METHOD OF AND APPARATUS FOR COOLING CONCRETE AGGREGATES

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The present invention relates to a method of and apparatus for cooling concrete aggregates. More specifically, the invention relates to a method of and apparatus for the selective precooling of the relatively coarse constituents of a concrete batch to a temperature which is at least as low as the degree of temperature necessary to attain a desired placement temperature of the final mix.

Modern specifications for large installations, particularly where concrete dams are concerned, require that the concrete shall not be placed if the temperature of the final mix exceeds a predetermined specified temperature. To accommodate these specifications, recent practice involves various methods of which the most prevalent are: (1) the use of cold air blasts for cooling the aggregate; (2) the cooling of the mix water, and (3) the use of ice for batching purposes. Various installations have employed these expedients, either singly or in combination, in an effort to attain the desired placement temperature. In many instances it has been found that even when all three expedients have been resorted to, the desired low placement temperature cannot be attained.

In addition to the frequent ineffectiveness of such methods of cooling, the fact that extremely complicated, expensive and cumbersome equipment, as well as additional manpower, must be employed has led to rather discouraging results. Since each large installation presents special problems and new methods of approach, a detailed discussion of all the many cooling expedients that have heretofore been resorted to is not within the scope of this specification, and it is deemed sufficient to state that in certain instances not only have the coarse aggregates been cooled but additionally heat exchangers have been provided whereby the fine aggregate or dry sand has been cooled with the sand flowing through water-jacketed flues. The use of silos for chilling the coarse aggregates has also been resorted to wherein the silos are partially filled with chilled water, the aggregates then introduced, and circulation of water by means of a pumping system maintained for a predetermined period of time, followed by drainage of the silos and discharge of the contents thereof. Such an inundation process has involved transportation difficulties, and it is the object of the present invention to obviate the necessity of inverting a continuous building to enclose the overhead bins as well as an insulated enclosure for the aggregate conveyor line leading from the cooling plant to the mixing plant. An air conditioning unit has been employed in the cooling plant building to circulate cooling air throughout the areas where the cooled aggregates are stored or handled.

The present invention is designed to overcome the above noted limitations, principally of manpower and equipment, that are attendant upon the use of present day practice in the precooling of aggregates prior to mixing and subsequent placement thereof, and toward this end it contemplates, briefly, the provision of a spray bin in advance of the mixer installation to consolidate practically all of the necessary handling of the aggregates prior to the mixing thereof in one location and to thereby eliminate much of the heretofore necessary equipment and manpower. According to the present invention it is contemplated that one workman shall be required to direct the material into the areas provided for it and to dispatch the material from the stock pile of aggregates, while a second workman is required to control the direction of water flow and to operate the discharge gates employed in connection with the process.

In addition to the multiple bin construction briefly outlined above, the apparatus employed involves a conveyor for conducting coarse aggregates to the spray bin assembly from the stock pile, a bypass conveyor conducting fine aggregate such as sand from the stock pile, and a mixer plant feed conveyor for receiving the cooled aggregate and sand from the spray bin assembly and the bypass conveyor, respectively, and for conducting them jointly to the mixer plant wherein they may be further treated by conventional processes prior to and during the mixing operation preparatory to placement of the batch. The equipment also may include a settling pond or surge tank to which fresh coolant water may be supplied and to which expended coolant water resulting from the spraying operation may be returned, a refrigeration plant or heat exchanger for cooling the water supplied from the surge tank to the spray bin construction, a shaker screen apparatus for equalizing the distribution of residual moisture in the aggregate after spraying thereof, a waste pond or the like for receiving the waste products such as slit from the shaker screen, together with such equipment as the necessary coolant conduits, valves for controlling or directing the flow of the coolant, and gates and other directional control mechanism for the aggregate material.

The provision of a method of and apparatus for cooling aggregates of the character briefly outlined above being the principal object of the invention, another object is to provide such a method and apparatus by means of which selective control of the treatment of the material may be obtained in order that aggregates of uniform water content may be forwarded to the mixing plant from the precooling station.

