

Aug. 27, 1929.

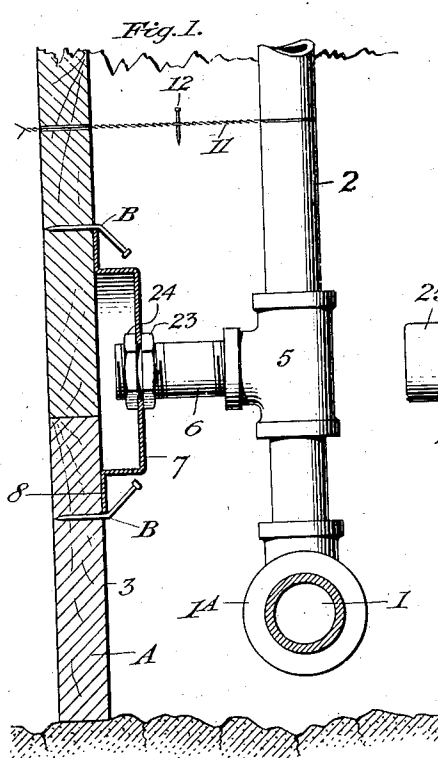
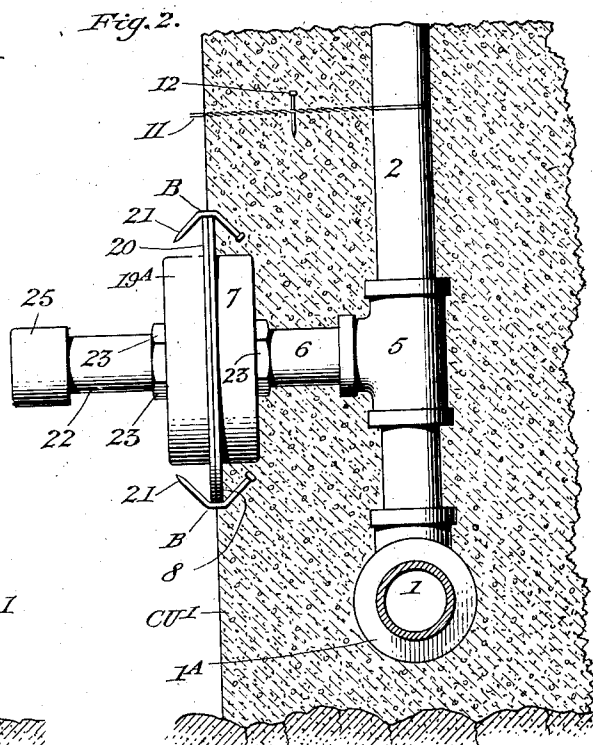
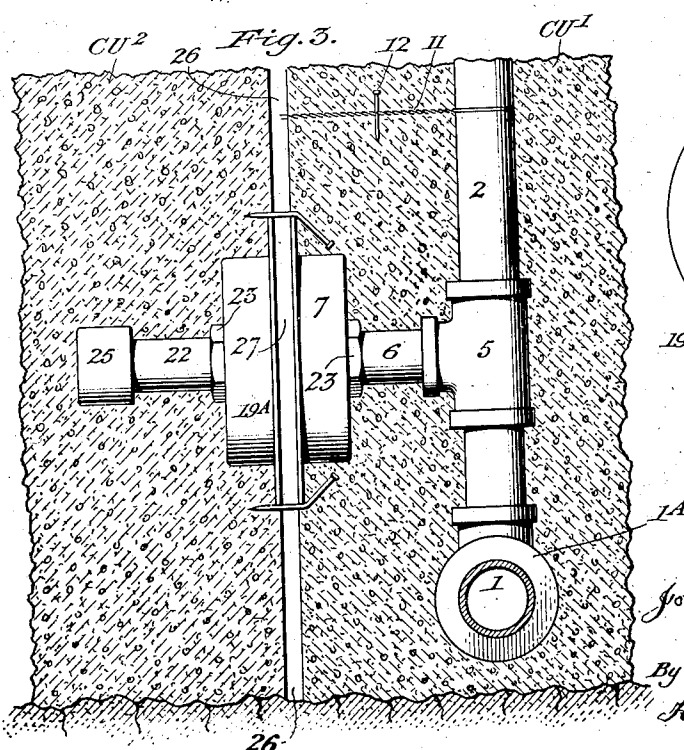
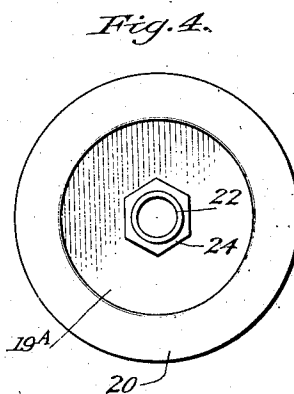
J. L. SAVAGE.

1,726,414

METHOD AND APPARATUS FOR GROUTING CONCRETE STRUCTURES

Filed Jan. 16, 1928

3 Sheets-Sheet 1



Inventor
John L. Savage.

