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Geisler et al.

[11] **3,848,810**

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[54] **CONCRETE-DISPLACEMENT APPARATUS**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **239/417.3,** 222/193, 239/424, 302/31

[51] **Int. Cl.** **A47f 1/03**

[58] **Field of Search** 239/655, 407, 416.5, 417.3, 239/676, 419, 424; 222/193, 194; 302/24, 29, 31, 64

[56] **References Cited**

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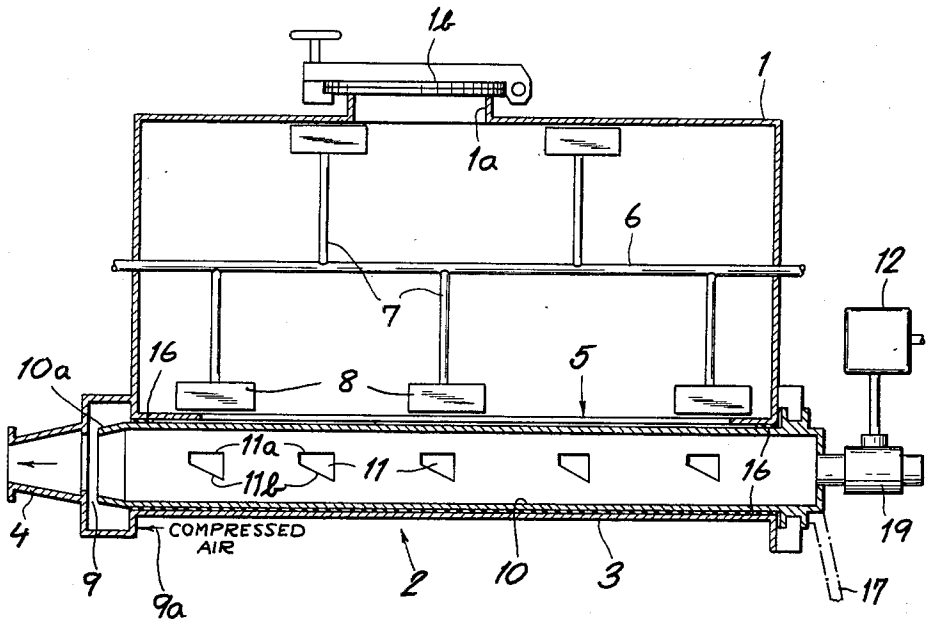
[57] **ABSTRACT**

A concrete-displacement apparatus, especially a concrete-spray machine for wet concrete (i.e., a loose slurry of concrete adapted to be displaced by air under pressure) comprises a mixing vessel and a feed device having a tubular slider or valve member, the feed device and slider being traversed by compressed air. The tubular slider is formed with one or more openings and is rotatable in an outer sheath or conduit to control the flow of the fluent materials through the conduit.

