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METHOD OF MIXING AND TRANSPORTING CONCRETE.

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1,185,118.


To all whom it may concern:

Be it known that I, JOHN H. MACMICHAEL, a citizen of the United States, residing at Toledo, in the county of Maumee and State of Ohio, have invented certain new and useful Improvements in Methods of Mixing and Transporting Concrete, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to an improved method or process for mixing ingredients, such as broken rock, sand, cement and water, used in the manufacture of concrete.

The object of the invention is to produce a superior final product, to expedite the making and delivering of the composition, and to economize in the manufacture. Figure 1 is a vertical section of an apparatus composed of parts whereby the invention can be carried out. Fig. 2 is an elevation of the same. Fig. 3 is a series of diagrammatic views illustrating the steps followed in the operation.

In the drawings, 1 represents a receptacle into which the ingredients are fed, in predetermined proportions, such as to have them properly related to each other in producing the final concrete product. I prefer to introduce them by means of a superadjacent hopper 2, into which they can be thrown miscellaneous from barrows or other carriers.

Between the hopper 2 and the receptacle 1 there is a valve mechanism at 3, which, as shown, is a rotary cylinder valve 4 with a large passageway 5 therethrough, and mounted in an approximately cylindrical casing 6. This valve or cutoff 4 can be turned part way and close the passage from the hopper 2 to the receptacle 1. Upon turning it part of a revolution, the valve opening or passage 5 is brought into alignment with the bottom of the hopper and the top of the receptacle, and the load contained in the hopper can be instantly dropped into the latter. This form of valve enables me to provide an air-tight closure for the receptacle 1.

It will be understood, as above indicated, that the rock, sand, cement and water, in suitable proportions, can be deposited in the hopper 2 without paying attention to the manner in which they are mixed or commingled, inasmuch as the desired mixing and commingling is attained at a later stage, as will be below described.

The receptacle 1 is shown as cylindrical at the upper part 7, and tapering or coniform at the lower part 8. It may taper from bottom to top, but that is not essential, as satisfactory results are obtained so long as the material finally passes through an orifice of suitable size, 9. The walls of the receptacle at no point furnish any obstruction in the pathway for the material as it travels through the receptacle and thence to the discharge.

10 indicates a discharge duct. It is of relatively large size, from six to ten inches in diameter, and at its initial, or receiving end, 11, it is fitted to the correspondingly sized orifice 9 at the bottom of the receptacle. At 12 this discharge duct 10 is curved, so that the path for the material is changed from the vertical to the horizontal, or even to an inclination upward. By having this conveying and discharging duct of relatively large diameter, it permits the mixing of the components of the concrete to be effected therein while the mass is being propelled or conveyed from the receptacle to the place of final deposit. 13 represents an air supply. It may be a tank or reservoir in which air is stored under compression, or a long main.

14 and 15, respectively, indicate air ducts leading from the air supply. That at 14 is connected, through the duct section 16 at the orifice 18, with the space or region at 17 in the upper part of the receptacle 1, above the mass of material which is to be expelled therefrom. The duct at 15 finally communicates through the duct section 18 with the chamber or region inside of the initial, or receiving, end of the duct 10. It is shown as so related to this duct that the air enters on lines tangential to the first part of the path of the material.

It will be seen that the air which enters the upper part of the receptacle, through the pipe section 14 at the orifice 18, merely tends to create and maintain more or less pressure above the mass in the receptacle, this pressure being distributed uniformly over the top superficial area of the mass. On the other hand, as above described, the air which enters the initial end of the duct
10, through the orifice at 16, enters with a very high velocity, the orifice being suitably reduced for the purpose of converting the original pressure into this high velocity. In other words, the parts of the apparatus are so constructed and related that two bodies of air are utilized, at different points, respectively, along the path of the concrete material, one air body being applied under such conditions that pressure is its principal working quality, while the other air body is utilized in such way that velocity is brought into play and made available. The jet of air, entering at 16 with this high velocity impinges with that velocity upon the small sub-masses of material which descend from the main chamber of the receptacle 1, and, immediately, these smaller sub-masses of material attain a high velocity corresponding to that of the air jet, and are forcibly propelled outward along the duct 10. In the meantime, the air which enters the upper part of the receptacle through the orifice 18 (which air, as above remarked, may be of initially the same pressure, substantially, as that of the air which is supplied for the jet at 16), is, by the mere pressure which it exerts, forcing the mass of material in the receptacle downward through the converging passageway 8 into the initial end of the duct 10, and into the path of the air jet at 16. The jet of high velocity, such as that which enters at 16, would not operate in the same way if introduced above the main body of the mass. And, vice versa, a mass of air introduced at the initial end of the duct merely under pressure, and not under velocity, would not be as advantageous in advancing the material through the duct. The jet orifice at 16 can be of any well known suitable form, tapered or cylindrical, but should have a cross area sufficiently reduced, relative to the cross area of the upper air chamber to give the proper jet effect.

