Jan. 31, 1956 J. J. DUGAS 2,733,053

MIXING MACHINE FOR EXPANDED CELLULAR CONCRETE

Filed Jan. 5, 1954 3 Sheets-Sheet 1

Fig. 5

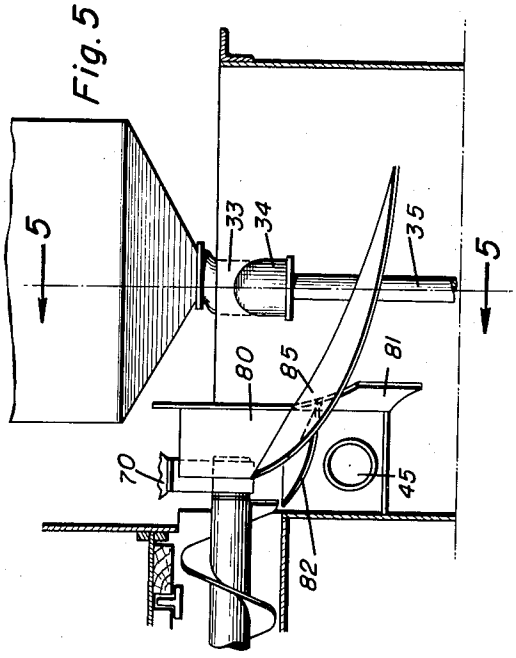


Fig. 6

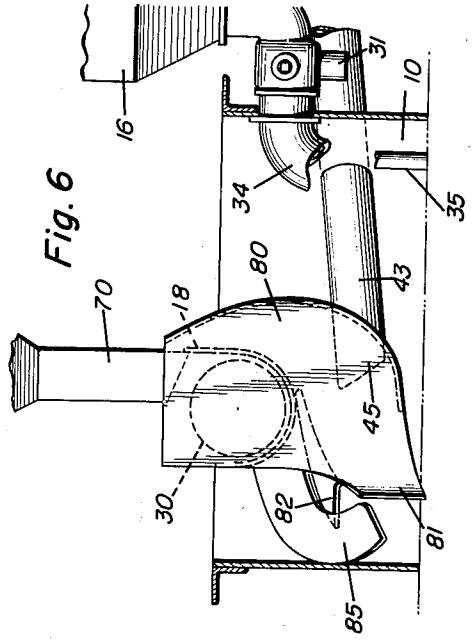


Fig. 1

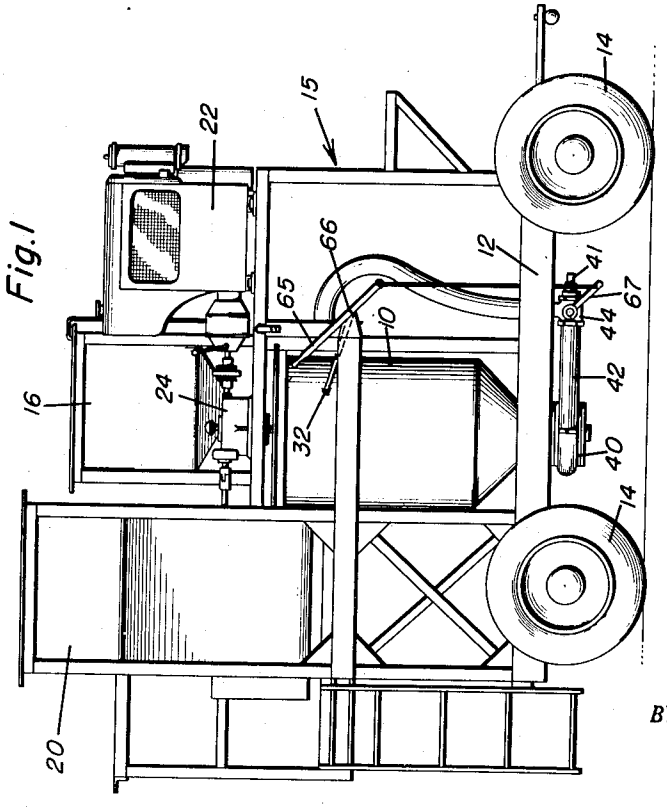
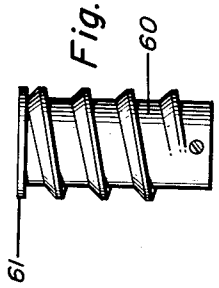