15 Claims, 5 Drawing Figures



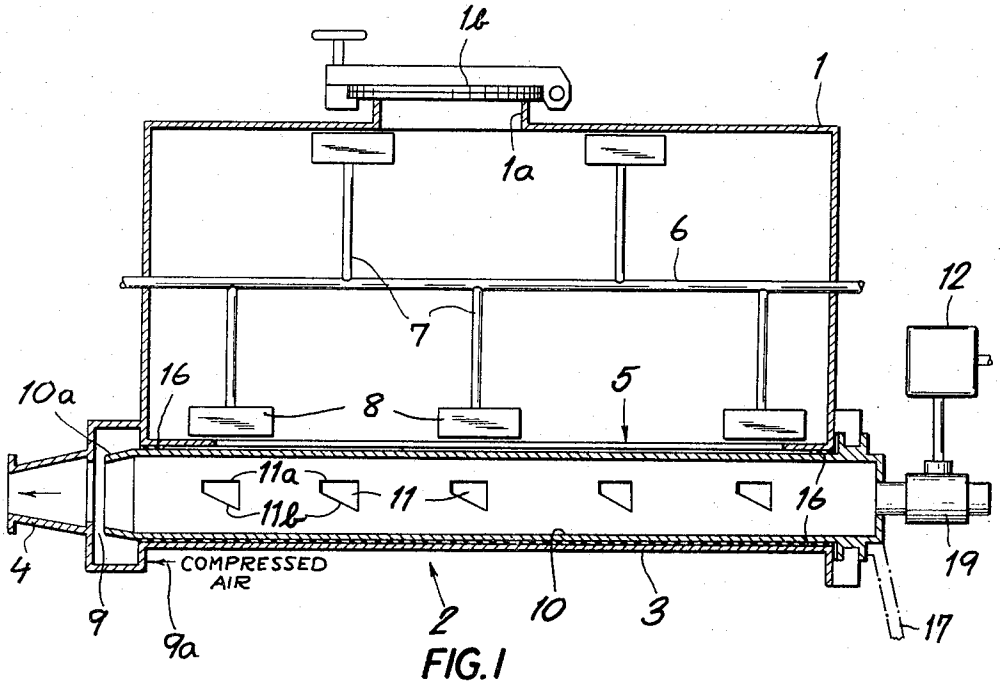


FIG. 1

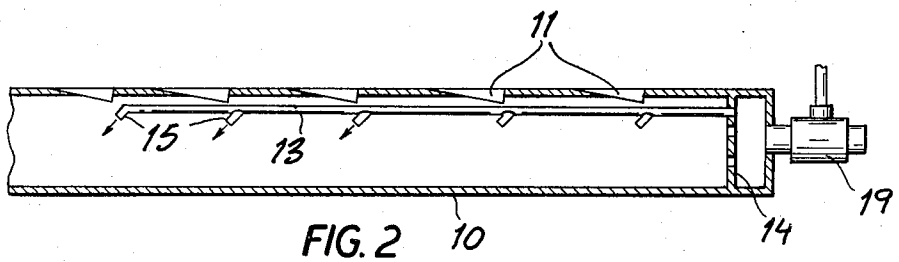


FIG. 2

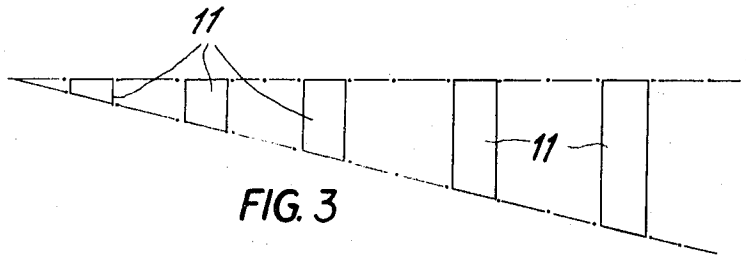


FIG. 3

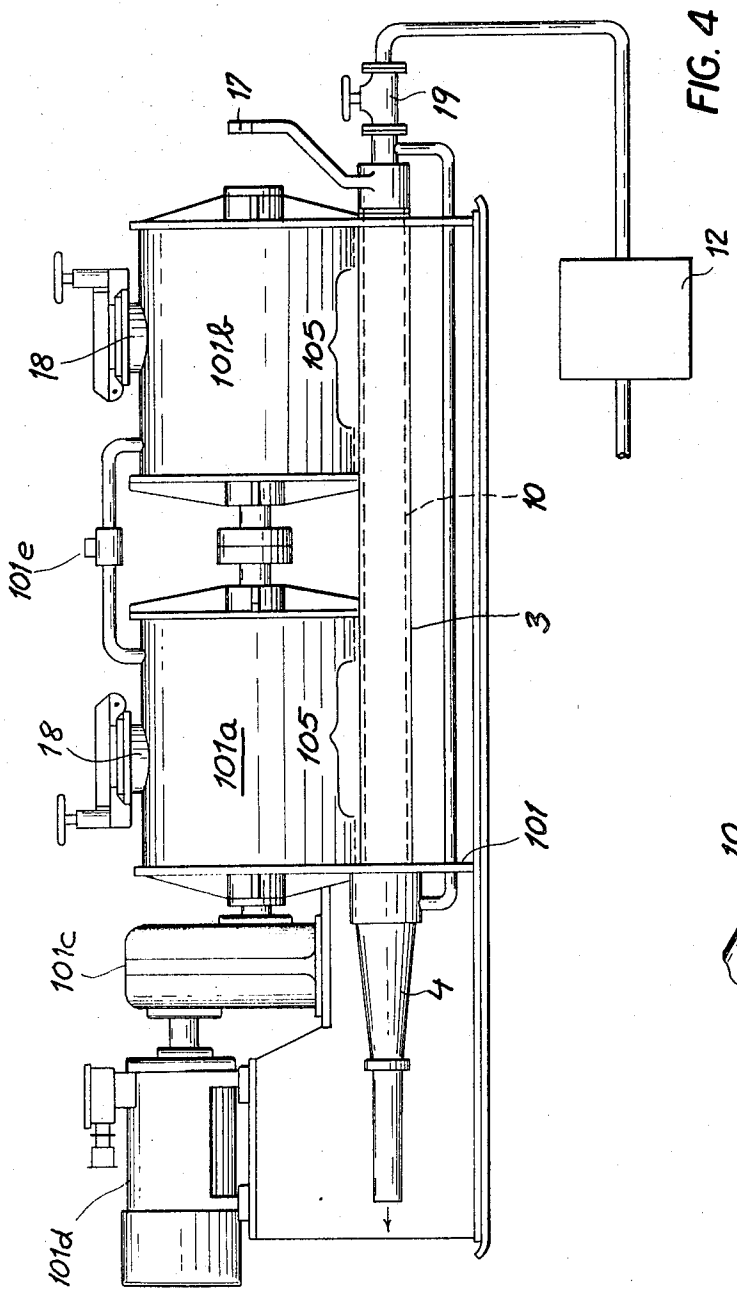

17
19
12
18
101B
105
10
101e
3
18
101a
105
101
101c
4
101d

FIG. 4

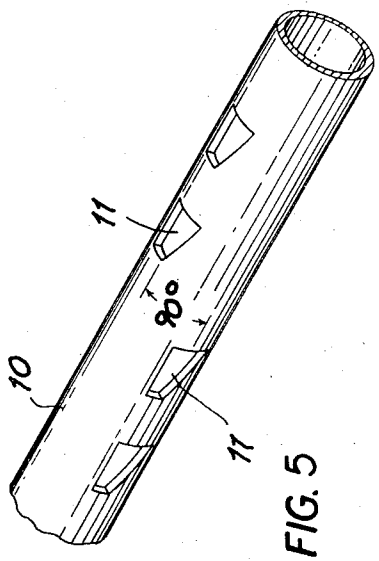

11
90°
10
11

FIG. 5

CONCRETE-DISPLACEMENT APPARATUS

FIELD OF THE INVENTION

Our present invention relates to a concrete-displacement apparatus and, more particularly, to a concrete-spray machine especially for wet concrete and like slurry-type materials.

BACKGROUND OF THE INVENTION

Slurry-like materials must be displaced for a number of purposes, e.g., from a mixing vessel to an utilization site and, for this purpose, complex pumps and flow-control systems have been provided heretofore.

Apparatus of this general type has proved to be especially desirable for the displacement of concrete and especially so-called "wet concrete" which may be forced through a duct by air for spraying onto a substrate. In prior-art systems, wet concrete has been formed by mixing cement and sand or another aggregate with water in a mixing vessel and displacing the mix under air pressure through a feed conduit to the spray nozzles. To control the metering of the mix into the conduit, a linearly shiftable slider has been provided which generally makes the size of the apparatus relatively large so that compact construction of the device is not possible. The concrete may be used for repairs or as the primary application to a substrate and may be of many different types. In general the dispensed concrete has been called air-entrained or pneumatic concrete. Other pumps may be provided along the line when spray-placed concrete is used. Pneumatic methods of the latter type are commonly used for placing concrete in tunnel linings using air guns.

