downward stroke of the piston 29 and under a pressure determined by the setting of the spring loaded inlet valve 32 in the cylinder 29 in the manner previously described.

The spring unit 38, 37*a*, and 39 is virtually a safety device by which the piston 29 working with the valve 32 closed on its seat is prevented from exerting such an amount of pressure as to tend to burst the hose lines 35.

There may be times when a continuous application of air to the "mud" lines 35 might be desirable for certain types of work to be performed by the apparatus under which conditions recourse may be had to the use of the valve 50 to open the air line 42 to the manifold 43*a* completely and for the desired period of time.

The technique of the use of the air in conjunction with the "mud" or fluid treatment material handled by my machine may be varied according to the different types of work that are to be performed by the machine.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid treatment material, a flexible conduit for conveying said material to a place of application thereof, a nozzle unit controlling the passage of material from said conduit to the point of use of the material, pressure means for forcing the material through the conduit, actuating mechanism for operating the said pressure means, and a pressure relief valve mechanism acting when the pressure in the said material conveying conduit reaches a predetermined amount to prevent building up of pressure in the last mentioned conduit such as might burst said last conduit.

2. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid treatment material, a flexible conduit for conveying said material to a place of application thereof, a nozzle unit controlling the passage of material from said conduit to the point of use of the material, pressure means including a piston for forcing the material through the said conduit under pressure, actuating mechanism for operating the said pressure means, and a pressure relief valve mechanism acting when the pressure in the said material conveying conduit reaches a predetermined amount to prevent building up of pressure in the last mentioned conduit such as might burst said last conduit, including a valve on the piston.

3. In a machine for supplying fluid treatment material to subgrade materials of pavement structures and the like, in combination, a fluid treatment material chamber, pressure means to act on the fluid material of the chamber, a fluid treatment material supply conduit leading from the pressure means aforesaid, a nozzle unit for said materials supply conduit, operating means for said pressure means, an air supply conduit, an air feed conduit connected to the air supply conduit and leading to the nozzle unit for supplying air to the latter and to the fluid material passing through the latter, valve means controlling the air supplied to the air feed conduit from the air supply conduit, and automatic operating devices for working said valve means to open the valve means before and after the pressure means operates to force fluid material through the fluid material conduit.

4. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid treatment material, a conduit for conveying said material to a place of application thereof, a nozzle unit controlling the passage of material from said conduit to the point of use of the material, pressure means for forcing the material through the conduit, an air supply conduit connected with the nozzle unit, actuating mechanism for operating the said pressure means, and valve mechanism intermittently operable by the last mentioned actuating mechanism for intermittently cutting off the supply of air to said nozzle unit.

5. A machine as claimed in claim 4, wherein the actuating mechanism comprises a shaft and a cam operated lever connected with the valve mechanism.

6. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid treatment material, pressure means associated with said chamber for subjecting the said material to pressure, a plurality of material conduits connected with said pressure means and through which the material is forced thereby, a nozzle unit for each of said material conduits through which the material passes to the place of use, each nozzle unit comprising a cut-off instrumentality for closing the nozzle unit and stopping the passage of material therethrough, the pressure means aforesaid comprising a relief valve mechanism operable when the passage of the material from a nozzle or nozzles is cut off to reduce or discontinue the action of the pressure means in forcing the fluid material through the conduits.

7. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid

treatment material, pressure means associated with said chamber for subjecting the said material to pressure, a plurality of flexible hose material conduits connected with said pressure means and through which the material is forced thereby, a nozzle unit for each of said material conduits through which the material passes to the place of use, each nozzle unit comprising a cut-off instrumentality for closing the nozzle unit and stopping the passage of material therethrough, the pressure means aforesaid comprising a relief valve mechanism operable when the passage of the material from a nozzle or nozzles is cut off to reduce or discontinue the action of the pressure means in forcing the fluid material through the conduits, a pressure air supply conduit, a plurality of air conduits communicating with said air supply conduit, each air conduit communicating with one of the nozzle units, and means for intermittently discontinuing the passage of air through said air conduits.

8. Means as claimed in claim 7, combined with a by-pass conduit connected with the pressure air supply conduit for supplying air continuously to the air conduits, and a valve controlling said by-pass conduit.

9. Means as claimed in claim 7, combined with a by-pass conduit connected with the pressure air supply conduit for supplying air continuously to the air conduits, a valve controlling said by-pass conduit, and a conduit for connecting the pressure air conduit with the material supply conduits for blowing out said conduits, and a valve controlling the last mentioned air conduit that leads to the material conduits.

10. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a chamber for supplying fluid treatment material, pressure means associated with said chamber for subjecting the said material to pressure, a plurality of material conduits connected with said pressure means and through which the material is forced thereby, a nozzle unit for each of said material conduits through which the material passes to the place of use, each nozzle unit comprising a cut-off instrumentality for closing the nozzle unit and stopping the passage of material therethrough, the pressure means aforesaid comprising a relief valve mechanism operable when the passage of the material from a nozzle or nozzles is cut off to reduce or discontinue the action of the pressure means in forcing the fluid material through the conduits, a pressure air supply conduit, a plurality of air conduits communicating with said air supply conduit, each air conduit communicating with one of the nozzle units, means for intermittently discontinuing the passage of air through said air conduits, valve means on each nozzle unit controlling the passage of air through the nozzle of said unit and operable by the pressure applied to the material passing through the material conduit connected with said nozzle unit.