By
H. S. Bailey, Attorney.

Aug. 27, 1929.

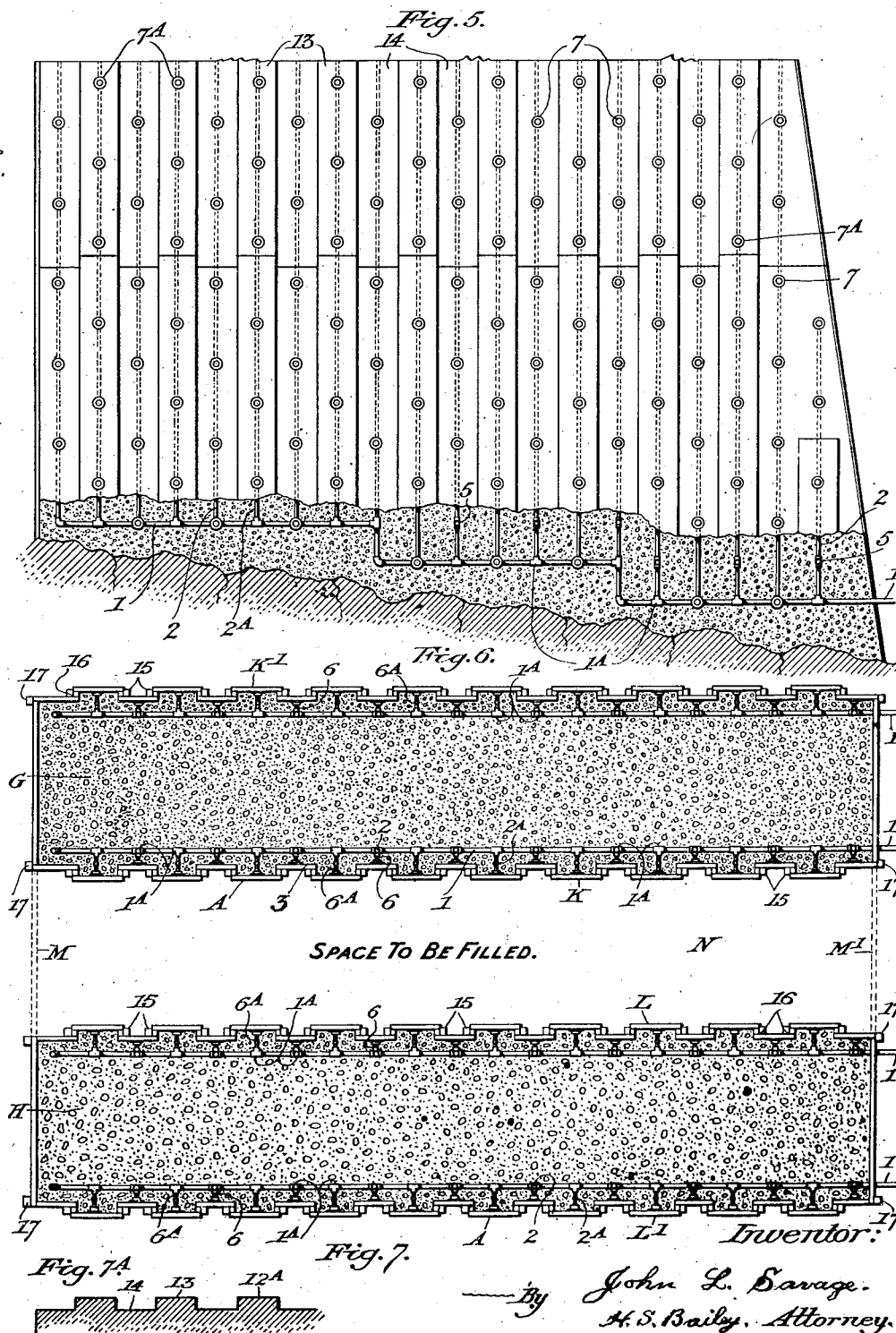
J. L. SAVAGE

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3 Sheets-Sheet 2



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METHOD AND APPARATUS FOR GROUTING CONCRETE STRUCTURES

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3 Sheets-Sheet 3

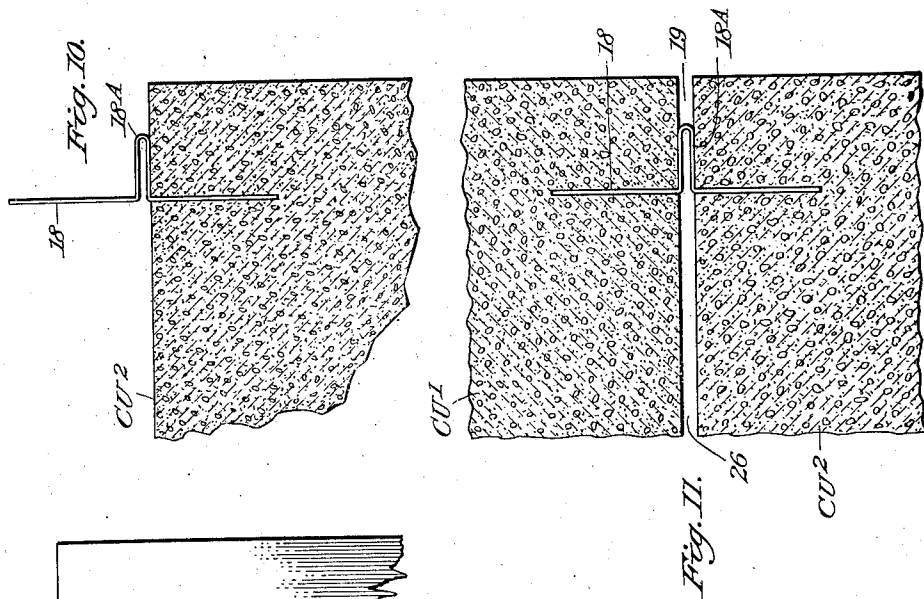
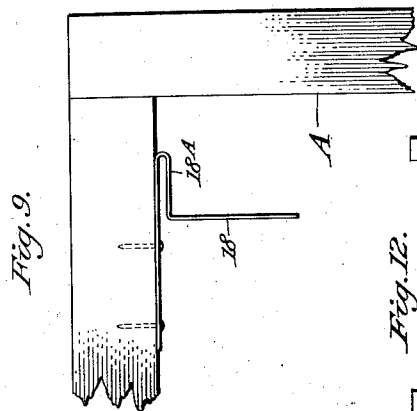
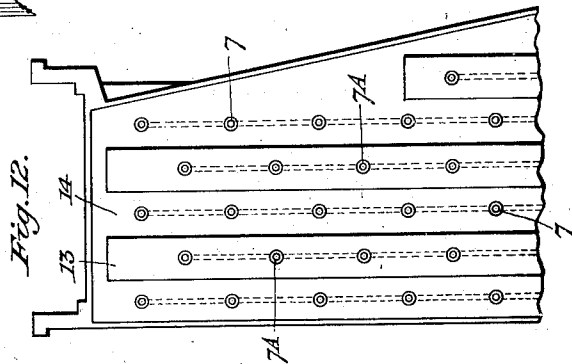
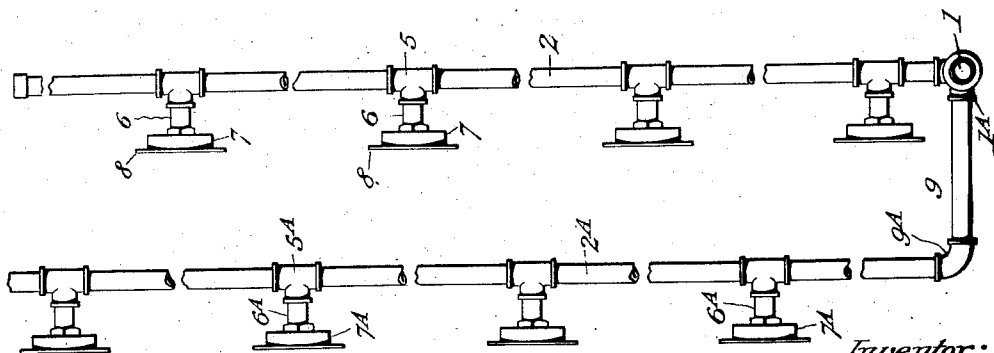


Fig. 8.

Inventor:

By John L. Savage.
H. S. Barby, Attorney.

Patented Aug. 27, 1929.

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UNITED STATES PATENT OFFICE.

JOHN L. SAVAGE, OF DENVER, COLORADO.

METHOD AND APPARATUS FOR GROUTING CONCRETE STRUCTURES.

Application filed January 16, 1928. Serial No. 247,045.

My invention relates to a new system and apparatus for introducing suitable grouting material into contraction joints or construction joints of concrete structures in the course of their erection, or, after their completion, and to avoid the attendant difficulties, uncertainties, and heavy expense which the use of the methods and equipment at present available entail.

It is well known to those skilled in the art that concrete contracts in setting and particularly when subjected to low temperatures and that any long concrete structure will develop transverse cracks at frequent intervals throughout its length as a result of this contraction. It is possible to control the location and extent of these contraction cracks by providing frequent joints in the concrete which in the terminology of the art are called "construction joints" or preferably "contraction joints." While these contraction joints are necessary and desirable for the purpose of pre-determining the location and direction of the contraction cracks they introduce planes of weakness through the concrete structure which are undesirable for structural reasons as compared with a monolithic structure. In order to minimize this structural defect and to strengthen these planes of weakness it has become the practice of engineers to require that all contraction joints in important concrete dams and other massive structures be filled under pressure with Portland cement grout or other cementing material at a time when the structure is at the lowest temperature and the contraction joints have the maximum opening. By this means the separate parts or units of the structure are cemented together, forming practically a monolithic structure. The grouting of vertical contraction joints in this manner is of particular importance in the case of concrete arch dams where it is essential to fill the joints with a strong grouting material in order to form a continuous arch cylinder to receive the arch thrust, and transmit it into the canyon walls through the abutments at each end of the dam.