Fig. 8



Joseph J. Dugas
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

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MIXING MACHINE FOR EXPANDED CELLULAR CONCRETE

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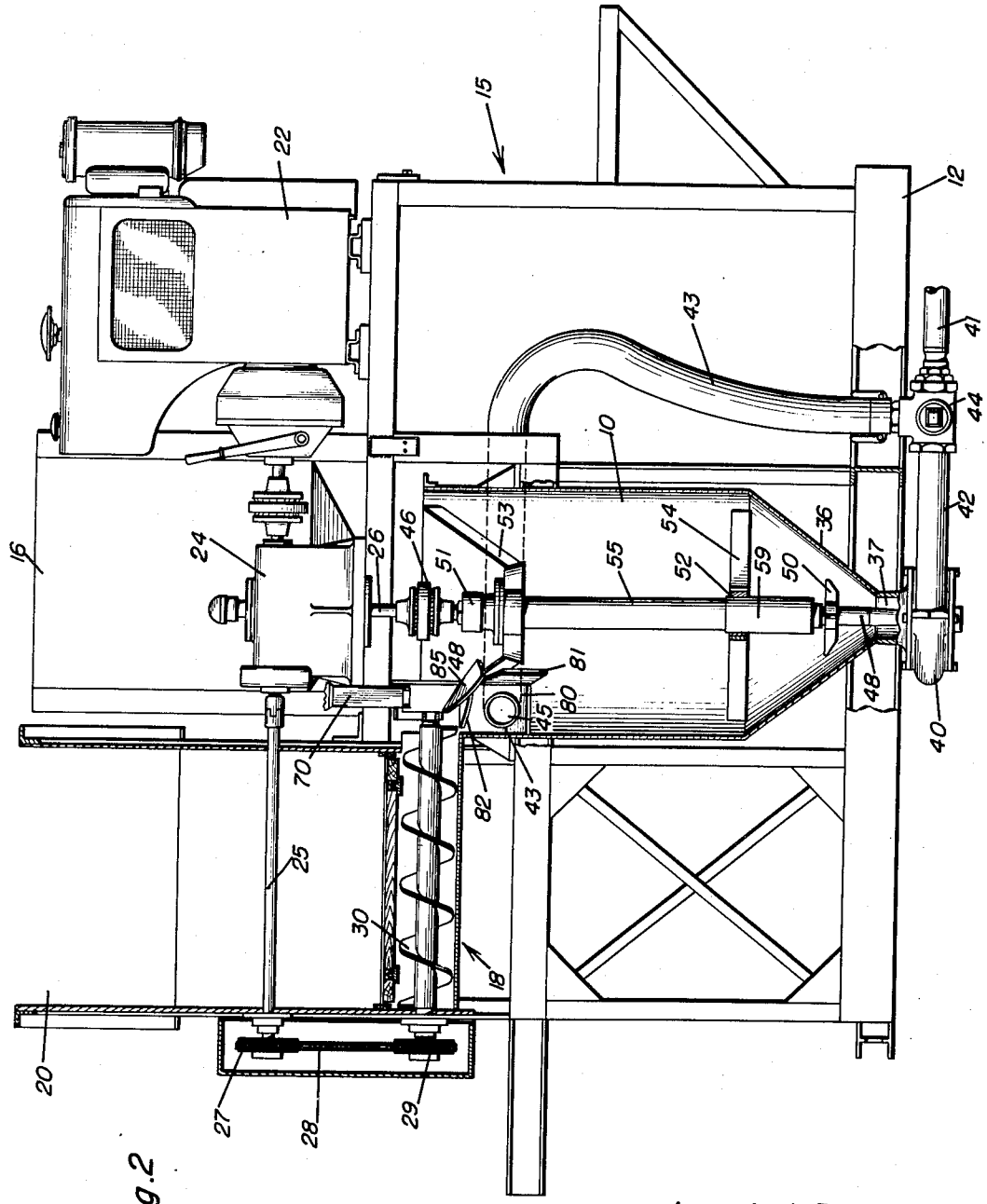


