May 9, 1933. J. T. VAWTER 1,908,578

APPARATUS FOR CONVEYING AND DEPOSITING CEMENTITIOUS MATERIAL

Filed Dec. 31, 1929 2 Sheets-Sheet 1

Fig. 1.

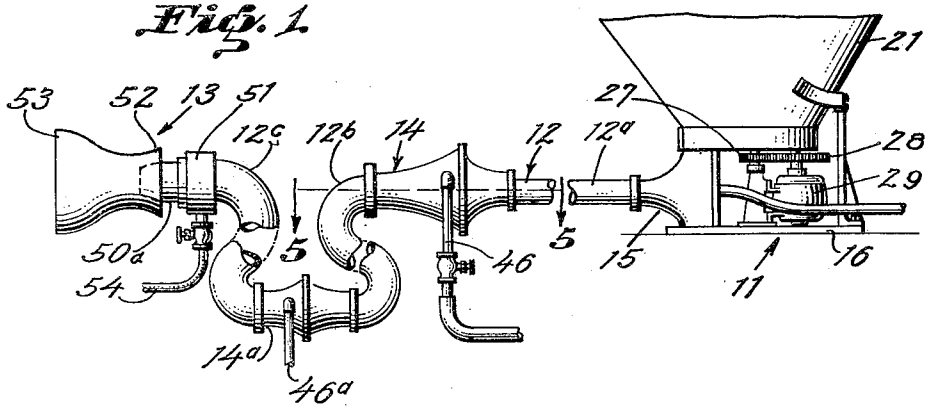

Fig. 5.

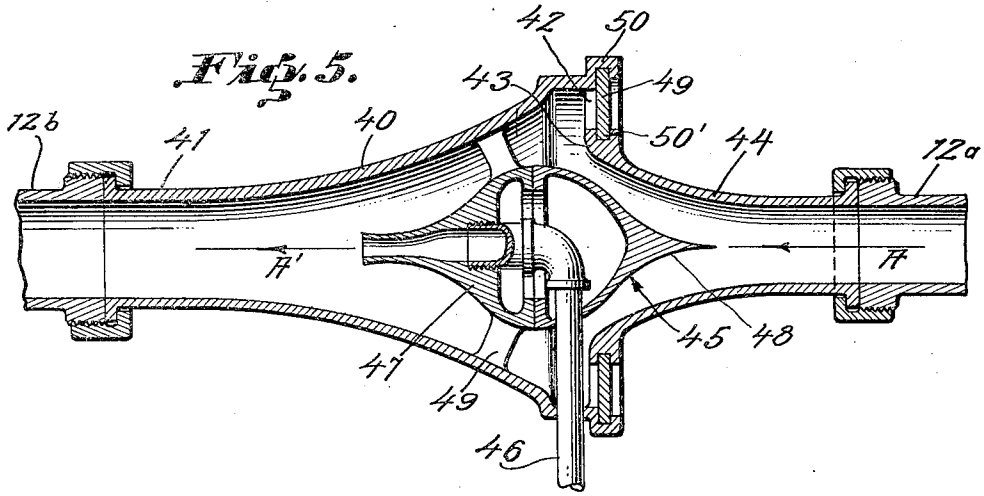

Fig. 6.

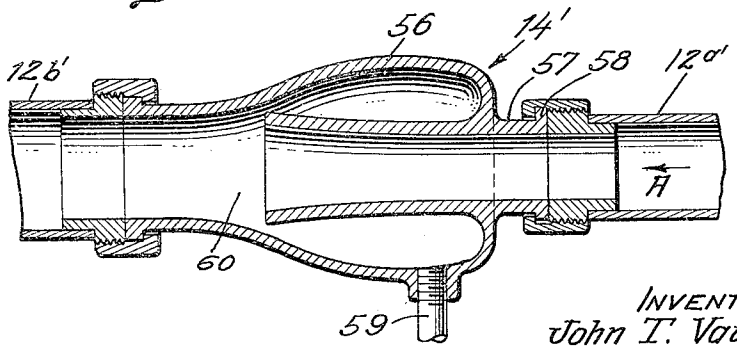

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Fig. 2.