11. A machine as claimed in claim 10, combined with a diaphragm carried by each nozzle unit and responsive to the pressure of the fluid material passing through the material conduit connected to said nozzle unit for the actuation of the nozzle valve mechanism that controls the supply of air to the nozzle unit by means of the air conduit connected therewith.

12. In a machine for supplying fluid material for treatment of pavement structures and the like, in combination, a pressure cylinder and piston unit, a chamber for supplying fluid material to said pressure cylinder, a fluid material conduit leading from the pressure cylinder, a nozzle unit at the end of said conduit opposite that connected to the pressure cylinder for directing the material in the conduit to the point of application thereof, operating means for the piston of said unit comprising a piston rod structure including a rod section having a valve thereon, the piston having a passage therethrough adapted to be closed by said valve, a second rod section connected to the first rod section carrying the valve, and yieldable means connecting the said rod sections so that upon predetermined resistance to the movement of the valve by its rod section tending to cause said valve to close the passage in the piston, said valve may open and permit the passage of the material in the cylinder backwardly in the direction of the supply chamber.

13. In a machine for supplying fluid treatment material to subgrade materials of pavement structures and the like, in combination, a chamber for fluid treatment material, pressure means to act on the fluid material of the said chamber, a fluid treatment material supply conduit leading from the pressure means aforesaid, a nozzle unit for said material supply conduit, operating means, an air supply conduit, an air feed conduit connected to the air supply conduit and leading to the nozzle unit for supplying air under pressure to the latter and to the fluid material passing through the latter, automatically operating valve mechanism to intermittently cut off the supply of air passing through the air feed conduit to the nozzle for action upon the fluid material passing through said nozzle, and an instrumentality controlled by the pressure of the treatment material at said nozzle for governing the supply of pressure air to said nozzle.

14. In a machine for supplying fluid treatment material to subgrade materials of pavement structures and the like, in combination, a chamber for fluid treatment material, pressure means to act on the fluid material of said chamber, a fluid treatment material supply conduit leading from the pressure means aforesaid, a nozzle unit for said material supply conduit, operating means, an air supply conduit, an air feed conduit connected to the air supply conduit and leading to the nozzle unit for supplying air under pressure to the latter and to the fluid material passing through the latter, automatically operating valve mechanism to intermittently cut off the supply of air passing through the air feed conduit to the nozzle for action upon the fluid material passing through said nozzle, and an instrumentality controlled by the pressure of the treatment material at said nozzle for controlling the time when the pressure air is supplied to the nozzle.

15. In a machine for supplying fluid treatment material to subgrade materials of pavement structures and the like, in combination, a chamber for fluid treatment material, pressure means to act on the fluid material of the said chamber, a fluid treatment material supply conduit leading from the pressure means aforesaid, a nozzle unit for said material supply conduit, operating means, an air supply conduit, an air feed conduit connected to the air supply conduit and leading to the nozzle unit for supplying air under pressure to the latter and to the fluid material passing through the latter, valve means to control passing of the pressure air through the nozzle, and an instrumentality coperable with said last valve means actuated

by pressure of the treatment material built up at the nozzle to open said valve means.

16. In a machine for incorporating fluid treatment material in the subgrade materials of pavement structure, and the like, in combination, a supply chamber for the treatment material, a fluid treatment supply conduit for conveying treatment material to the subgrade materials which are to be treated, material pressure means for forcing the treatment material through the material supply conduit, air pressure supply means and air pressure conduits connecting said pressure air supply means to the material conduit above mentioned, mechanism for intermittently cutting off said air supply means, and an instrumentality controlling the cutting off means so that air under pressure is supplied to the material conduit before and after the operation of the pressure means that forces the treatment material through the conduit to the point where the treatment material is supplied to the subgrade materials.

17. In a machine for incorporating fluid treatment material in the subgrade materials of pavement structure, and the like, in combination, a supply chamber for the treatment material, a fluid treatment supply conduit for conveying treatment material to the subgrade materials which are to be treated, material pressure means for forcing the treatment material through the material supply conduit, air pressure supply means and air pressure conduits connecting said pressure air supply means to the material conduit above mentioned, mechanism for intermittently cutting off said air supply means, an instrumentality controlling the cutting off means so that air under pressure is supplied to the material conduit before and after the operation of the pressure means that forces the treatment material through the conduit to the point where the treatment material is supplied to the subgrade materials, a nozzle connected to the treatment material supply conduit at its outflow end to direct the material passing therethrough to the point of use, and valve means on said nozzle for controlling the issuing of the treatment material therefrom in cooperation with the mechanism for intermittently cutting off the air supply means above referred to.

18. In a machine for incorporating fluid treatment material in the subgrade materials of pavement structure, and the like, in combination, a supply chamber for the treatment material, a fluid treatment supply conduit for conveying treatment material to the subgrade materials which are to be treated, material pressure means for forcing the treatment material through the material supply conduit, air pressure supply means and air pressure conduits connecting said pressure air supply means to the material conduit above mentioned, mechanism for intermittently cutting off said air supply means, an instrumentality controlling the cutting off means so that air under pressure is supplied to the material conduit before and after the operation of the pressure means that forces the treatment material through the conduit to the point where the treatment material is supplied to the subgrade materials, a nozzle connected to the treatment material supply conduit at its outflow end to direct the material passing therethrough to the point of use, valve means on said nozzle for controlling the issuing of the treatment material therefrom in cooperation with the mechanism for intermittently cutting off the air supply means above referred to, and an instrumentality controlled by the building up of pressure of the treatment material at the nozzle automatically governing the action of the valve means on the nozzle.

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