OBJECTS OF THE INVENTION

It is an object of the present invention to provide a concrete-displacement apparatus which is more compact than the previously described type and enables fine control over the flow of the fluent mixture to the duct or conduit traversed by air.

Another object of the invention is to provide a concrete-spray machine, especially for so-called wet concrete, which is of minimum size and high accuracy with respect of metering the concrete mixture to a duct.

SUMMARY OF THE INVENTION

These objects and others are attained, in accordance with the invention, in a concrete-spray apparatus, especially for wet concrete, which comprises a mixing vessel and a feed pipe below this vessel and communicating therewith through a window, the metering means for the concrete mix comprising a metering tube rotatable in the pipe and provided with one or more openings in its wall for adjustable alignment or registry with the window to control the flow of concrete from the mixing vessel to the pipe, the pipe and the apertured metering tube being traversed by air under pressure.

Since the system of the present invention provides the slider as a metering tube with one or more filling openings in the tube wall and the tube is rotatably mounted within the concrete-feed pipe, it is possible to obtain a surprisingly fine adjustment of the metering of wet concrete through the feed pipe.

According to a feature of the invention, the main air stream traverses the feed pipe and the metering tube and enters the latter through one end thereof, while a bypass duct carries a smaller portion of the compressed air from a nozzle plate at the end of the pipe and tube longitudinally along the interior of the latter and is formed with nozzles or fittings inclined toward the axis of the tube in the direction of advance of the concrete through it.

More particularly, the bypass duct is provided along an upper portion of the tube which fits closely and sealingly within the feed pipe, while the nozzles and fittings are directed toward the bottom of this tube in the direction mentioned. In this manner accumulations of concrete along the bottom or trough formed by the bottom of the metering tube can be conveyed even upon standstill (closure of the metering-tube openings) of the concrete-spray machine in the forward direction and can be carried off to clean the tube and remove any residues therefrom.

While the openings in the metering tube may be of uniform cross-section in the direction of flow of the concrete, it has been found to be advantageous to make the openings of decreasing cross-section in the flow direction, the result being an especially fine control of the fluent-material stream.

According to another feature of the invention, the mixing vessel is subdivided longitudinally in the direction of flow of the material into a plurality of mixing compartments each of which has a window registering with a respective axial section of the metering tube and the openings of the respective sections are provided in respective rows therealong. The rows of adjacent sections are angularly offset from one another so that independent control of the outflow the mixing compartments can be attained, e.g., when one compartment is to be used to prepare a mix while the finished mix in the other is discharged.

Preferably, two such mixing compartments are provided in succession along the mixing vessel and are separated from one another by suitable partition means or are formed as separate mixing drums and the rows of openings of the metering tube are angularly offset by 90°.

Advantageously, the vessel is elongated horizontally and is provided at its bottom with the aforementioned elongated window while the feed pipe and metering tube extend axially along the bottom of the vessel beneath the window, the feed pipe being cut away to register with the window and being formed, at its end remote from a discharge extremity, with a nozzle plate subdividing the airstream into a main flow through the pipe directly and a secondary flow through the bypass duct mentioned earlier.

DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a vertical section through a concrete-spray machine along the axis of the feed pipe and metering tube;

FIG. 2 represents a modification of the system of FIG. 1;

FIG. 3 is a developed view of the openings in a metering tube for the systems of FIGS. 1 and 2;

FIG. 4 is a side-elevational view of another concrete-spray machine embodying the invention; and

FIG. 5 is a detail perspective view of a portion of the metering tube of FIG. 4.

SPECIFIC DESCRIPTION

In FIG. 1 we have shown a concrete-spray machine which comprises a mixing vessel 1 which is horizontally elongated and is provided with an opening 1*a* closeable by a hatch 1*b* and through which the ingredients for forming a wet concrete mix may be introduced. Air-entrained concretes which may be dispensed according to the invention include any of the pneumatically displaced concretes described in CONCRETE MANUAL, U.S. Department of the Interior, Bureau of Reclamation, 7th Edition; Denver, Col.; 1963.