In order that all contraction joints in a concrete structure may be filled up in such a manner that the two closely adjoining parts or units may be bonded integrally together, some continuously connected conduit system must be provided that will form the passageway by which the cementing fluid

or grout can be discharged under pressure into the contraction joints between each adjoining pair of concrete units.

My invention contemplates in the accomplishment of these results the use of any system of operative procedure, and any arrangement of pipes or conduits that are embedded in the body of the concrete at a distance far enough back from the formed face to provide convenient and rigid attachment to the forms and to insure their proper protection by embedment in the concrete, and any system or arrangement of pipes, which provide closed conduits for leading the cementing fluid or grout to predetermined points along the contraction joint between different units of a concrete structure.

In the accompanying sheets of drawings I have illustrated my invention applied to a large dam, but it will be understood that the specific form of its application as herein illustrated is illustrative of the principle of the invention, and is capable of being varied to suit the type of structure in which it is to be employed or utilized.

The objects of my invention are:

First; to provide a conduit system and apparatus for grouting the construction joints or contraction joints which will occur between different parts of a concrete structure of large dimensions such as a massive concrete dam or retaining wall in which one or more parts or units of the structure are built up progressively to partial or full height and allowed to harden in advance of the other parts or units of the structure which are later poured against the formed faces of the parts or units first built.

Second; to provide a conduit system and apparatus for grouting concrete structures whereby the shrinkage and temperature cracks developing between the different parts or units of the structure, which have been poured at different times, are grouted under pressure with cement grout and strongly bonded to form them into one integral whole.

Third; to provide a simple, inexpensive, easily erected grouting system of sufficiently rigid construction to remain in place while the concrete structure is being poured and which will be effective in thoroughly filling all contraction joints when the pressure grouting operation is performed.

Fourth; to provide a conduit supplying, distributing and introducing system and apparatus which can be progressively installed

unit by unit as the forms for each successive vertical increment of a large concrete unit are erected upon and above the concrete previously poured and seasoning, and thereby avoiding any necessity of following any special erection and construction programs from those which would be followed were a grouting mechanism not used.

Fifth; to provide a plurality of conduits communicating independently between predeterminedly positioned points of entry into the space to be grouted or filled, and the outside source of supply where the grouting material is introduced under pressure, with said plurality of communicating conduits entirely embedded and contained within the concrete first poured and seasoned, and thereby effectually protected from injury during the period of construction of the adjacent concrete units on either side.

I attain these objects by the mechanism and system illustrated in the accompanying drawings, in which:

Figure 1 is a vertical sectional view, showing a fragment of the wood form or lagging for confining a unit or part of the concrete structure, in connection with a grout supplying header pipe (1), a riser pipe (2), a horizontal nipple (6), and a conduit outlet box (7) through which grout is forced into the contraction joint.

Figure 2 is a vertical sectional view of a portion of a finished concrete unit, showing the embedded grout supplying pipes and conduit outlet box and a similar conduit outlet box secured on the embedded outlet box.

Figure 3 is a vertical sectional view through portions of two finished and hardened concrete units, showing the contraction joint (26), between the units, and the separated conduit outlet boxes through which the grout can flow from the supply pipes to the contraction joints.

Figure 4 is a front view of one of the conduit outlet boxes.

Figure 5 is a side view partly in section of a structural concrete unit, showing the grout supplying header pipe (1), embedded therein, the riser pipes (2), connected therewith and the conduit outlet boxes (7) which are connected by short pipes or nipples (6) with the riser pipes, the unit having the appearance it presents when ready for the pouring of an adjoining unit or part of the concrete structure.

Figures 6 and 7 are plan views of two wooden forms confining two concrete units or parts of the concrete structure, showing the embedded grout conveying pipes connected to the forms, the two units being separated by a space to receive a third unit after the first and second units have hardened.

Figure 7^A is a plan view of a fragment of one of the concrete units, showing the con-

figuration of one of the side faces thereof.

Figure 8 is an end view showing the manner of connecting the two sets of riser pipes with a common header pipe.

Figure 9 is a plan view of a fragment of a concrete-holding form, showing a metal strip secured to one side thereof which later closes the contraction gap between two adjoining concrete units.

Figure 10 is a plan view of a portion of a hardened unit, and the gap-closing strip partially embedded therein.

Figure 11 is a plan view of fragments of two hardened units, showing the contraction gap between them, and the gap-closing strip partially embedded in each unit; and

Figure 12 is a side view, showing the upper portion of the unit illustrated in Figure 5.