Fig. 2

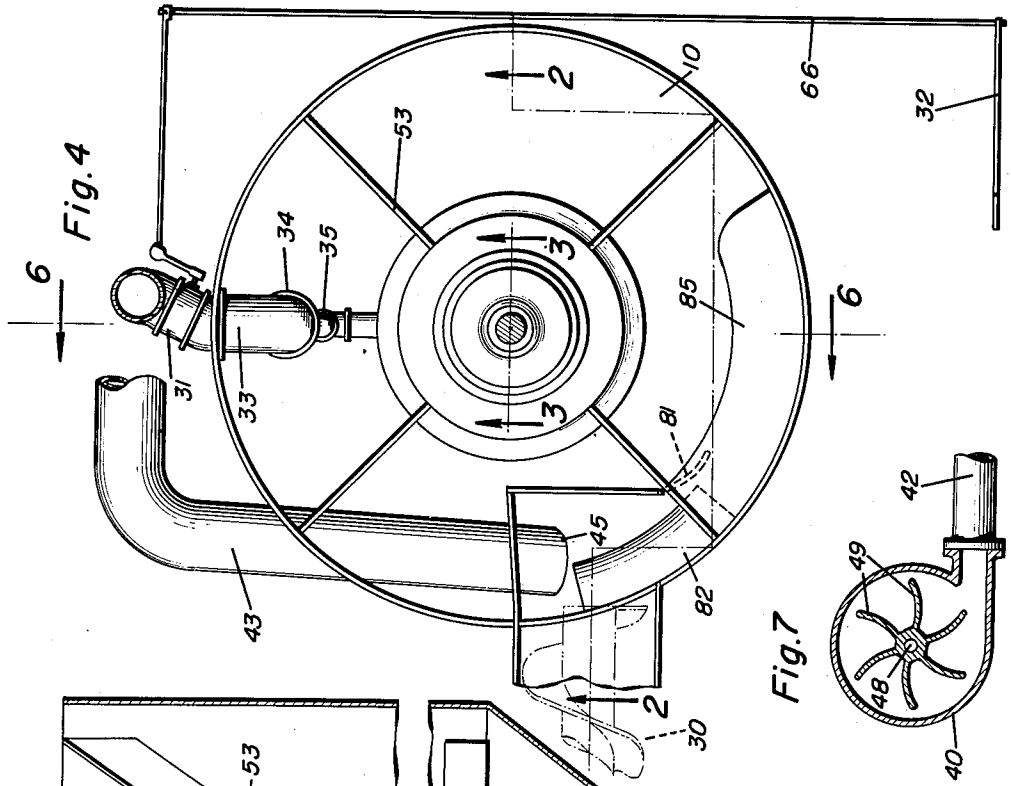
Joseph J. Dugas
INVENTOR.

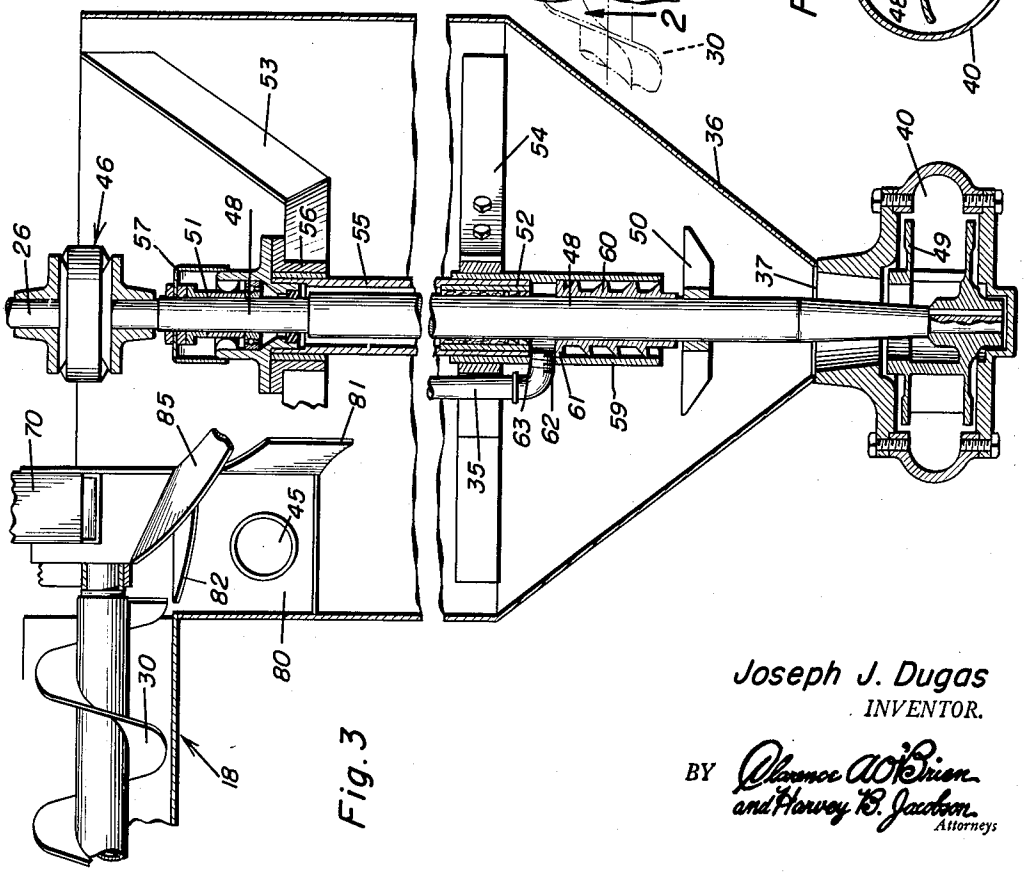
BY Clarence A. O'Brien and Harvey B. Jacobson
Attorneys

Jan. 31, 1956 J. J. DUGAS 2,733,053

MIXING MACHINE FOR EXPANDED CELLULAR CONCRETE

Filed Jan. 5, 1954 3 Sheets-Sheet 3





Joseph J. Dugas
INVENTOR.