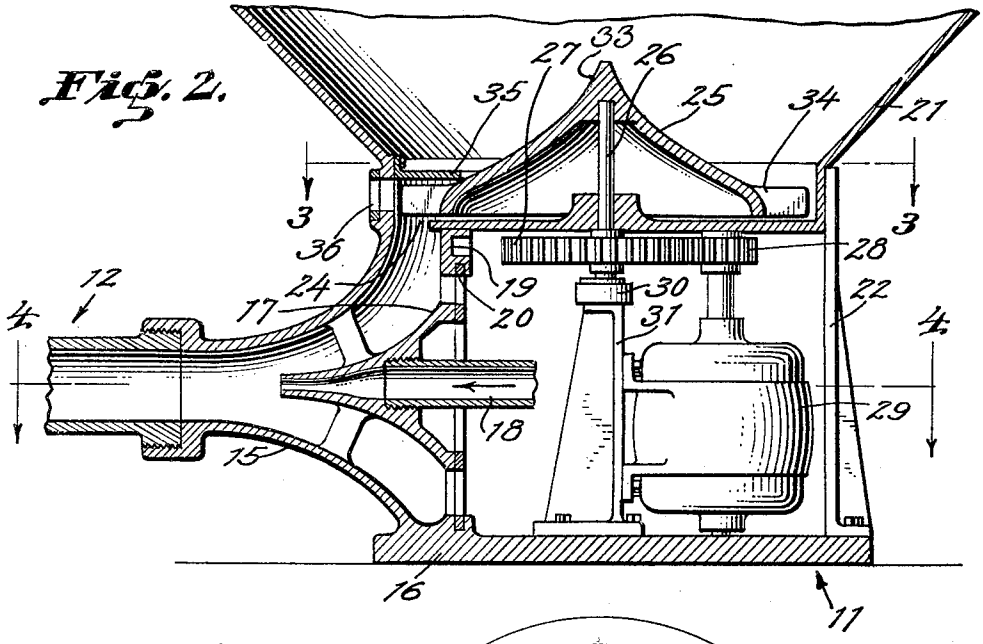
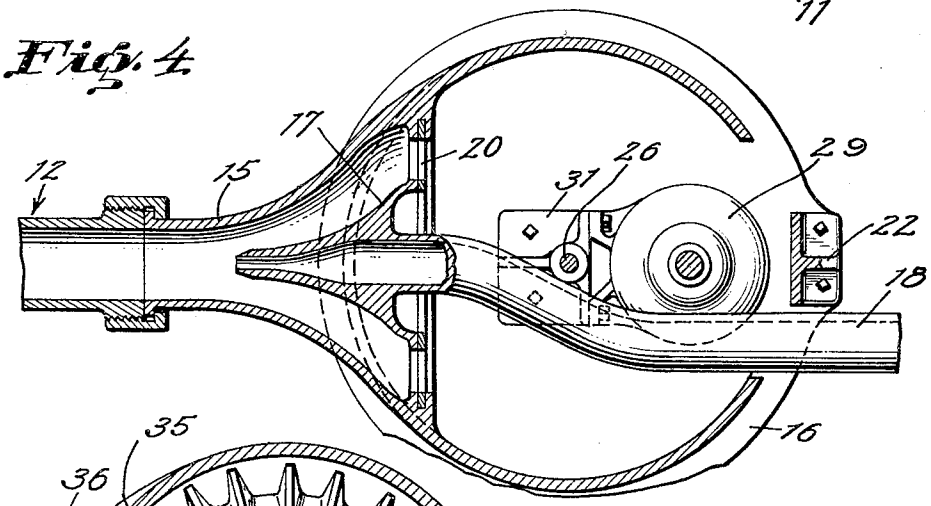


Fig. 4.