Referring now to the drawings the apparatus I employ to accomplish the objects of my invention consists of a header pipe 1, which is placed horizontally or approximately so at the lower confines or bottom edge portion of each of the contraction joints, being set preferably parallel thereto, and to this header pipe 1, I secure at predetermined distances apart, along its length, the lower ends of pipes 2, which I term riser pipes, and they extend up vertically and parallel to the inside face 3 of the wooden lagging form A, which will be the face of the concrete unit or block of concrete along which the contraction joint is to occur to the top surface of the completed structure.

In the preferred construction of the header and riser pipes 1, 2, and 2A respectively, the header pipe is preferably 1 inch in diameter and riser pipes are preferably one-half inch in diameter, and are made of any predetermined length, and the sections are connected by T's 5 and 5A respectively. To the T's 5, are threaded nipples 6, which project horizontally from the T's, and to the outer end of each nipple 6 is secured a dish shaped cup 7, that is provided with a circular flange 8, and the cup 7 is adjustably secured on the end of the nipple 6 by lock nuts 23 and 24, as this arrangement allows the cup to be adjusted on the nipple 6, so that the face 8, of its flange, can be screwed up tight against the inside surface of the inner face 3 of the form A.

My invention contemplates the securing of the flange 8, of the cup up against the inside face 3, of the form A, by any suitable means; but I preferably secure it to the inside face of the form with nails or similar suitable attachments substantially as shown in the accompanying drawing at B. I preferably have the vertical riser pipes 2 and 2A made in a number of units whose equal lengths each is slightly shorter than the desired vertical distance between the horizontally positioned nipples 6 that communi-

cate with the dish or cup pieces 7 and 7A which are fastened to the inner face 3 of the walls of the forms A and their opposing ends are attached to the horizontal nipples 6, whose opposite ends are screwed into the T fitting 5. This unit method of assembly and emplacement is particularly well adapted to structures of the largest size and also permits making the lengths of the units composing the riser pipes such, that, if the structures wherein they are used be so great as to necessitate several successive pourings of concrete in vertical sequence one above another with the successive raising of the forms after each pour, these lengths will either singly or in multiples equal the amount that the forms are raised in these progressive steps of pourings required to reach the final completed height of the structure. In addition to the support afforded the vertical riser 2 by the horizontal nipple 6 connecting to the cup or dished piece 7, I place a double wire 11 around the riser pipe 2, above the T 5, and pass these wires through the wall of the form A, and tie their protruding ends firmly together. I then insert a suitable nail 12 or bar through the parallel pair of wires about midway between the form and the riser pipe and by turning the nail or bar in a plane at right angles to the common axis of the wires, twist the wires around each other tightly, and this twisting causes a tension to exist in the wires, which pulls against the riser pipes, and this pull is resisted by the horizontal nipple 6, connecting the riser 2 to the cupped dish pieces 7 against the inside surface 3 of the wall of the form A, so that by means of the cupped piece 7, with its horizontal nipple 6, connecting it to the riser pipe 2, and the twisted wires 11 pulling against this horizontal thrust resisting nipple member 6, and the similar treatment of the other like units in the same manner, make and comprise a strong rigid structure for the purpose intended, which can be built up readily as fast as the forms are erected, and will remain fixed in the predeterminedly selected and erected positions while the concrete is poured into the completed forms and thereafter as well. The header pipes 1, are made up of sections of pipe connected by T couplings 1A, the alternate T couplings having their center openings pointing outward, and to these latter couplings are connected relatively short horizontal pipes 9, to the outer ends of which are attached either T couplings or elbows 9A, the elbows being shown in Figure 8, and to the elbows are connected the riser pipes 2A, made up of pipe sections and T couplings 5A, and to these couplings are connected nipples 6A to which are connected flanged cups 7A similar to the cups 7 on the nipples 6. The risers 2A are about nine inches to the outside of the risers 2; and

the cups 7A alternate with respect to the positions of the cups 7 as clearly shown in Figure 5. The purpose of the double row of risers, will hereinafter appear.

Two header pipes 1 extend along the opposite sides of each unit of concrete to be made as shown in the plan view Figure 6, and a large number of riser pipes 2 and 2A, are connected to the top of these two header pipes 1, and to the horizontal pipes 9 respectively, and are placed at any predetermined distance apart. Both of the header pipes and all of the riser pipes 2 and 2A, are installed inside of the forms A, as soon as they are erected, for those units of the structure which are to be poured first, and are positioned a reasonable distance back from the face 3 of the form A which produces the contraction joint face, so that when the forms A are filled with concrete, the header pipes 1, and the riser pipes 2 and 2A, are completely surrounded and embedded within the concrete.