A further object of the invention is to provide a novel apparatus for precooling the relatively coarse aggregates preparatory to the mixing of the concrete batch, together with means for insulating the precooled material during the transfer to the mixing plant in order that there shall be no transfer of heat from the ambient atmosphere to the precooled materials prior to their arrival at the mixing plant.

Yet another object is to provide a method and apparatus for precooling aggregates which, in addition to very materially reducing the manpower and equipment necessary to obtain the desired results, affords a system of operation which is highly selective in its treatment of the materials and which may be conducted with a minimum of effort on the part of the operators thereof.

Other objects and advantages, not at this time set forth, will become more readily apparent as the nature of the invention is better understood.

In the accompanying two sheets of drawings forming a part of this specification, a preferred embodiment of the invention has been shown.

In these drawings:

Figure 1 is a flow chart illustrating the method employed in connection with the invention and showing schematically a novel type of spray bin assembly employed in practicing the same.

Fig. 2 is a side elevational view, almost entirely sche-
matic in its representation, of the spray bin assembly as utilized in a typical installation. Fig. 3 is a schematic plan view of the installation. Fig. 4 is a circuit diagram of an electric distribution control system which may be employed in connection with the invention. Fig. 5 is an hydraulic circuit diagram of a gate control system which may be employed in connection with the invention, and Fig. 6 is a time chart showing a purely arbitrary schedule of operations of the apparatus for a selected concrete installation.

While the invention is susceptible of various modifications and alternative constructions, there is shown in the drawings and will herein be described in detail the preferred embodiment, but it is to be understood that it is not thereby intended to limit the invention to the form disclosed, but it is intended to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring now to the drawings in detail and in particular to Fig. 2, the central mixing plant installation, designated in its entirety at 10, may be of any suitable design and will be availed of the usual features associated with such plants including the material batchers 12, cement tank 14, aggregate compartments 16, charging hopper and distributor 17, collector cone 18 and all other apparatus common to such installations. In the present instance the installation may include a refrigeration and ice plant 20, ice elevator 22, ice screw 24 and ice batcher and chute 26, all for delivery of batched ice to the batch materials in order to maintain the low delivery temperature of the precooled aggregate materials conducted to the mixing plant according to the present invention and to further lower this temperature, if necessary, to attain the required low placing temperature of the mixed concrete materials.

The character of the central mixing plant 10 may vary widely for different installations and no claim is made herein to any novelty associated therewith. It is simply the aim of the present invention to deliver the materials undergoing batching, particularly the coarse aggregates delivered to the aggregate compartments 16, at the lowest temperature practicable for further treatment at the mixing plant. One type of installation with which the present invention may be associated has been disclosed by illustration and description in a publication entitled "Johnson Concrete Plants, Portable and Stationary," which is a catalog of the C. S. Johnson Company of Champaign, Illinois. This installation is illustrated on page 58 of said publication and is widely known as the Johnson-Oto-Bin.

The installation illustrated at 10 is of the Oto-Bin type and is illustrated in Figs. 1, 2 and 3 as having six aggregate compartments although the enclosure for the compartments is provided with eight sides. Obviously, a greater or lesser number of aggregate compartments may be provided if desired.

The materials of a batch to be charged into any one of the batchers 12 are carried to and fed into the distributing hopper 17 by means of a conveyer 28 leading from a spray bin installation or assembly 30 by means of which the coarse aggregates are cooled according to the present invention.