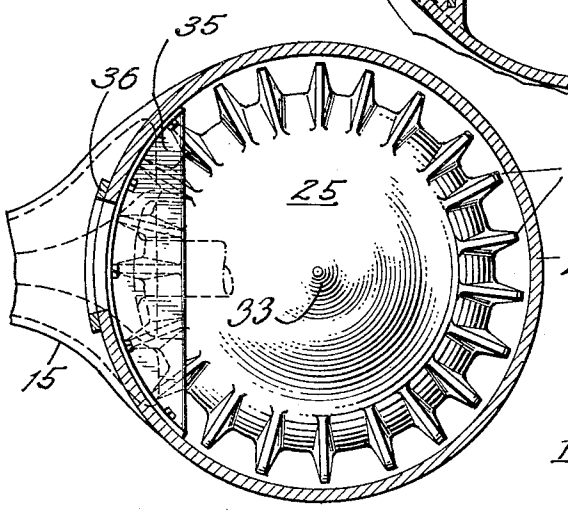


Fig. 3.

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1,908,578

UNITED STATES PATENT OFFICE

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APPARATUS FOR CONVEYING AND DEPOSITING CEMENTITIOUS MATERIAL

Application filed December 31, 1929. Serial No. 417,633.

This invention has to do with the pneumatic conveyance of materials in pipes, conduits or the like, and is more particularly related to the conveyance of finely divided material in conduits by means of air (or other suitable gas) under considerable pressure. The method and apparatus contemplated by this invention have been developed especially for use in mixing, conveying and depositing cementitious or plastic material and while this particular application of the invention commonly known as a cement gun system will be used, in the following description, it is to be understood that this invention is adapted for use in the conveyance of material other than cement mixtures, such as sawdust, shavings, grain, or the like.

The apparatus commonly employed in cement gun practice comprises what is ordinarily known as a gun which is connected with a conduit having a nozzle at its outer end.

The general construction of the system contemplated by this invention, comprises a gun embodying the principal of an injector which is constructed in a manner such that air at atmospheric pressure is drawn into the system, mingled with the charge to be conveyed, and accelerated by means of a jet of highly compressed air. This action is effective to reduce the pressure and materially increase the volume of the gas introduced at the intake of the conduit. The conduit used in the system contemplated by this invention comprises a plurality of sections which increase in cross-sectional area away from the injector and the entrance of each of these sections is provided with an injector unit whereby additional gas under pressure is introduced into the stream of material flowing through the conduit. These injectors, which will be hereinafter referred to as relay injectors, embody the jet and tromba principle, arranged so that the tromba is effective to produce suction in that region of the conduit which is behind the injector.

It is well known to those familiar with the art, that the pressure of the gas at the inlet of the conduit in a system of this character can never be less than the internal resistance of the conduit. Further, that the initial velocity of the gas at the inlet must be sufficient to start and accelerate the material to be conveyed therethrough. It will be seen therefore that when the resistance of the conduit is increased, as would be effected by increasing its length, there must be a corresponding increase in pressure to effect the conveyance of material therethrough. It will also be apparent that with a fixed capacity source of compressed gas this increase in pressure is attended by a proportional decrease in volume and that the decrease in volume, the cross-sectional area of the conduit remaining constant, results in a decrease in velocity. Consequently, it has always been necessary heretofore in overcoming internal resistance in conduits, to increase both the pressure and the volume of the conveying medium. This requires the use of extremely large compressor units which are expensive and difficult to move from place to place.

The primary object, contemplated by this invention, is to produce a system of the class described in which a comparatively small volume of gas compressed to a very high pressure may be used to convey large quantities of material over any predetermined distance.