In laying out a unit of concrete, I preferably form its border outline along its sides into a continuous succession of corrugations 12A, the surface of each of which is preferably equal in length, that is, the flat straight surface 13 of the projecting portions of the corrugation are equal in length to the length of the flat straight surface 14 of the recessed portions of the corrugations, as shown in Figure 7, and this outline of the border or boundary of each unit necessitates that the form A be also built in this corrugated outline and in its construction vertical posts 15 or studding is placed at the intersecting of the parts of the form A at its inside corners 16, and at those vertical end portions 17 of the form A, which prescribe the opposite outside edges of the contraction joint in a vertical plane. I insert bands of metal 18 or other suitable material having V-shaped folds 18-A along the central portion of their widths, with their folded portion resting against the contracting joint forming faces of the forms which in this case would be the outside surface of the form A, the purpose of these bands being to form a stop which will later prevent the grout from escaping from along the contraction joint faces at the opposite corners 19 of the entire height of the unit.

The corrugations 13 and 14 in the form A, of the concrete units G and H of Figures 6 and 7 that are opposite to each other form a continuous tongue and groove surface throughout practically their entire length; and assuming that these two units G and H which are defined by the opposite forms K and K¹ of the unit G, and the opposite sides L and L¹ of the form H, have been poured and have hardened, then by closing up the opposite ends M and M¹ of the space N, this space or unit N can be poured, and when

it is poured the concrete flows into the vertical groove members against the surfaces 14, that define the depth of these grooves; and this tongue and groove construction of new units between hardened units results in the new units being rigidly locked by these numerous tonguelike keys that enter the hardened units, against any possible movement whatever from down stream pressures that would flow against its upstream end, as the units in dam construction are placed transversely across the length of the dam, but the units can be arranged in any other predetermined positions relative to the length and breadth of other kinds of concrete work.

After the concrete has been poured and has set, the forms are removed in the usual manner, and the form facing portions of the cup-shaped dish pieces are then exposed with their flanged edges flush with the surface of the concrete and the ends of the nails which held and secured them to the forms are now left protruding from the concrete.

I now place another set of cups 19A, that are also provided with flanges 20 that are identical in shape and size with those cups 7 that are now embedded in the concrete, against the faces of their flanges 8, and by bending the protruding ends 21 of the nails B over the peripheral edge of this opposing cup member 19A, I secure them firmly in place against the cup pieces 7 carried by the concrete as shown in Figure 2.

Into the middle diameter or central portion of each of this second set of cup pieces, I place or insert a pipe nipple 22 into a threaded or unthreaded hole in the center of the cup piece provided for that purpose, and secure the nipple 22 by screwing a locking nut 23 against the outside surface of the cup piece 19A, and in case the hole is unthreaded a similar nut 24, see Figure 4, can be screwed onto the end of the nipple 22 against the opposite inside surface of the cup piece as well. On the outer end of this pipe nipple 22, I screw a cap 25 to close its open end. This protruding nipple 22 with its cap 25 forms an anchorage for their cup piece 19A to rigidly secure it in the concrete which will later be poured around it.

After each of the flush embedded cup pieces 7 in the concrete first poured has had attached to it its opposing mating cup piece 19A, with its anchoring nipple 22 and cap 25, the concrete can then be poured as soon as the side forms for this adjacent unit are erected and are connected to the concrete units on either side already poured.

When this adjacent connecting concrete mass is first poured and while still in its workable semi-liquid and plastic condition, it is in intimate contact with the contraction joint faces of the seasoned concrete on either

side previously poured, but as it begins to set and harden, considerable rise in the temperature in the interior of its mass occurs, and as the process of hardening and setting enters into its final stages this temperature becomes less and less, and the drop in temperature produces a reduction in its mass and its physical dimensions, thus causing its outer confines to contract towards its center and those portions originally in contact with the mating face portions of the completed structure first poured on either side recedes from those faces, leaving an aperture or crack 26 between them and inasmuch as the cup pieces last placed with their nipples 22 and caps 25 are firmly anchored by these nipples and caps in this new contracting concrete, they also recede back from the flanged faces 8 of the cup pieces 7 embedded in the concrete first poured, so that this receding movement produces a gap between the faces of the mating cup pieces 7 and 19A, in the concrete unit CU¹ first poured and those in the concrete unit CU² last poured.

When this receding movement between the mating cup pieces occurs, it is resisted only by the bent nails 21 over their mating flanged edges, and these nails B consequently are straightened sufficiently by the relative movement of the mating edges, as shown in Figure 3 to accommodate this movement.

In Figure 1, I illustrate a complete fluid grout conveying unit set up within a form A and at a short but predetermined distance from it and with its cup member 7 secured to the inside face of the form A by the nails.

The cup member 7 is illustrated, adjustably mounted on the outer end of the horizontal pipe member 6 or 6A by means of the check nuts; consequently it can be forced tightly up against the inside surface of the form A by the outside check nut, and then the nails are driven into the form and then bent down over the peripheral edge of the flange 8 of the cup 7, and then the double wire 11 is applied to still further draw the top portion of the upper riser pipe towards the form, and then after the vertical part of the piping and the cup have been completely and properly adjusted, this unit would appear as illustrated in Figure 2.