Located more or less remotely in relation to the central mixing plant 16, and also to the spray bin installation 30 are the supply sources of the different aggregate materials such as stone of different sizes, gravel of different sizes, sand, etc. These sources may be stock piles or bins, such being immaterial to the present invention and the sources are designated at 32. The supply sources for the aggregates are disposed above a conveyer 34 and a series of material batchers 35 may be provided, one for each supply source. Suitable means may be provided for operating the batchers 35 in accordance with the demand for the different aggregate materials required at the spray bin assembly and at the mixing plant. The conveyer 34 terminates at its discharge end in a pivoted distributor 36 which may be either manually operated or operated electrically, pneumatically, hydraulically or otherwise by remote control. According to a preferred embodiment of the invention, remote control of the distributor 36 is desirable in that the same may be operated under the control of a workerman at the spray bin assembly 30, all in a manner that will become clear presently. An electrical control mechanism for the pivoted distributor 36 has been shown in Fig. 4 and will be described presently.

The pivoted distributor 36 is adapted to selectively discharge materials from the stock pile conveyer 34 onto the receiving end of an inclined conveyer 38 leading to the spray bin installation 30 or onto the receiving end of a by-pass conveyer 40 which in turn discharges the material fed thereto onto the receiving end of the conveyer 28 so that materials may be conducted directly from the stock pile 32 to the mixing plant 10 without being subjected to precooling treatment.

The conveyer 38 is employed for the purpose of conducting the coarser aggregates to the spray bin installation 30 for cooling purposes while the finer aggregates, such as sand, are directed to the conveyer 40 for bypassing directly to the mixing plant 10.

Referring now to Fig. 1, the spray bin installation 30 has associated therewith a reservoir for supplying chilled water for spraying over the coarse aggregates conducted thereto by the conveyer 38 and toward this end a refrigeration plant 42 may be located adjacent the spray bin installation and is adapted to receive a supply of coolant water from a surge tank 44 which in turn receives the heat-exchanged coolant water from the spray bin installation 30. A water supply source 46 is provided for replenishing any coolant water which may be lost in the process. The spray bin installation 30, which will be described in detail presently, includes a shaker screen mechanism for screening the chilled aggregate to insure a more uniform moisture content of the aggregate before it is conveyed to the mixer installation, and the rejected moisture-laden residue from this shaker screen construction may be discharged to a waste pond 48.

Referring now to Figs. 2, 3 and 4, the precooling spray bin installation 30 is similar in its general organization to the above mentioned Octo-Bin installation 10 and includes a frame-like structure 52 having a tower section 54 provided with side walls 56 of which there are preferably eight in number. The tower structure 54 also includes a foundation 58 and an aggregate compartment 60 in which there is disposed a pivoted distributor hopper 62 designed for receiving the coarse aggregates issuing from the discharge end of the conveyer 38 and for selectively distributing them into any one of a number of aggregate compartments 64 (Figs. 1 and 3) of which there may be six in number.

The six aggregate compartments 64 are arranged radially in the tower structure 54 and the usual cement tank such as is shown at 14 in the mixer installation 10 has been omitted. The aggregates are selectively distributed to their respective compartments by means of the pivoted distributor hopper 62. The sides of the aggregate compartments 64 slope steeply and provide for free and fast flowing of the aggregates. Each compartment 64 is provided with a gate 66 which may be of clamshell type and which may be electrically, pneumatically, hydraulically, or otherwise controlled. The pneumatic control for one of the gates 66 is disclosed in Fig. 5 and will be described in detail subsequently.

The lower ends of the aggregate compartments 64 communicate with a collector cone 68 which is common to all of the gates 66 and the lower end of the cone discharges onto a shaker screen assembly 70. Coarse materials issuing from the screen are conducted directly
onto the conveyor 28, the receiving end of which underlies the discharge end of the screen. An imperforate tray 72 which excellently underlies the screen discharges waste materials for conductions to the waste pond 48.

The gates 66 are not watertight and, during the time that coolant water is being sprayed into various compartments which are filled with coarse aggregate, the high-expendable coolant water trickles or flows through the closed clamshell gates and be received upon a tiltable deflector plate 67 (see also Fig. 5) for selective direction into a manifold trough or most 69 encircling the installation from whence it may be conducted to the surge tank 44. Alternatively, the pivoted deflector plate 67 may be so positioned as to direct the aggregate, when the gates 66 are open, into the collector cone 68 after coolant water has been drained from compartment 64.