The mixing vessel 1 is provided above a feed device 2 consisting of a feed pipe 3 and a spray head 4 at one end of the pipe 3 through which the concrete is directly dispensed or indirectly fed to a pipe for spraying through an air nozzle further downstream.

The window 5 at the base of the mixing vessel 1 communicates between the latter and an upper portion of the feed pipe 3 to enable wet concrete to pass from the former into the latter.

In the mixing vessel 1 there is provided a mixing shaft 6 which is oriented horizontally and is formed with angularly spaced radial arms 7 at the ends of which mixing paddles 8 are provided.

The downstream end of the pipe 3 is formed with an annular nozzle 9 supplied with compressed air as represented at 9*a* so that the wet concrete is entrained by the air through the nozzle.

Within the feed pipe 3, there is provided a metering tube 10 of generally cylindrical configuration and with a forwardly tapering end 10*a* projecting with clearance into the annular compressed air chamber 9, the metering tube 10 being formed with a row of filling openings which, on proper angular orientation of the tube 10, register to a greater or lesser degree with the window 5. In the embodiment of FIG. 1, the openings 11 are all of identical cross-section, although the width of each opening decreases in the forward direction, the opening having common sides 11*a* lying along a generatrix of the tube 10 and an inclined (helical) side 11*b* to form a trapezoid (developed) with the side defined by a generatrix.

In the system of FIGS. 2 and 3, the successive openings 11 in the direction of feed of the fluent materials are progressively more closely spaced and of decreasing cross-sectional area as best seen in FIG. 3.

Within the metering tube 10, a bypass duct 13 is provided and terminates in a nozzle plate 14 at the right-hand end of the metering tube 10, the nozzle plate 14 distributing the major portion of the airstream through the interior of the metering tube 10 from the right-hand end thereof and a smaller portion of the airflow through the bypass duct 13. A compressed air source (e.g., a compressor 12) is connected to the feed pipe 3 at its right-hand end and a regulating valve 19 for the compressed air is provided between the compressor 12 and the feed pipe 3.

The bypass duct 13 is formed with downwardly and forwardly directed nozzles or fittings 15 as previously described.

The metering tube 10 is journaled for rotation within the feed pipe 3 and a seal layer is provided at 16 between the inner surface of the feed pipe and the outer surface of the metering tube 10 so that, when the metering tube 10 is offset through 90° to dislocate the openings 11 from the window 5, there is no leakage of concrete into the interior of the metering tube 10. The sealing means may be an elastic wear-resistant sealing material such as silicone rubber or Teflon.

The metering tube 10 is provided with drive means for angularly displacing same relative to the feed pipe 3, either in the form of a motor drive or in the form of a lever 17 for manual operation.

In FIG. 4 we have shown an arrangement in which two mixing drums 101*a* and 101*b* are mounted upon a support 101 and have their mixing paddles driven through a gear transmission 101*c* by an internal-combustion engine 101*d*, the hatches 14 affording access to the interiors of the drums which otherwise are similar to the mixing vessel of FIG. 1. An inlet 101*e* permits water to be supplied selectively to the drums and the latter are provided with windows 105 alignable with respective rows of openings 11 on the metering tube 10 of the feed pipe 3. The other elements illustrated are identical to those of FIGS. 1 – 3 except that the rows of openings, respectively alignable with the windows 101*a* and 101*b*, are angularly offset from one another by 90° (see FIG. 5).

We claim:

1. A concrete-spray machine comprising a mixing vessel provided at its bottom with a window; a feed pipe underlying said vessel and communicating therewith through said window; a metering tube rotatable in said feed pipe and having at least one opening formed in the wall of the metering tube registerable with said window upon angularly displacement of said tube relative to said pipe; means at one end of said pipe for discharging pneumatically entrained concrete therefrom; means for supplying compressed air to the other end of said pipe for passage through said tube and entrainment of concrete passing through said window toward said one end; and a bypass duct extending at least partly through said tube and receiving air from said other end of said pipe, said bypass duct being formed with outlets inclined downwardly in the direction of flow of concrete through said tube.