It must be remembered that the materials in the mass (of such nature that, when properly commingled and properly contacting with water, the ingredients will form "concrete") are liable to "set" if they are permitted to stop, or are arrested at any point. The entire mass temporarily held in the receptacle 1 (composed of the ingredients of concrete in the proper relative proportions) must be expelled therefrom and driven along the duct 10 to the place of delivery, in a few seconds of time. They are not completely or thoroughly commingled when they are introduced into the receptacle 1. In fact, my purposes and apparatus are such that there need be no preliminary mixing or commingling whatever. The several ingredients, in their proper proportions, can be indiscriminately dumped or shoveled into the receptacle 1, with the assurance that before they reach the point of delivery at 19, they will be mixed and mingled in a way that gives a concrete mass superior to any produced by the concrete mixers hitherto used. But, as above remarked, this operation of mixing and delivering must be done with great rapidity, not only because of the fact that the mixed mass must be put in its final place at as early an instant as possible after the contact of the water with the other ingredients, but also because of the liability of the materials, as above described, to set or harden at points along the duct. And hence it is that great importance is incident to the employing of air jet of high velocity at the initial end of the duct 10, and to the simultaneous downward feeding of the mass in the receptacle 1 under the action of the pressure above.

The handling of the different parts of the apparatus in such way that the pressure in the initial end of the duct shall be properly related to the pressure in the upper part of the receptacle 1, above the mass of material, is a matter of great importance. It is seen that the material which is moving along the duct 10 tends to reduce the velocity of the air from the orifice at 16 and to cause a back pressure, which is needed to accumulate. This back pressure, if great enough, will be felt in an upward direction at the bottom of the mass in the receptacle 1. And the operation must be so carried on that this backward or upward pressure shall not materially interfere with the downward feeding pressure exerted by the upper mass of air at 17. The air at the bottom should act by its velocity as nearly exclusively as possible, for, in such case, the back pressure in the end of the duct 10 will be at its minimum, and the pressure at 17 in the upper part of the receptacle can work with the greatest efficiency in rapidly delivering the material to the high speed jets at the receiving end of the duct.

In order to permit the operator to effect the thorough mixing of the materials, and, at the same time, eject them from the receptacle 1, and rapidly advance them through the duct 10 to the place of delivery 19, I prefer to employ two air controllers or valves, as shown at 20 and 21. By means of that at 21, the operator can readily control the jets at the receiving end of the duct, while with that at 20, he can control the volume, and, to some extent, the pressure of the air which is introduced into the space 17, in the upper end of the receptacle.

Ordinarily the preferred steps in operation are (after a mass of materials of properly proportioned quantities have been introduced into the receptacle 1) to first open the jet valve at 21. This begins to at once impart velocity to the lowermost parts of the material, which have begun to squeeze downward through the orifice 9, and to start...
a stream of this material through the duct. 10. Immediately after this stream has started, and the downward passing parts of the mass have been put under the inertia of propulsion, the valve at 20 can be gradually and rapidly opened, and a volume of air under pressure introduced to the space at 17, which compels the entire mass to move downward, rapidly, into the path of the air jets at 16.

With a properly constructed and properly handled set of parts, a relatively large mass of material (one-fourth of a cubic yard) can be ejected from the receptacle 1, thoroughly mixed in the duct 10, and delivered at a relatively great distance (three hundred and fifteen feet I have reached) in the period of from two to four seconds, with a comparatively low air pressure, eighty to one hundred and twenty pounds, in the main or supply reservoir 13.

Cement is one of the bodies which, upon the addition of water, tends to crystallize and harden or set. If it be mingled with pieces of rock, or the like, the latter are firmly bound together upon the addition of water, if the crystallizing or setting action can proceed without interference. But if, after crystallizing commences the mass is seriously agitated by rolling, stirring, or the like, there is a fracturing of initial crystals and an interfering with the fullest cohesion that is possible.

The water should be distributed in the shortest possible time, and after the water and cement are distributed the movement of the solid pieces of said masses should be stopped and the concrete mass put into position as speedily as possible.