The coolant water is conducted from the refrigeration plant 42 to a vertical standpipe 80 which leads upwardly and centrally through the framework 52 and tower structure 54 and which communicates with a series of downwardly inclined headers or manifolds 82, each having a shut-off valve associated therewith, there being one header for each of the six compartments 64 with each header extending downwardly along an edge of the compartment at one side thereof. A series of horizontal branch pipes 84 extends laterally from each header or manifold and overlies the various compartments at different elevations therein. Spray nozzles 86 are provided at spaced points along each of the branch pipes 84 for directing coolant fluid downwardly onto the aggregates contained within the respective compartments.

In practicing the method of the present invention, it is contemplated that one workman shall be stationed at a ground location adjacent the spray bin installation 30 and that another workman shall be stationed in the tower 54 thereof. Each person who is employed at the tower and such workmen as are employed at the central mixing plant 10 and at the stock pile 32, may be in constant communication with one another through a suitable telephone communication system so that each may be approached of the requirements of the others in the performance of their respective duties. The ground workman may be provided with suitable controls for operating the pivoted distributor 36 for the selective discharge of materials from the conveyor 34 to the conveyors 38 and 40 and he may also be provided with controls for operating the adjacent compartments 64 associated with the respective aggregate compartments 64.

A simplified control diagram for selective operation of the pivoted distributor 36 is shown in Fig. 4. In this diagram, the pivoted distributor 36 is shown as being in the form of a gate member mounted on a vertical shaft 37 which carries a worm wheel 39 meshing with a worm 41 mounted on the motor shaft 43 of a reversible motor M. The gate member or distributor 36 is movable from the full line position wherein materials issuing from the conveyor 34 are directed to the conveyor 38, to the dotted line position wherein the materials are directed to the conveyor 40. The motor M is connected through leads a and b to a conventional reversing switch S to which current may be supplied from a suitable source, not shown.

It is obvious that selective movements of the pivoted distributor 36 may be controlled from the ground station of the spray bin assembly 30 by other means whether electric, hydraulic or otherwise.

Referring now to Fig. 5, a simplified control diagram for selective operation of the various gates 66 and deflector plates 67 at the bottom of the aggregate compartments 64 is shown. In this view the aggregate compartments are shown as being arranged linearly but it will be understood of course that they are arranged radially about the central axis of the tower 56. Each of the aggregate compartments 64 is shown as being provided with an air ram 90. Differential air pressure is available to control the operations of the air ram for the various aggregate compartments. Toward this end, there is diagrammatically illustrated a source of air such as for example, a tank or reservoir 92 wherein the pressure is maintained at fifty pounds. Leading from this tank is a conduit or pipe 94 which connects with the inlet port 96 of a control valve V located at the ground station of the expanded spray bin assembly. The conduit or pipe 94 is connected with the discharge end of the spray bin assembly 30 and conveys air to the various air rams 90. The valve V is provided with a core 98 having a directional passage 100 therein capable of selective communication with the inlet port 96 and a series of outlet ports 102 communicating with the respective branches a, b, c, d, e and f' lead from the valve to the various air rams 90. The valve V is provided with a core 98 having a directional passage 100 therein capable of selective communication with the inlet port 96 and a series of outlet ports 102 communicating with the respective branches a, b, c, d, e and f' lead from the valve to the various air rams 90. The valve V is provided with a core 98 having a directional passage 100 therein capable of selective communication with the inlet port 96 and a series of outlet ports 102 communicating with the respective branches a, b, c, d, e and f' lead from the valve to the various air rams 90.

For purposes of illustration, it will be assumed that three grades of coarse aggregate material are required in the final mixing and are to be cooled by the spray bin equipment at the installation 30. These materials have been designated as fine, intermediate and coarse, respectively.