2. The machine defined in claim 1, further comprising means for rotating said tube relative to said pipe.

3. The machine defined in claim 1 wherein said tube is formed with a plurality of such openings in a row in said tube.

4. The machine defined in claim 1 wherein said tube is formed with a plurality of such openings in a row and said openings are of progressively decreasing width in the direction of flow of concrete along said tube.

5. The machine defined in claim 1 wherein said tube is formed with a plurality of such openings in a row and said openings are of successively decreasing area in the direction of flow of concrete through the tube.

6. The machine defined in claim 1 wherein said tube is formed with a plurality of openings in a row, each of said openings having edges lying along helices of said tube.

7. A concrete-spray machine comprising a mixing vessel provided at its bottom with a window; a feed pipe underlying said vessel and communicating therewith through said window; a metering tube rotatable in said feed pipe and having at least one opening formed in the wall of the metering tube registerable with said window upon angularly displacement of said tube relative to said pipe; means at one end of said pipe for discharging

pneumatically entrained concrete therefrom; means for supplying compressed air to the other end of said pipe for passage through said tube and entrainment of concrete passing through said window toward said one end; and a layer of an elastic and wear-resistant material interposed between said tube and said pipe.

8. The machine defined in claim **7** wherein said tube is formed with a plurality of such openings in a row and said openings are of progressively decreasing width in the direction of flow of concrete along said tube.

9. The machine defined in claim **7** wherein said tube is formed with a plurality of such openings in a row and said openings are of successively decreasing area in the direction of flow of concrete through the tube.

10. The machine defined in claim **7** wherein said tube is formed with a plurality of openings in a row, each of said openings having edges lying along helices of said tube.

11. A concrete-spray machine comprising a mixing vessel provided at its bottom with a window; a feed pipe underlying said vessel and communicating therewith through said window; a metering tube rotatable in said feed pipe and having at least one opening formed in the wall of the metering tube registerable with said window upon angularly displacement of said tube relative to said pipe; means at one end of said pipe for discharging pneumatically entrained concrete therefrom; and means for supplying compressed air to the other end of said pipe for passage through said tube and entrainment of concrete passing through said window toward said one, end said tube being formed with a plurality of such openings in a row in said tube, each of said openings being of progressively decreasing width in the direction of flow of concrete through said tube.

12. A concrete-spray machine comprising a mixing vessel provided at its bottom with a window; a feed pipe underlying said vessel and communicating therewith through said window; a metering tube rotatable in said feed pipe and having at least one opening formed in the wall of the metering tube registerable with said window upon angularly displacement of said tube relative to said pipe; means at one end of said pipe for discharging pneumatically entrained concrete therefrom; means for supplying comtube and entrainment of concrete passing through said window toward said one end said tube being formed with a plurality of such openings in a row in said tube, the openings of said row being of successively decreasing area in the direction of flow of concrete through said tube.

13. The machine defined in claim **11** wherein said openings have edges lying along helices of said tube.

14. A concrete-spray machine comprising a mixing vessel provided at its bottom with a window; a feed pipe underlying said vessel and communicating therewith through said window; a metering tube rotatable in said feed pipe and having at least one opening formed in the wall of the metering tube registerable with said window upon angularly displacement of said tube relative to said pipe; means at one end of said pipe for discharging pneumatically entrained concrete therefrom; means for supplying compressed air to the other end of said pipe for passage through said tube and entrainment of concrete passing through said window toward said one end, said vessel being subdivided longitudinally into a plurality of mixing chambers each formed with a respective such window and said tube is formed with respective rows of longitudinally spaced openings for communication with said windows, the rows communicating with windows of adjacent chambers being mutually angularly offset about the axis of said tube.

15. The machine defined in claim **14** wherein two such chambers are provided and said rows are angularly offset by 90°.

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