In the injector type of gun, referred to above, and which will be more fully described later in the specification, the pressure of the air entering the conduit system at the point of intake is reduced and the energy liberated by the reduction of pressure is utilized in drawing in and compressing additional atmospheric air. The volume of "driving air" is therefore materially increased, first by the expansion incident to the released pressure of the air coming from the compressor and, second by the drawing in of additional air. This increase in volume is naturally attended, within the conduit, by an increase of velocity which admits an increase in the supply of material to be conveyed in the conduit. This reduction of pressure, at the intake, is made possible by the removal of a portion of the line resistance ahead of the intake which is accomplished

by the insertion of the relay injectors referred to above.

From this construction, it will be seen that a comparatively small volume of air under the highest pressure, economically obtainable, may be introduced at the gun and at the various relay injectors to convey a quantity of material over a distance which would, with the ordinary cement gun system, require a much larger volume of compressed air than is employed in the system contemplated by this invention.

Other advantages of this invention, together with further objects attending its development will be best understood from the following description in the accompanying drawings in which:

Fig. 1 is an elevational view showing a cement gun system of the class described,

Fig. 2 is a sectional elevation of the injector type of gun shown in Fig. 1,

Fig. 3 is a plan section taken substantially in a plane represented by line 3—3 in Fig. 2,

Fig. 4 is a plan section taken substantially in a plane represented by line 4—4 in Fig. 2,

Fig. 5 is a plan section of a relay injector taken in the plane represented by the line 5—5 of Fig. 1,

Fig. 6 is a sectional elevation of a modified form of relay injector.

More particularly describing the invention as herein illustrated, reference numeral 11 indicates what will be hereinafter referred to as an injector gun by means of which a cement mixture or other suitable material is fed through a conduit 12 to a nozzle 13. The conduit 12 is made up of a plurality of sections indicated at 12*a*, 12*b* and 12*c*. These sections increase in diameter in the order named and relay injectors indicated by reference numerals 14 and 14*a* are interposed between the various conduit sections.

The details in the construction of a preferred form of gun are best illustrated in Fig. 2 wherein the gun 11 is shown as comprising a tromba 15 which is supported upon a suitable base member 16 and has mounted therein an injector 17. The injector 17 is in internal communication with an air or gas line 18 from which compressed air or gas is directed through the jet and into the tromba from a compressor (not shown). The back of the tromba 15 is provided with an apertured cover plate 19 having a damper 20 by means of which the supply of atmospheric air drawn into the tromba may be regulated.

The material to be conveyed in the system is contained within a hopper 21 which is supported by the open top portion of the tromba 13 and a standard or bracket 22. The bottom 23 of the hopper is provided with an opening 24 which is immediately above the top opening in the tromba and a feed wheel 25 is mounted on the base of the hopper and is adapted to receive rotation through a shaft 26 which carries a gear 27 meshing with a pinion 28 driven from any suitable source of power such as the motor 29. The lower end of the shaft 26 is shown as being supported in a thrust bearing 30 mounted on the upper end of a standard 31. The feed wheel 25 is preferably provided with a substantially conical central section 33 and has formed on its periphery a plurality of teeth 34 which carry the material in the hopper beneath a plate 35 mounted above the periphery of the wheel over the aperture 24 which leads into the tromba. The hopper may also be provided with an adjustable gate 36, adapted for use in cleaning the wheel.

The details in the construction of the relay injector units are best illustrated in Fig. 5 where the unit 14 is shown as comprising a tromba 40 having a forwardly tapered end portion 41 which is adapted for attachment to the rear end of the conduit section 12*b*. The rear end portion of the tromba 40 is connected by means of a spider 42 with the front end portion 43 of a rearwardly tapered collar 44. The rear end portion of the collar 44 is adapted for attachment to the front end of the conduit section 12*a*. A nozzle 45 is mounted in the tromba 40 so that a stream of gas under pressure entering the nozzle through the pipe 46 is directed into the stream of material flowing through the conduit in the direction of the arrows A and A'. The nozzle 45 is made in the form of a shell comprising a front section 47 and a rear section 48. This shell may be supported in the tromba in any suitable manner such as by means of a plurality of thin brackets 49, and for the most efficient operation of this unit I consider it preferable to form the shell in a manner such that the cross sectional area between the outer surface of the forward section 47 and the inner surface of that portion of the tromba to which it is adjacent, is substantially the same at all points. Likewise the outer surface of the rear portion 48 is similarly arranged with respect to the inner surface of the collar 44.