The material placed on the conveyor 38 is elevated to the tower structure of the spray bin assembly from whence it may be distributed to the various aggregate compartments 64 by proper manipulation of the pivoted distributor hopper 62. Two adjacent compartments 64 may be filled with the coarse material, two other adjacent compartments may be filled with the intermediate material, and the remaining two compartments may be filled with the fine grade of material. After compartments 64 have been filled, all of the shut-off valves 83 may be opened and coolant water allowed to flow simultaneously onto the aggregate in all of the compartments. The length of time during which this simultaneous spraying is maintained will vary for different sizes of aggregates. However, many installations will accommodate cyclic operation of the apparatus in such a manner that a quantity of aggregate equal to the entire capacity of all of the bins passes from the stock pile to the final mixing plant during the course of approximately one hour and ten minutes following ten minutes for the material in transit. This involves an hourly cycle of operation for the spraying bin assembly and such cyclic operation of the apparatus will accommodate a large variety of conditions. For illustrative purposes, however, an instance has been selected wherein the temperature of the aggregate arriving at the tower of the spray bin assembly is between 70 and 80° F. and wherein a reduction in the temperature of the aggregate to approximately 43° F. is required when the cooled aggregate reaches the mixer storage bins at the mixing station 10. Obviously for certain other conditions the machine may be run on a faster or slower cycle or the hourly cycle may be maintained and the spraying and draining time for the aggregate may be varied.
For descriptive purposes, in Figs. 1 and 3, the six aggregate compartments have been labelled A, B, C, D, E, and F reading in a clockwise direction. The compartments A and B may contain the coarser aggregates, the compartments C and D may contain the intermediate aggregates, while the compartments E and F may contain the smaller aggregates.

Under the conditions outlined above and assuming that the apparatus is to be operated upon the basis of an hourly cycle wherein material issuing from the stock pile will arrive at the mixing plant in the course of one hour and ten minutes, it may be assumed that five minutes will be required for passage of the material from the stock pile to the various aggregate compartments and that another five minutes must be allowed for passage of the cooled material along the inclined conveyor to the mixing plant. This leaves a full hour for treatment of the material in the precooling apparatus. It has been found that in order to effectively reduce the temperature of the coarsest fractions, the bins A and B to the desired low temperature, approximately fifty minutes of spraying time will be required. For the intermediate grade of aggregate in the bins C and D, forty minutes may suffice. For the relatively small aggregate in the bins E and F, one-half hour of spraying time is sufficient.

After the preliminary, simultaneous spraying of the aggregate compartment and the various bins 64, and immediately prior to the commencement of regular mixing operations at the mixing plant, the spray bin apparatus may be started upon its regular hourly cycle basis. Thus after the coarse aggregates in the bins A and B have been sprayed by the cooler fluid for approximately twenty minutes, the shut-off valve 83 of the compartment A is completely closed and this compartment is allowed to drain for approximately ten minutes, after which time the ground operator, by manipulation of the valve V, may open the clamshell gates 66 associated with this compartment and allow the drain fluid to run out through the collector cone 68 beneath the gate. The material which passes through the collector cone 68 is deposited upon the shaker screen 70 and the aggregate is thereby further relieved of a large portion of its remaining moisture content and also of any silt or sediment of small size which passes through the screen, and this material is directed by the imperforate screen tray 72 to the waste pond 48.

The sprayer may then perform the necessary operations for draining the material in the compartment B which also contains relatively coarse aggregate. Thus, by opening the valve 83 associated with this compartment, the supply of coolant water issuing to this compartment is completely shut off and the aggregate is allowed to drain for approximately ten minutes after which time the gates 66 are opened and the material therein is emptied into the collector cone 68 for conduction to the shaker screen 70.

The purpose of the shaker screen 70 is to provide a more uniform moisture content of the aggregate before it is conveyed to the mixer plant. The shaker screen is designed to throw off, to a large extent, the surface moisture remaining on the aggregate materials. The screen mesh of the shaker screen is sufficiently small as to serve for all sizes of material issuing from the aggregate compartments.