BY Clarence A. O'Brien and Harvey B. Jackson
Attorneys

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MIXING MACHINE FOR EXPANDED CELLULAR CONCRETE

Joseph J. Dugas, New Orleans, La., assignor to Higgins, Inc., New Orleans, La., a corporation of Louisiana

Application January 5, 1954, Serial No. 402,329

8 Claims. (Cl. 259—165)

This invention relates to mixing machines for cement, concrete and similar materials and it has for its main object to improve the mixing machine for a special kind of cement or concrete, particularly for that type which is usually termed "expanded cellular cement" or "aerated concrete" and which includes a large number of gas bubbles. Concrete of this type, on account of many advantages associated with it, is extensively used. This particular type of concrete has been described for instance in U. S. Patent No. 2,560,871 to George H. Johnson and Roland C. Higgins.

In order to mix concrete of this type it is not sufficient to produce a rotation accompanied by some movement due to gravity, such as done in the usual mixer in which the container is rotated. The expanded cellular cement is formed by means of gas produced during the mixing process and therefore not only the various products forming the mix have to be distributed uniformly but also the gas developed has to be evenly distributed through the entire mass and the large gas bubbles have to be broken up so that gas bubbles of average size result which are more or less uniform in character and are evenly distributed. Further, the accumulation of gas in large pockets has to be prevented.

These results can only be obtained by means of a new type of mixing machine such as has been described for instance in my earlier Patent No. 2,513,012. The main object of the present invention is an improvement of the above mentioned type of mixing machine.

The principle on which the mixing machine according to said earlier patent is based consisted in feeding the solid material into a recirculation stream at a slow rate in such a manner that the fluid to which some of the solids had been introduced is drawn off at the bottom of the mixing tank and is again injected at the top of the tank in a stream striking the cement and also the walls of the tank with some force and at an angle and producing a mixture of the compounds and also distribution of the gas bubbles developed during the mixture by the swirling or vortex motion within the tank which is directed downwardly by suitable means, this downward motion being supported and maintained by mixing paddles located in the lower portion of the mixing tank.

This recirculation is continued until all the solids have been introduced and until the desired uniform distribution of the solids and gases has been obtained.

This thorough mixing by recirculation and by deflection, and the initiation of a swirling movement and introduction of the solids into the recirculation stream, hitting them under an angle, is just sufficient, as was found, to obtain a thorough and uniform mixture and distribution of the gas bubbles; but it was also found that under adverse circumstances (which usually depend on the materials which must be used locally) it is sometimes not sufficient to produce the desired result, or it requires a mixing time or a rate of mixing which is not satisfactory.

It is therefore the main object of the invention to

improve the mixing system to such an extent that it will work in a completely satisfactory manner under practically all circumstances.

Further difficulties experienced in connection with the production of a concrete of this type consist in the penetration of the violently agitated concrete which passes the mixing tank into the bearings of the shaft which drives the paddles and the recirculation pump and in the maintaining of a proper sealing of the lubricated parts, preventing their contact with the cement slurry, and in the prevention of agglomerations of the cement slurry on the shaft and on other parts which afterwards harden.

A further object of the invention is to protect the drive shaft which drives the mixing paddles and the pump, and especially the bearings of the shaft against contact with the cement slurry in a most efficient manner.

A further object of the invention consists in introducing the two different groups of solids, namely the cement and the dry chemicals which are introduced in order to produce gas formation through two different distinct channels in order to improve the gas distribution and in order to reduce the dust and to accelerate the production of a more uniform mix.

A still further object of the invention consists in protecting the inlet for the cement against the formation of agglomerations usually due to the splashing of the mix, as the said inlet is located close to the recirculation stream which causes a very violent turbulent movement when injected into the tank.

Further and ancillary objects of the invention and more specific objects will be explained in connection with the detailed specification.

The invention is illustrated in the accompanying drawings showing essentially one embodiment thereof. It is however to be understood that the embodiment of the invention shown has been selected in order to explain the principle of the invention and the best mode of applying said principle and that therefore this modification is shown by way of example only. No attempt is made to illustrate all possible modifications and it will therefore be clear to the expert in this field that many constructional details may be changed and that a departure from the specific embodiment which has been illustrated is not necessarily a departure from the principle of the invention.

In the drawing:

Figure 1 is an elevational side view of the complete machine as assembled.

Figure 2 is an elevational partly sectional view of the main part of the mixer the section being taken along line 2—2 of Figure 4.