By the present method large masses can, in a few seconds, as above stated, be completely hydrated and mixed and quickly put in position for setting.

I do not limit myself to the details of structure shown in the accompanying drawings, as I carry out this process in mechanism of either of various forms.

I do not herein present claims for the apparatus which I have shown and described, or for the mechanism in my earlier application 580,582, preferring to herein present claims which relate to the pneumatic mixing of the previously unmixed ingredients of the concrete while pneumatically transporting them; and to claim the more specific matters of method and of mechanism in said earlier application 580,582.

What I claim is:

1. The herein described method of pneumatically conveying and mixing the ingredients of concrete, such as rock pieces, sand, cement and water and simultaneously producing concrete therefrom, it consisting in forming successive charges by supplying, for each charge, proportioned quantities of the rock, sand, cement and water, initially separate from each other, to an air-tight receiver at the initial end of an elongated, path-defining, relatively wide, conveying and mixing duct; and causing a body of air under pressure to impinge upon the charge, prior to the complete comminizing of the sub-masses thereof, at points near those where it enters the said conveying and mixing duct, and propel and rapidly move the said charge through the said duct, thereby agitating the particles of the sub-masses relatively to each other and effecting the mixing of the said proportioned sub-masses while pneumatically propelling them along the said duct.

2. The herein described method of pneumatically conveying and mixing the ingredients of concrete, such as rock pieces, sand, cement and water and simultaneously producing concrete therefrom, it consisting in supplying initially separate masses of said rock, sand, cement and water, proportioned to constitute a charge of concrete, to an air tight receptacle at the initial end of an elongated, confined relatively wide, pathway; and causing a body of air under pressure to impinge, at points near the initial end of the said elongated pathway, upon the charge prior to the complete comminizing of its constituent sub-masses of rock, sand, cement and water, and to propel and rapidly move said charge and to agitate the particles of the different ingredients among each other thereby effecting the mixing of said proportioned sub-masses while propelling them along said path.

3. The herein described method of pneumatically conveying and mixing the masses of the rock pieces, sand and cement, together with water, constituting a charge of concrete, it consisting in supplying separate proportioned quantities of said rock, sand and cement, while dry or unmixed, and supplying a quantum of water therewith, to an air-tight receptacle having a receiving region and an elongated conducting region extending to the place where the concrete material is to be finally deposited; and causing a body of air under pressure to impinge upon the charge, prior to the complete commingling of its sub-masses, at points near the initial end of the conducting region, the said air propelling and rapidly moving said charge along the conducting region, agitating, among each other, the particles of the said sub-masses, and effecting the mixing thereof in the proper proportions for concrete while propelling them along said path.

4. The herein described method of pneumatically conveying and mixing masses of rock pieces, sand, cement and water, proportioned to constitute a charge of concrete, it consisting in supplying the masses
of rock, sand, cement and water, prior, to the stage of complete concrete-formation to a receptacle having an air-tight receiving region and an elongated, relatively wide, conducting region extending to the place where the concrete material is to be finally deposited; and causing a body of compressed air to impinge, at points near the initial end of the said conducting region, upon successive portions of the said charge prior to the complete commingling of the sub-masses thereof, the said air propelling and rapidly moving said charge through said region and agitating the particles of rock, sand, cement and water among each other, while being propelled along said region, to effect the mixing of the said proportioned sub-masses.

5. The herein described method of pneumatically conveying and mixing the components of a concrete mass, to-wit, rock pieces, sand, cement and water, which consists in delivering to an air blast the said ingredients prior to the complete commingling, causing the said air blast to alter the distribution of the initially segregated rock and other materials and forcibly advance them through a partially obstructed or reduced pathway, and to commingle the said ingredients while they are being forcibly advanced, and at finally deliver them, with the water and the crystallizable ingredients uniformly distributed over the rock and other ingredients and with all the ingredients uniformly mingled in a concrete mass.

6. The herein described method of pneumatically conveying and mixing masses of rock pieces, sand, water and cement, and simultaneously producing concrete, it consisting in forming a charge by supplying proportioned masses of said rock, sand, cement and water, to an air-tight receiver at the initial end of an elongated path-defining, relatively wide, conveying and mixing duct, causing the said charge, as an entirety and prior to the complete commingling of its sub-masses, to move bodily from the receiver toward the said duct, and causing a body of air under pressure to impinge at points near the initial end of the said duct upon the charge, the said air propelling and rapidly moving the said charge along the duct, agitating the particles of the sub-masses relatively to each other, and effecting the mixing of the said proportioned masses while they are pneumatically propelled along the duct.