Then the next step is to secure the cup member 19A to the face of the cup member 7, and as above described, and then pour this second unit with concrete, which after hardening having receded from that previously poured, then presents the condition as shown in Figure 3, which is now ready to receive the grouting material between the two masses of concrete, which is accomplished by pumping the grout into the header pipe 1 and forcing it into and between the two oppositely opposed but now slightly separated cups 7 and 19A, through the opening 27 between which the grout is forced throughout

the entire area of the crack 26 from its bottom portion to the top of it, and then as can be seen in Figure 3, the cup 19A, and its horizontal nipple 22 and its cap 25 are embedded rigidly in the mass of concrete CU² and the two masses or units of concrete are now integrally united into one monolithic block of concrete. In the construction of high dams, the units of concrete are so lofty that they have to be built up to their final height by a number of successive pourings, one upon one another; consequently there are horizontal joints between the units as well as the vertical contraction cracks that occur between those units that have set and hardened and the units that are poured afterwards against their sides, and in extending the riser pipes from their header pipes vertically upward through a high unit, I preferably place the cup members 8 feet apart, as illustrated in Figure 5, which enables form erection and the successive vertical pourings of the unit until its final height is achieved to be performed in an easy and simple manner, insuring that, by thus making the grouting system of vertical increments of equal length, it can be inserted within and fastened to the forms as fast as they are erected, and attached to the system in place below, contained in the concrete already poured and seasoning.

When the entire concrete structure has been completed, I have provided direct communication from the common header pipe 1, which I have placed in a parallel position to the bottom portion of each contraction crack 26, see Figures 3 and 6, through the vertical risers 2 and 2A, and the horizontal nipples 6 to the aperture 26 between each of the flanged edges of the opposing cup pieces 7 and 19A into the contraction joints or cracks 26, see Figure 3, separating the different concrete masses CU¹ and CU², comprising the completed units, and these communicating points are all predetermined, and exactly positioned, at intervals both vertically and horizontally, sufficiently close as to insure that when the grouting material is introduced under pressure from the exposed ends of the common headers at the bottom-most portions of those contraction joint apertures, that as this grouting medium rises from the lower portions towards the top portions of the structure, it drives out the air before its advance, through the top of the aperture and the exposed open ends of the riser pipes carried to the top of the structure for that purpose, filling every portion of the joint voids in its upward course and finally appearing at the top of the joints and beginning to overflow from the tops of the riser pipes, which are progressively capped off to prevent escape of the grout until the highest ones are reached, at which stage the pumping of grout into the bottom

header pipe is discontinued, the header plugged, and that particular joint is then complete as soon as the grout has set.

From consideration of the foregoing, it is evident that if, for any reason it should be found desirable or necessary to reverse the sequence of installation of the units of my invention in the forms with reference to that concrete poured in the first units of the structure, and that which is poured later, as herein described, that this can readily be done, and in so doing will in no way depart from the spirit, import and intent of my invention.

The same procedure of pumping grouting media of any suitable material under pressure into the bottom header pipes of each of the remaining joints in turn until each system has been entirely filled progressively from the bottom to the top is followed until all the joints are grouted. The work of grouting can be performed at any time after the concrete has hardened upon both sides of the joint or joints, but the best results are obtained when the concrete has a temperature below normal and has attained maximum contraction as in the winter.

When using cement grout, I preferably pump each space that forms the contraction crack 26, full of clear water before starting to introduce the grout, as this moistens all surfaces which the grout is required to bond, and insures that the grout will reach all portions of the voids in the crack with its proper free flowing consistency, which it would not otherwise retain were it progressively coming in contact with dry concrete and losing its moisture content by absorption therein.

While I have throughout the foregoing description referred to the contraction crack apertures as being in a vertical plane, my invention contemplates a similar and equally efficient use on those which may be required on other than vertical planes as well, and I accordingly include these contraction crack apertures which are often required and provided in other than vertical planes, as being within the spirit and intention of this application.

In the operation of my system and apparatus for closing the contraction cracks formed in concrete units while erecting them, the great value and the advantages of my arrangement and construction are:

That the filling or bonding mixture is introduced into the joint at predetermined separate points progressively from the bottom of the structure towards the top, insuring free escape of the air upwards from the ascending bonding mixture, avoiding any possibility of entrapped or imprisoned air or gases forming pockets or gaps where bonding could not otherwise occur, that the conduit system supplying the predeter-