Figure 3 is a partly sectional elevational view of the mixing tank, the section in this case being taken along line 2—2 of Figure 4 until the tank is reached then the tank being shown with the wall removed, while some parts in said tank are shown partly in section this section being taken along line 3—3 of Figure 4.

Figure 4 is a plan view of the mixing tank.

Figure 5 is a view of the entrance end for the cement partly in section the shell of the tank being shown in section along line 2—2 of Figure 4, while the inner structure of the tank is shown in elevational view with the shell removed.

Figure 6 is an elevational side view of the tank with the shell of the tank shown in section the pre-mixing chamber being shown in side view, the section being taken along line 6—6 of Figure 5.

Figure 7 is a sectional elevational view of the pump.

Figure 8 is an elevational view of the screw used in the protective device.

The general arrangement of the mixing machine is similar to that described in the aforementioned earlier

Patent No. 2,513,012 and the principal elements of the mixing machine are essentially the same as those described in the said earlier patent. The mixing machine comprises a mixing and recirculation tank **10**, mounted on a wheeled frame **12** supported by the wheels **14**, said wheeled frame bearing an upwardly extending supporting frame structure **15** on which the various units of the mixing machine are mounted.

The machine comprises further a water tank **16** and a cement tank **20** for holding the cement, the lower portion of the tank being formed as a hopper leading to a feeding mechanism generally indicated at **18**. The feeding mechanism and all other mechanisms are driven by means of an engine **22** of any type by means of a gear box **24**.

The gear box **24**, as seen in Figure 1, is so arranged that from it two axles or shafts at right angles to each other may be driven. One of these shafts **25** drives a sprocket wheel **27** by means of a chain **28** and another sprocket wheel **29** drives the screw conveyor **30** which feeds the cement flowing into the hopper formed in the lower portion of the cement tank **20** to the mixing tank **10**.

The water tank **16** is provided with a feed line, controlled by a float operated automatic refillling device of the well known type (not shown in the drawing). The feed line of the water tank is controlled by a manually operated valve. The water tank is emptied by means of a hand operated discharge valve **31**, only diagrammatically indicated in the drawings. Both the feed valve and the discharge valve **31** may be operated by means of the same manual control lever **32** adopting two different positions. In one position the feed valve is opened while the discharge valve is closed. Then water is fed to the tank and feeding continues automatically until the float operated device closes the feed line.

The water tank **16**, when the discharge valve **31** is opened, empties a predetermined quantity of water into the mixing tank through the pipe **33** and the elbow piece **34**.

The tube **33** and the elbow piece **34** also discharge some water into the small pipe **35** (Figures 5 and 6) for a purpose which will be explained below.

The upper portion of the mixing tank **10** is cylindrical while the lower portion **36** is conical. The conical end leads to an outlet opening **37** which is connected with the inlet end of a centrifugal pump **40**.

The pump **40** may be in all respects of the usual type, but it differs from the standard type insofar as the rotor of the pump, as seen in Figure 8, is of a diameter which is smaller than the casing within which it works. This permits the rotor blades to act as a further mixing element, as the slurry is not only driven out but is also thoroughly beaten while in the pump casing.

This beating of the slurry produces violent but thorough mixing and distribution of the gas, so that the pump is to be considered as one of the mixing elements of the arrangement.

The pump **40** is capable of forcing the slurry which runs through the outlet **37** of the mixer into the recirculation pipe **42** under a sufficient pressure. The pipe **42** is controlled by a valve **44** which is a three way valve, connecting on one side with the pipe **43** leading back to the upper portion of the tank and on the other side with the pipe **41** which may be connected with a hose leading to the place where the expanded cellular concrete is to be deposited. During the mixing, when recirculation takes place, the slurry is forced through the pipe **43** which leads back to the upper portion of the tank and enters the tank through a suitable opening projecting into the interior of the tank. The end **45** of the tube **43** leads approximately to a point which is directly beneath the cement feeding screw **30**.

The centrifugal pump **40** is driven by means of the axle **26** which, through a coupling **46**, indicated in outline only, drives the shaft **48** on which the hub of the rotor **49** of the pump **40** is mounted.

The shaft **48** in addition carries an impeller **50** with blades forcing the slurry formed in the tank downwardly towards the outlet opening **37**.

The shaft **48** is journaled in two bearings **51** and **52**, which are supported by means of sleeves carried by spider arms or radial supporting brackets **53**, **54** which are either welded or screwed to the tank walls.