As soon as the cobble material has been discharged from the cobble compartment A, this compartment is then ready to receive another charge of the material. As regards the two compartments A and B, the alternate spraying operation lasting approximately fifty minutes and the draining operation lasting approximately ten minutes is carried out continuously.

Treatment of the intermediate material in the compartments C and D is similar to that in the compartments A and B with the exception that the spraying and draining portions of the regular cycle are varied slightly. Inasmuch as it does not require quite as long a period of spraying time to reduce the intermediate aggregate to the desired low temperature, this aggregate may be subjected to the spraying operation for approximately forty minutes. By the same token, the intermediate aggregate, since it is possessed of smaller interstices, will require a longer period of draining time and thus the operations performed upon the large aggregate in the compartments A and B may likewise be performed upon the compartments C and D utilizing a forty minute period for spray and a twenty minute period of drain to complete the regular apparatus cycle.

The spraying and draining of the materials in the compartments C and D may likewise be conducted alternately just as in the case of the compartments A and B.

In a similar manner, the fine material in the compartments E and F may be conducted simultaneously with the treatment of the intermediate material and with the treatment of the coarse material. However, due to the smaller interstices of the fine material in the compartments E and F, a shorter spraying time of thirty minutes and a longer draining time of thirty minutes is resorted to thus completing a regular cycle for the small aggregate.

From the above description it will be seen that the coarse material in the compartments A and B, the intermediate material in the compartments C and D, and the fine material in the compartments E and F are subjected to alternate, but different, periods of spraying and draining time, respectively, and that the operations on these pairs of compartments are conducted simultaneously so that once during each hour cycle of the apparatus as a whole, a discharge of the partially drained material from each individual compartment to the collector cone takes place. It is not necessary that any definite pattern of sequential operation as regards the six compartments be placed in effect although for smooth and continuous operation it is contemplated that the various spraying and draining operations be resorted to may take place according to a predetermined time chart. As the character of the aggregate reaching the spray bin assembly varies slightly from time to time, the operator will in his best judgment vary the period of spraying time, of draining time, or both, to attain the desired low temperature and moisture content of the materials leaving the mixing plant and deposited upon the conveyor 25 leading to the main mixing plant.

In the timing chart of Fig. 6, a purely arbitrary and more specific hour schedule has been illustrated for an installation calling for approximately forty-five minutes spraying time for each of the coarse cobble aggregate compartments A and B, approximately ten minutes draining time, four minutes filling time, and allowing one minute discharge time; forty minutes spraying time for each of the intermediate cobble aggregate compartments C and D, fifteen minutes draining time, with the same filling and discharge time being allotted therein; and approximately thirty minutes spraying time and twenty-five minutes draining time for the smaller cobble aggregate compartments E and F.

As previously described, the preliminary setting-up time consumes approximately one hour. This includes simultaneous spraying of the aggregates in all of the compartments 64. When cyclic operation is in effect, a short period of time, for example two minutes, is allowed for discharging of the first compartment A and three minutes may be allowed for the refilling thereof. At five minutes in the cycle the spraying of the coarse material in the compartment A may commence and about this time the pivoted distributor 36 may be switched over to deliver sand to the bypass conveyor 40. The spraying operation continues until fifty minutes in the cycle when the draining of the cobble material in the compartments C and D, utilizing the valve 83 which controls the spraying of the compartment A. At the end of the cycle the gate 66 of the compartment A is opened to discharge the contents thereof
and the discharge consumes approximately two minutes in the next succeeding cycle.

While the compartment A is thus being treated, compartment B along with a coarse cobbled material receives its spraying operation from fifteen minutes in the first cycle until the end of the cycle and the draining operation is conducted during the first ten minutes of the next cycle. Discharge of the compartment B takes place at ten minutes in the succeeding cycle and recharging thereof takes place within fifteen minutes in this latter cycle. The operations for compartments A and B are continuous throughout the various cycles.