7. The herein described method of mixing and delivering the proportioned initially separate masses of rock, sand, water and cement finally constituting a charge of concrete, it consisting in supplying the said masses, prior to their complete commingling, to a partially obstructed or reduced path having a receiving region and a conducting region and extending to the place where the concrete material is to be finally deposited, and causing a body of air under pressure to impinge upon the mass prior to the complete commingling of the sub-masses, the said air propelling, agitating and rapidly moving the mass and effecting the mixing of the said proportioned sub-masses while propelling them along said path.

8. The herein described method of preparing a finally mixed concrete-like mass composed of proportioned sub-masses of rock, sand, cement and water, which consists in bringing them together, prior to their complete commingling, in a path extending from a receiving region to the place of final deposit and partially obstructed or reduced at one or more points, and causing a body of air under pressure to impinge upon successive portions of the mass prior to the complete commingling of the sub-masses, the said air propelling, agitating and rapidly moving the materials constituting the said portions of the mass and effecting the mixing of the constituents of the concrete while propelling them along said path, relatively wide, and with the water and the crystallizable ingredients uniformly distributed over the rock and other ingredients and with all of the ingredients uniformly mingled in a concrete mass.

9. The herein described method of mixing the components of a concrete mass, to-wit, rock, water, sand and cement, which consists in delivering to an air blast the said ingredients prior to their complete commingling, causing said air blast to alter the distribution of the initially segregated rock material and commingle the said ingredients while forcibly advancing them through a prolonged, relatively laterally wide path, which is partially obstructed or reduced at one or more points, and finally delivering them, with the water and the crystallizable ingredients uniformly distributed over the rock and other ingredients and with all of the ingredients uniformly mingled in a concrete mass.

10. The herein described method of mixing the rock, sand, cement and water ingredients of a mass from which concrete is to be formed, and delivering the concrete at the place of final deposit, consisting in delivering to an inclosed chamber or duct having a receiving region and an elongated mixing region the unmixed incompletely mingled proportioned ingredients for a concrete mass, subjecting small successive parts of the said ingredients immediately upon their passage from the receiving region to the mixing region and prior to their being mixed and mingled to the action of an air jet of high velocity, and causing said jet to effect the complete mingling of the particles of the masses and propel them each other while they are being propelled through the said mixing region, and simultaneously causing the initial mass in the receiving re...
11. The herein described method of mixing the rock, sand, cement and water ingredients of a mass from which concrete is to be formed, and delivering the concrete at the place of final deposit, consisting in delivering to an inclosed chamber or duct having a receiving region and an elongated mixing region the unmixed incompletely mingled proportioned ingredients for a concrete mass, subjecting them to the action of an air body under pressure and distributed in the receiving region over the entire mass therein and causing said mass to move bodily from the receiving region, deflecting the materials immediately on their leaving the receiving region from the lines of their travel therethrough to different lines of travel through the mixing region, subjecting small successive parts of the said ingredients at the place of deflection adjacent the mixing region to the action of an air jet of high velocity directed along the second lines of travel, and causing the air to effect the mixing and complete mingling of the particles of the ingredient masses among each other while they are being propelled through the mixing region and prior to their being mixed and mingled to the action of an air jet of high velocity, and causing said jet to effect the complete mingling of the particles of the ingredient masses among each other while they are being propelled through the said mixing region, and simultaneously causing the initial mass in the receiving region to move under air pressure to the points where the materials enter the path of the said jet.

13. The herein described method of mixing the rock, sand, cement and water ingredients of a mass from which concrete is to be formed, and delivering the concrete at the place of final deposit, consisting in delivering to an inclosed chamber or duct having a receiving region and an elongated mixing region the unmixed incompletely mingled proportioned ingredients for a concrete mass, subjecting them to the action of an air body under pressure and distributed in the receiving region over the entire mass therein and causing said mass to move bodily from the receiving region, deflecting the materials immediately on their leaving the receiving region from the lines of their travel therethrough to different lines of travel through the mixing region, subjecting small successive parts of the said ingredients at the place of deflection adjacent the mixing region to the action of an air jet of high velocity directed along the second lines of travel, and causing the air to effect the mixing and complete mingling of the particles of the ingredient masses among each other while they are being propelled through the mixing region.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN H. MACMICHAEL.

Witnesses:

ADA LOUISE KATZ,
ANNA S. KATZ.