It has been found that it is essential for a continuous and uninterrupted operation to protect the bearings of the shaft **48** and especially the oil carrying parts, and this is especially necessary in the upper portion of the tank when the speed of the slurry in the longitudinal direction is slow. At such a slow speed it is necessary to avoid the sticking of parts of the slurry to parts connected to the shaft and bearings because at this slow speed the slurry may harden and thus form excrescences on the shaft which may disturb the operation. To obtain such protection the shaft bearings **51** and **52** and the shaft portion between the bearings are encased within a protective tube **55**. Near the upper bearing **51** the tube **55** may be held by the sleeve **56**, supporting the bearing. As the bearing is located essentially above the level which is reached by the slurry in the tank this bearing **51** may be protected merely by a sleeve or cap **57**. The lower bearing however is located in the lower portion of the tank above the impeller **50** and is specially protected by a downward extension **59** of the protective tube **55** surrounding the shaft **48**. This section of the protective tube houses a sealing and cleaning screw **60** fitting into the protective tube **55** and seated on the shaft **48** with which it is fixedly connected by some suitable means, such as a setscrew. The screw thus rotates with the shaft. This screw is provided on its upper end with a flange **61** which enters a shoulder **62** in the protective tube. Immediately above said shoulder **62** an opening **63** is provided in the protective tube **55** into which the end of the tube **35** is inserted, which tube, as above mentioned is connected with a discharge elbow **34** of the water tank discharge tube **33**. The screw **60** when rotating with the shaft **48** repels the slurry and drives it out of the tube, thus keeping it away from the oil seal and bearings which are above the screw. The pipe line **35** always receives a charge of water when the fresh water tank is discharged into the mixing tank for the mixing of a fresh batch.

The water flows down in this case through the pipe **35** and along the screw, during the filling of the tank with water and flushes that portion of the tube which is below the shaft bearing **52** thus removing any matter which may cling to the screw **60**. Thus all accumulations of slurry which might harden are prevented and the life of the bearing and of the seal which is abnormally short in this type of mixers can thus be brought to normal standards.

The recirculation of the slurry conveyed from the outlet opening **37** back into the tank towards the top of the same by means of pipes **42**, **43** is controlled manually by valve **44**, a three way valve which controls the communication of discharge pipe **42** with pipes **43** and **41** and which is operated by means of a manual lever **65** (Figure 1) movable around an axle **66** which is fixed on the frame. The valve is provided with an operating lever **67** the end of which is connected by means of a link or wire with the end of lever **65**. The downward movement of the handle lever **65** thus moves the operating lever of the valve connecting the discharge pipe **42** with the pipe **41** leading to the distributing hose.

A special mixing arrangement for the materials which are filled into the mixing tank is illustrated in Figures 3, 4, 5 and 6. In order to make expanded cellular concrete, Portland cement is mixed with water, aluminum flakes, caustic soda and a bituminous emulsion, the usual process being to mix the bituminous emulsion with water, to then add the Portland cement and, after the mixing has progressed, to add first the aluminum flakes and then the

sodium hydroxide, violent mixing taking place after each addition. The two dry substances, namely aluminum flakes and sodium hydroxide are added by means of a special funnel 70 which is located above and near the delivery end of the cement feeding screw 30. Portland cement is filled into the container 20 and is delivered into the hopper at the lower end of the container 20 and into the feeding chamber 18 within which the conveyor screw 30 moves.

The conveyor drives the cement towards the mixing tank and near the delivery end of the feeding chamber 18 a pre-mixing chamber 80 is arranged within the mixing tank. As seen this premixing chamber is a partly open chamber, closed merely at the back portion (see Figure 6) which is the portion provided with an opening through which the end section of the recirculating pipe 43 enters the pre-mixing chamber. The recirculated slurry is thus delivered into the pre-mixing chamber 80. The open front of the chamber 80, termed the front because the matter fed into the premixing chamber moves towards this side, is provided with a guiding baffle 81 for the jet of recirculated slurry which issues from the orifice of the recirculating pipe 43, passes the pre-mixing chamber and strikes the wall of the tank and is deflected by said wall and by the baffle 81.

The Portland cement which is discharged through the feeding chamber 18 by means of the conveyor screw 30 into the pre-mixing chamber drops partly on the guiding baffle 82 which is a curved inclined plate, the end of which is located above the space left between baffle 81 and the wall of the mixing tank 10. The Portland cement is thus partly discharged directly into the re-recirculating stream and partly drops on this baffle and is therefore discharged into the recirculating stream just where it is deflected between the wall of the tank and the baffle and starts a swirling or vortex motion within the main tank. That portion of the cement which overruns the inner end of the baffle falls into the stream of recirculating slurry issuing from the orifice 45 of the tube 43 a little ahead of this point.

To impart to this swirling or vortex motion which is started by the recirculated slurry a downwardly inclined impulse a further guiding baffle 85 is provided, the upper end of which is located near the open end of the pre-mixing chamber, which leads downwardly along a spiral along the inner wall of the tank 10.