The treatment of intermediate materials in the compartments C and D is substantially the same as for the compartments A and B with the exception that the period of spraying time involved is forty minutes with a fifteen minute period for draining as shown in the chart. Similarly, the treatment of the fine materials is shown in the chart as involving thirty minutes for the spraying operation and twenty-five minutes for draining time. In the case of each grade of material, the same alternate or staggered spraying and draining periods are maintained with the treatment accorded the three grades of materials overlapping one another.

It is to be noted that the conveyor 34 leading from the stock pile 32 is in intermittent operation, supplying sand and a permeable gate at the corners of the compartments alternately, in alternate fashion. As shown in Fig. 2, the cooling plant 30 and conveyor 40 discharge to a common point or collecting station on the conveyor 28 which thus carries at alternate times both the untreated sand and the cooled aggregate. That is, the conveyor 28 leading to the mixing plant 10 is in substantially continuous operation supplying the discharged precooled materials or the untreated sand alternately to the mixing plant 10. The deflector plates 67 and the clamshell gate 66 operate under the same controls and the plates 67 direct expended coolant water to the surge tank 44 each time the gates 66 corresponding thereto are closed during the spraying and the draining periods of the respective compartments.

By practicing the invention as hereinafter presented, there is obtained a synchronized control of the movement of the batched materials supplied from the stock pile 32 in conjunction with the batch charging with the precooling plant and the batch charging device 17 at the mixing plant, and also in conjunction with the conveyor belts employed in connection with the invention. By following the predetermined sequence of operations, the possibility of over-charging the aggregate compartments or any of the receiving compartments is effectively supplied and minimized. In this manner, the various aggregate charges are properly separated in transit to and from the precooling apparatus 30 as well as being properly separated while undergoing cooling treatment.

I claim as my invention:

1. A cyclically operable method of precooling a plurality of aggregates of different sizes prior to mixing the aggregates to form concrete, each cycle of said method comprising the steps of assembling segregated quantities of the aggregates, spraying the aggregates with cold water for different fractions of the cycle in proportion to the sizes of the aggregates, draining the respective aggregates for the remaining portions of the cycle, said remaining portions thereby being inversely proportional to the sizes of the aggregates, and removing said quantities of the aggregates after draining, said spraying being initiated for the respective aggregates in a staggered rotation throughout said cycle so that said assembling and removing operations for the respective aggregates will also be staggered along said cycle.

2. In an apparatus for precooling concrete aggregates, a series of closely grouped aggregate compartments, a liquid permeable gate at the bottom of each compartment operable when closed to retain aggregate in the compartment while permitting drainage of liquid therethrough, a collector funnel common to all of said gates for receiving the discharged aggregate from the various compartments when their respective gates are opened, a movable deflector plate disposed beneath each gate and movable to selectively direct material discharged from its respective compartment into said funnel or to divert the same from the latter, means operatively connecting said gates and deflector plates for positioning the latter in their material-diverting positions when the gates are closed, means for selectively spraying coolant liquid over the aggregate in each compartment, and means for opening and closing said gates.

3. In an apparatus for precooling concrete aggregates, a series of closely grouped aggregate compartments, a liquid permeable gate at the bottom of each compartment operable when closed and retain aggregate in the compartment while permitting drainage of liquid therethrough, a collector funnel common to all of said gates for receiving the discharged aggregate from the various compartments when their respective gates are opened, a shaker screen disposed beneath said collector funnel, a movable deflector plate disposed beneath each gate and movable to selectively direct material discharged from its respective compartment into said funnel or to divert the same from the latter, means operatively connecting said gates and deflector plates for positioning the latter in their material-diverting positions when the gates are closed, means for selectively spraying coolant liquid over the aggregate in each compartment, means for opening and closing said gates, and means for actuating said shaker screen.