mined points of entry into the joint is entirely removed from and separate from and independent of the joint aperture, thereby making certain the delivery of the bonding mixture to the predetermined points of entry into the joint aperture, that the size and cubical content capacity of the elements comprising my invention are materially less than any other similar invention now in use, and this consequent reduction in the amount of grouting medium required to fill my elements permits the grouting to be accomplished in a shorter space of time as less grout is required, and this time saving is of great importance, as it is essential that all the grout be in place before its setting and hardening cycle commences; that the headers, and vertical risers can be and are made from standard products obtainable from stocks and purchasable anywhere in the open market, that their size and points of interconnection can be varied at will to fit each individual application and condition, utilizing standard pipe, pipe T's, crosses, elbows, caps, etc., or standard electric conduit, conduit T's, crosses, elbows, caps, lock nuts, etc., such material of either type being readily and quickly obtainable from the main commercial centers throughout the world; that the same is also true for the dish pieces in the aperture faces, as these may be standard electric conduit box covers of pressed metal; that any or all of this material can be purchased in stock lengths and cut up in the field to meet the required conditions; that prolonged and costly delays necessitated by obtaining special connections from a remote and possibly single source of supply are eliminated; that the ease and celerity with which the various units can be assembled and installed in the forms is increased; and that the total expenditure of moneys required for attaining the desired result is greatly lessened; and that the results so attained are superior and preferable to that of any other arrangement now in use.

My invention provides an inexpensive system and apparatus for constructing and grouting concrete structures, as all of the materials I employ can be obtained at supply houses, and all of the materials I use can be quickly erected in position to receive the concrete, and while I have illustrated and described the preferred construction and arrangement of my system and apparatus for construction and grouting concrete structures I do not wish to be limited to the construction and arrangement shown, as changes may be made in it without departing from the spirit of my invention.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. Apparatus for grouting the contraction

joint between two concrete units, comprising a header and distributor pipes located in the space in which one unit is to be poured, means fixed to the ends of the respective distributor pipes and yieldingly secured to the forms defining the contraction joint face of the first unit to prevent concrete from entering the distributor pipes during pouring of the said unit, individual covers and means for yieldingly securing the same to the respective means on said distributor pipes after pouring of the said unit and removal of the forms, and means associated with said covers for fixing the same in the other concrete unit.

2. The invention as set forth in claim 1, wherein the said means in the distributor pipes comprise cup-shaped elements having their outer open ends contacting with the said forms.

3. Apparatus for grouting the contraction joint between two concrete units, comprising a header and a plurality of distributor pipes, fittings on the ends of said pipes and having flanges abutting against the forms defining the contraction joint face of the unit in which said pipes are embedded, covers yieldingly secured against the said flanged fittings to close said pipes, and means anchoring said covers in the second unit.

4. In apparatus for grouting the contraction joint between two concrete units, the combination with means embedded in the first unit and defining a header in the base portion of said first unit, vertical channels rising from said header, and a plurality of horizontal channels branching from said vertical channels and terminating flush with the joint face of said first unit, of individual closures for each of said branch channels, said closures being yieldingly secured to the first unit after stripping the forms therefrom, and means on said closures for securely anchoring the same in the second unit.

5. In apparatus for grouting the contraction joint between two concrete units, the combination with a vertical pipe in the first unit and spaced from the joint face thereof, a plurality of branch pipes extending from said vertical pipe towards said joint face, and flanged means on said branch pipes providing a temporary closure for said branch pipes during pouring of the first unit, of covers for cooperating with said flanged means after stripping of the forms from the first unit to close said branch pipes during pouring of the second unit, means for yieldingly affixing said covers to the respective flanged means, and means for anchoring said covers in the second unit.

6. In apparatus for grouting a contraction joint between two concrete units, the combination with a grout distributing pipe terminating adjacent the form defining the joint face of the first unit, a flanged fitting

on said pipe and engaging the form to close the end of said pipe, and nails partially driven into said form and having their outer portions bent toward said flanged means to hold the same against the form, of a cover for closing said pipe after said form is stripped from the first unit, and means on said cover for anchoring the same in the second unit, the nail ends exposed by removal of the form constituting means for yieldingly securing said cover to said flanged means.

7. In apparatus for grouting a contraction joint between two concrete units, the combination of a header within and adjacent the bottom of the space in which one unit is to be poured, vertical risers communicating with said header, branch pipes extending from said risers, flanged means on said branch pipes and means yieldingly holding said flanged means in contact with the surface against which said concrete unit is poured.

8. The invention as set forth in claim 5, wherein said flanged means comprise cup-shaped elements having peripheral flanges.

9. The invention as set forth in claim 5, wherein said flanged means and said covers

each comprise identical cup-shaped elements having peripheral flanges.

10. In a concrete construction of the type described, the combination with forms defining the contraction joint face of a massive concrete unit, of means for closing the end of the contraction joint, a header and vertical risers spaced from and positioned by said forms, branch pipes extending from said risers toward said forms, and outlet means on said branch pipes and having flanges contacting with said forms to close said branch pipes during pouring of the unit, said flanged means being permanently secured to said branch pipes and yieldingly secured to said forms, whereby upon separation of said forms and the concrete unit, said branch pipes are opened into the contraction joint space.

11. The invention as set forth in claim 10, wherein each of said joint closing means comprises a metal strip having lateral wings embedded in the concrete units and an intermediate V-shaped fold located in the joint space.

In testimony whereof, I affix my signature.

JOHN L. SAVAGE.