This combination of elements results in a most violent but also most uniformly regulated mixing, as the slurry which is driven out from the end 45 of pipe 43 is projected against the wall of the tank and deflected in a completely positive way, the material following a spiral path leading towards the bottom of the tank, while the Portland cement and the dry ingredients which are added may also be regulated and distributed in such a manner that the mixture while very thorough and even violent occurs always in the same way.

Once the downwardly directed swirling or vortex motion has been imparted to the mixture, this movement will continue along the mixing tank and will be assisted and reinforced by means of the impeller 50 near the outlet opening which is so shaped as to produce such a downwardly directed movement so that the slurry can circulate rapidly, but can advance in a longitudinal direction, that is in a direction parallel to the axis of the tank, only to a predetermined extent.

The slurry is then pressed by the impeller 50 into the outlet opening 37 and is admitted to the pump 40 where it is again beaten and is sent up through the recirculation tubes 42 and 43 for repeated treatment as long as the batch is treated in the tank.

After the batch treatment has been completed the manual lever 65 is pushed down, the three way valve 44 is reversed and the completed mix is delivered through the pipe end 41 to the hose which leads it to the place where it is to be used.

The operation of the mixing machine will be clear from the foregoing description.

After the tanks, containers and hoppers have been filled and operation has been started by coupling the drive shaft of the engine 22 with the gear box 24 and by moving the manual water control handle 32 into its discharge position so that water from the water tank 16 may flow into the mixing tank, and after handle 32 has been again moved back to its refilling position in which the tank 16 is filled under the control of the float and after handle 65 is brought into recirculation position, a batch is mixed in the mixing tank by introducing the various compounds. Portland cement is continuously fed at a predetermined rate through the chamber 18 by the screw conveyor 30 until it drops from said chamber into the pre-mixing chamber 80. Upon coupling of the drive shaft to the gear box 24 the shaft 26 is rotated, rotating the pump 40, and the mixture which now flows to the pump through the discharge opening 37 is not only forced through the pipes 42 and 43 back into the pre-mixing chamber but is also thoroughly beaten while passing the pump thus making the mixture more uniform. The mixture, under the pressure of the pump, is not only forced back to the mixing chamber but is ejected from the orifice 45 of the pipe 43 in the form of a jet. The recirculation stream after having passed the pre-mixing chamber 80 hits the wall of the tank 10 and is deflected thereby and is guided, partly by means of the guide plate 81 tangentially along the wall.

Portland cement is continuously flowing over the baffle plate 82 into the recirculation stream and therefore this stream first hits the cement and drives it against the wall, thus producing a most energetic mixing of the incoming cement with the recirculated slurry. The recirculation stream is not only guided tangentially by the wall and guide plate 81 but is further guided by the baffle plate 85 arranged just above the recirculation stream which imparts to said stream a downward movement on account of its inclination and of its location adjacent to the pre-mixing chamber. The guide plates and baffles thus produce by their coordinated action a swirling or vortex movement along a downwardly directed spiral.

Into the recirculation stream also a thin stream of dry components flows through the small pipe 70, the stream carrying the solids also being deflected by the wall of the mixing chamber. Therefore immediately after the introduction of solids a most energetic mixing action occurs which is initiated when the stream hits the wall and which continues during the swirling movement which the stream performs along the wall.

During this turbulence and energetic mixing movement not only a thorough mixing of the solids which have been introduced into the slurry occurs but all gaseous matter whether introduced into the stream or whether formed by chemical reaction within the stream is thoroughly mixed and evenly distributed. Especially air or gas pockets and even large air or gas bubbles are eliminated and destroyed.

The process continues until the entire batch material has been poured and the batch has been mixed thoroughly. When the batch is completed the lever 65 is again actuated by the operator changing the position of the three way valve 44 so that the discharge pipe 42 is now in communication with pipe 42 through which the completed mixture may now be discharged as above described.

While one example of a practical embodiment of the invention has been described above it will be clear that many changes may be made in the structure which has been illustrated without in any way departing from the essence of the invention as defined in the annexed claims.

Having described the invention what is claimed as new is:

1. A mixing machine for concrete, comprising a mixing tank, means for supplying the same with a predetermined quantity of water, a container for solid substances, and means for feeding the said solid substances into the mixing

tank, a recirculation system, including means withdrawing the mixture made in the mixing tank, raising the mixture above the normal fluid level in the tank and injecting it again under pressure through a jet forming pipe into the tank below the point where the means for feeding the solid substances introduce the latter into the mixing tank, the pressure being sufficient to form a coherent substantially horizontal jet stream projected towards and against the wall of the tank, a premixing chamber closed at one side and provided with an opening through which the jet forming pipe passes, said premixing chamber being open at the opposite side and arranged within the mixing tank near said aforesaid point of introduction of the solid substances, and means arranged near said mixing chamber for imparting to the recirculated substantially horizontal jet stream projected towards the wall of the tank a swirling movement along the wall of the mixing tank following a downwardly directed spiral while moving along the mixing tank walls.