4. In an apparatus for precooling concrete aggregates, a series of sector-shaped aggregate compartments arranged in closely grouped relationship about a vertical axis, being a drain and discharge opening at the bottom of each compartment, a liquid-permeable gate for each drain and discharge opening and operable when closed to retain aggregate within the compartment while permitting liquid to escape therethrough, said apparatus comprising a precooling station located intermediate said stock pile and said mixing plant, said apparatus comprising a precooling station located intermediate said stock pile and said mixing plant.
tributing station located intermediate said precooling plant and said stock pile, a first conveyor extending from the stock pile to said distributing station, a second conveyor for coarse aggregates extending from said distributing station to said precooling plant for delivering coarse aggregates thereto, a collecting station positioned adjacent said precooling plant, a third conveyor extending from said distributing station to said collecting station for delivering fine aggregates to the latter, a fourth conveyor leading from said collecting station to said mixing plant, a distributor element adjacent the forward end of said first conveyor movable from one extreme position wherein aggregate issuing from said first conveyor is directed onto said second conveyor to another extreme position wherein the aggregate is delivered to said third conveyor, means at said precooling plant for effecting cooling of the aggregate delivered thereto, means for discharging cooled aggregates from said precooling plant directly onto said fourth conveyor, and means for selectively operating said distributor element.

7. In an apparatus for precooling a plurality of different concrete aggregates, the combination comprising an elevated bin having a plurality of compartments for holding quantities of the different aggregates, means for filling said compartments in rotation with the different aggregates, said compartments having respective gates for discharging the aggregates from said compartments in rotation, means for selectively spraying cooling water over the aggregates in said respective compartments for cooling the aggregates, the water draining out of said compartments, means for collecting the aggregates from said gates, and means for diverting the draining water from said last mentioned means.

8. In an apparatus for precooling a plurality of concrete aggregates of different size grades, the combination comprising an elevated bin having a plurality of compartments for holding quantities of the different aggregates, a conveyor for raising the aggregates to the top of the bin, means for selectively loading said conveyor with any of the different aggregates, means for selectively directing the aggregates from said conveyor into any of said compartments to fill said compartments in rotation with the different aggregates, respective gates at the bottoms of said compartments for discharging the different aggregates therefrom in rotation, means for selectively spraying cooling water into said compartments for cooling the aggregates in rotation, said gates being liquid permeable so that the water will drain therethrough from said compartments, a collector funnel underlying all of said gates for receiving the cooled aggregates therefrom, said compartments having respective diverting means operative when said gates are closed to divert the water from said funnel, a shaker screen for receiving the aggregates discharged by said funnel and removing excess water from the aggregates, means for conveying and carrying off the cooled aggregates from said shaker screen, and means for carrying off the water from said diverting means.

References Cited in the file of this patent

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Inventor</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>715,671</td>
<td>Oliver</td>
<td>Nov. 18, 1902</td>
</tr>
<tr>
<td>1,304,619</td>
<td>Stamp</td>
<td>May 27, 1919</td>
</tr>
<tr>
<td>1,704,268</td>
<td>Venable</td>
<td>Mar. 5, 1929</td>
</tr>
<tr>
<td>1,828,458</td>
<td>Butler</td>
<td>Oct. 20, 1931</td>
</tr>
<tr>
<td>1,871,166</td>
<td>Fahrbach</td>
<td>Aug. 9, 1932</td>
</tr>
<tr>
<td>2,138,277</td>
<td>Johnson</td>
<td>Nov. 29, 1938</td>
</tr>
<tr>
<td>2,276,471</td>
<td>Eberhart</td>
<td>Mar. 17, 1942</td>
</tr>
<tr>
<td>2,397,959</td>
<td>Gephart</td>
<td>Apr. 9, 1946</td>
</tr>
<tr>
<td>2,480,727</td>
<td>Greyson</td>
<td>Aug. 30, 1949</td>
</tr>
</tbody>
</table>