For the purpose of providing an additional regulation in the quantity of air passing through the conduit system I provide the rear end of the tromba 40 with an adjustable damper 49. The damper is shown as being slidably mounted between annular channels 50 and 50' which are formed on the inner surface of the tromba member 40 and the forward outer edge of the collar 44.

The nozzle indicated by reference numeral 13 may be any well known type of nozzle but is shown as comprising a nozzle of the type shown and described in my copending application Serial No. 417,950, filed January 2, 1930, and comprises an inner nozzle 50*a* mounted in a water ring 51 and extending into the throat of a tromba member 52 which has an enlarged funnel-like outlet, opening

53. This nozzle 13 is designed to draw atmospheric air into a stream of mixed concrete ejected from the inner nozzle 50*a* and to thereby decrease the velocity of the stream and consequently reduce the rebound at the surface of application.

In the operation of this device as a cement gun, the hopper 21 is first filled with a sand mixture. (It is to be understood, of course, that a screw conveyor or equivalent structure, may be substituted for the hopper 21.) Compressed air is then admitted to the injector 17 and the rotation of the feed wheel 25 is started. The damper 20 is then adjusted so that the quantity of atmospheric air drawn into the tromba is sufficient to materially reduce the effective pressure of the compressed air at the outlet of the tromba 15 and to consequently greatly increase the volume of air which is injected into the conduit with the cement mixture. The quantity of air delivered into the relay injectors is adjusted so that the velocity of the material passing through the entire system is maintained substantially constant. The water for hydrating the cement is delivered to the water ring through the water conduit indicated by reference numeral 54.

The modified form of relay injector 14′ shown in Fig. 6 embodies a tapered shell 56 which receives a flared nozzle or nipple 57, the outer end 58 of which is attached to a conduit section 12*a*′. The outlet end of the shell 56 is attached to a conduit section 12*b*′. In the operation of this device, air under pressure is introduced into the shell at 59 and in passing through the throat section 60 of the shell, assists in drawing the material through the conduit 12*a*′, and in advancing same through conduit 12*b*′.

From the foregoing detailed description of the apparatus, it should be apparent that the objects and advantages of the process, as set forth in the forepart of the specification are efficiently accomplished. It is to be understood however, that while I have herein described and illustrated one preferred form of apparatus and one advantageous application of the process contemplated by this invention, that the invention is not limited to the precise details of the above description, but includes within its scope whatever changes fairly come within the spirit of the appended claims.

I claim as my invention:

1. A conveying system of the class described embodying: a tromba; a nozzle in said tromba; means for delivering material to be conveyed into said tromba; means for delivering gas under pressure to said nozzle to form a gas jet; a conduit at the outlet of said tromba for receiving the material projected therefrom by said jet; a relay injector in said conduit in spaced relation with the outlet of said tromba; a relay tromba associated with said relay injector; and an adjustable damper for optionally admitting atmospheric air to said relay tromba.

2. In a conveyor system of the class described: a conduit composed of sections, each of said sections being of larger internal diameter than the preceding adjoining section; means interposed between adjacent sections for admitting gas under pressure into said conduit; and means associated with said first mentioned means operable to admit atmospheric air into said conduit.

3. In a conveyor system of the class described: a conduit composed of sections, each of said sections being of larger internal diameter than the preceding adjoining section; means interposed between adjacent sections for admitting gas under pressure into said conduit; and means associated with said first mentioned means operable to admit controllable amounts of atmospheric air into said conduit.

In testimony whereof, I have hereunto set my hand at Los Angeles, California, this 18th day of December, 1929.

JOHN T. VAWTER.