2. A mixing machine for concrete, comprising a mixing tank, means for supplying the same with a predetermined quantity of water, a container for solid substances, and means for feeding the said solid substances into the mixing tank, a recirculation system, including means withdrawing the mixture made in the mixing tank, raising the mixture above the normal fluid level in the tank and injecting it again under pressure through a jet forming pipe into the tank near the point where the means for feeding the solid substances introduce the latter into the mixing tank, the pressure being sufficient to form a coherent substantially horizontal jet stream, projected against the wall of the tank, a premixing chamber closed at one side provided with an opening through which the jet forming pipe passes, and open at the opposite side, arranged within the mixing tank near said aforesaid point of introduction of the solid substances, so that the latter are delivered into the jet stream, a baffle arranged near said point, directing the solid substances into the substantially horizontal concentrated and coherent recirculation jet stream injected into the tank by the recirculation means, and further baffle plates near said pre-mixing chamber for directing the recirculation stream downwardly through the tank in a spiral along the wall of the tank.

3. A mixing machine for concrete containing gaseous matter, comprising a mixing tank, means for supplying the same with water, a container for cement, a cement feeding chamber and means for introducing continuously cement into the mixing tank, means for introducing additional solid substances, recirculation means including a recirculation pump and a recirculation pipe system leading to a point above the normal fluid level in the tank near the point of introduction of the cement into the mixing tank, said pump producing a sufficient pressure for producing a recirculation jet stream issuing substantially in a horizontal direction from the orifice of a jet forming pipe of the system and directed against the wall of the mixing tank, a premixing chamber within said mixing tank, arranged near the point of introduction of the cement, closed at one side which is provided with an opening through which the jet stream forming pipe passes, while open at other sides, said jet forming pipe of the recirculation system projecting through the closed side of the premixing chamber into the same, and projecting a recirculation jet stream through the pre-mixing chamber against the wall of the mixing tank, a baffle above said recirculation stream protecting the cement feeding chamber inlet and distributing and directing the cement into the recirculation stream in front of the point at which the latter hits the wall of the pre-mixing chamber, and further guide baffles directing said recirculation stream after it hits the wall of the mixing tank, producing a horizontal and downwardly directed movement within the mixing tank following a downwardly directed spiral.

4. A mixing machine as claimed in claim 3, wherein a guiding baffle is provided which projects from a side wall of the said pre-mixing chamber outwardly and is curved approximately in conformity with the curving of the wall of the mixing tank for guiding the recirculation stream along said mixing tank wall on the inner side.

5. A mixing machine as claimed in claim 3 wherein a further guiding baffle is arranged along the wall of the mixing tank, starting at a point located near and above the recirculation stream and curved in a downwardly directed spiral to impart a corresponding downwardly directed movement to the recirculation stream producing, together with the component of movement along the wall, a movement of the mixture along a downwardly directed spiral.

6. A mixing machine as claimed in claim 3, wherein the means for introducing additional solid substances consists in a pipe arranged above and adapted to discharge on the baffle directing and distributing the cement.

7. A mixing machine for expanded cellular cement, comprising a mixing tank with an open top and an outlet end at the bottom, a recirculation system including a rotational pump connected with the outlet end and pipes leading from said pump to and into the top portion of the tank, a cement storage tank and feeding means delivering the cement into the mixing tank near the open end of the same, means for driving said pump including a vertical drive shaft within said mixing tank, a protective outer sleeve surrounding a portion of said vertical drive shaft, a protective inner sleeve carrying a feed screw member fixedly held on the drive shaft and rotating with the same, mounted near the lower end of the sleeve, with screw turns feeding towards said end, for preventing penetration of the mixture into the sleeve at the open end thereof.

8. A mixing machine for expanded cellular cement, comprising a mixing tank with an open top end and an outlet end at the bottom, a water tank for supplying water to said tank, and a water feed pipe leading from said water tank into the open end of the mixing tank, a cement container and cement feeding means, delivering cement from said container into the open end of the mixing tank, a recirculation system for the mixture in the mixing tank, including a rotational pump arranged at the outlet end of the tank and recirculation pipes connected with said pump leading back to the upper end of the tank, a protective outer sleeve surrounding a portion of said vertical drive shaft, a protective inner sleeve carrying a feed screw member, fixedly held on the drive shaft and rotating with the same, arranged near the lower end of the sleeve with screw turns feeding towards said end, for preventing penetration of the mixture into the sleeve at the open end thereof, and a water pipe connected with the water feed pipe and leading to the protective sleeve for flushing the latter and the protective feed screw member each time when water is admitted to the mixing tank.

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