Dec. 16, 1941. R. S. CHARLES 2,266,000

WELL STRAINER

Filed Oct. 7, 1940

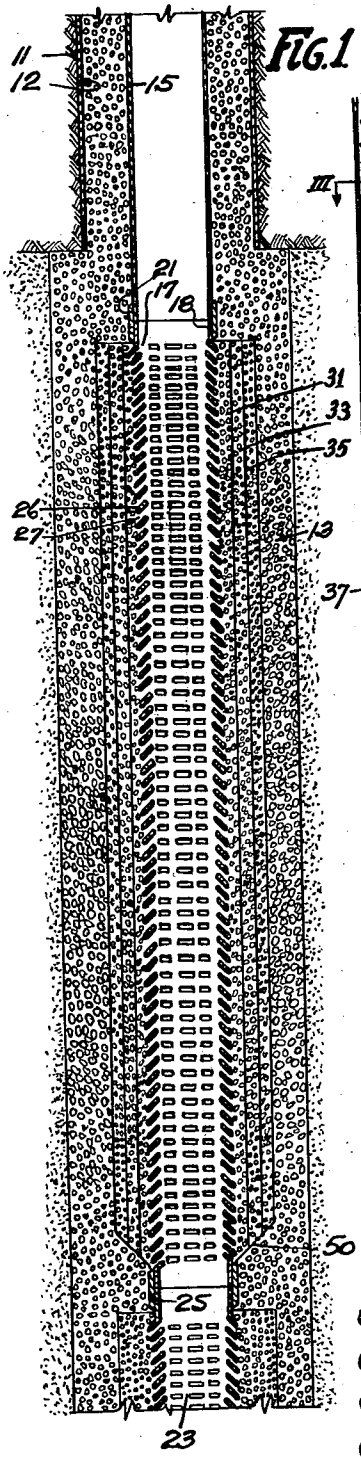


FIG. 1

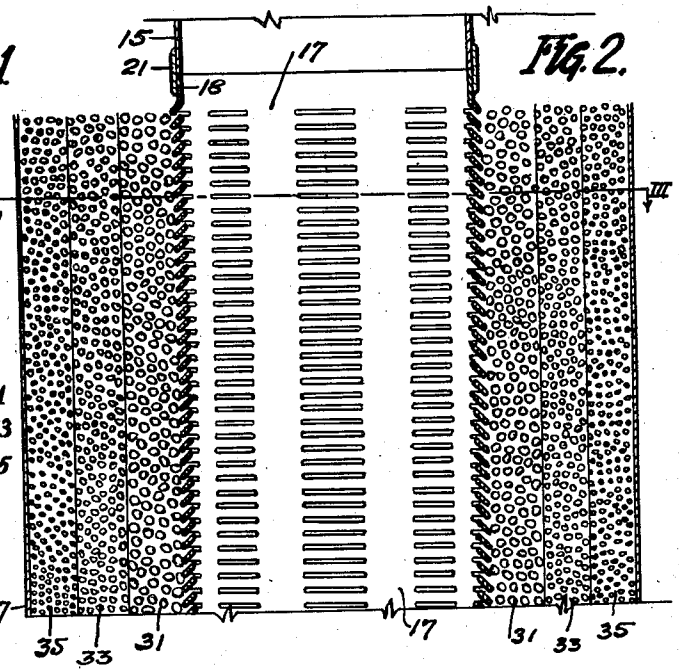


FIG. 2.

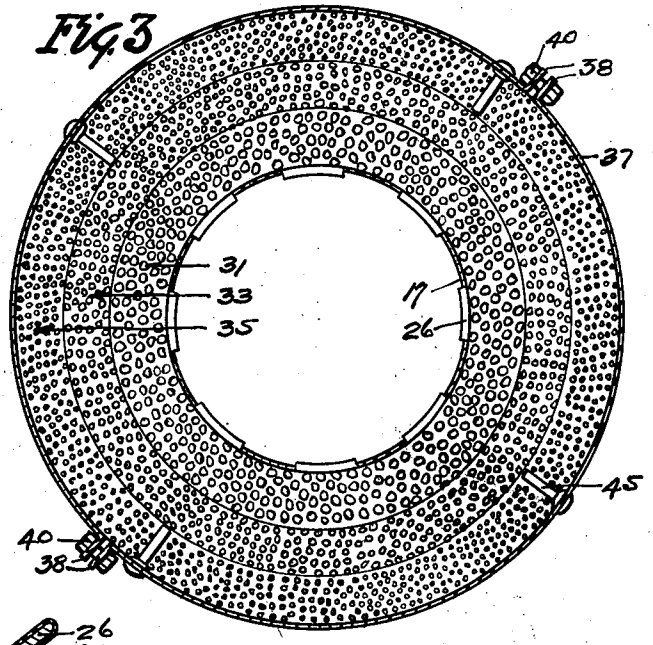


FIG 3

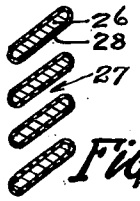


FIG 4.

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Patented Dec. 16, 1941 2,266,000

UNITED STATES PATENT OFFICE

2,266,000

WELL STRAINER

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Application October 7, 1940, Serial No. 360,043

5 Claims. (Cl. 166—5)

This invention relates to certain new and useful improvements in means and methods for surrounding well screens with aggregate such as gravel to accomplish an efficient strainer permitting large liquid flow yet holding back the sands from which the liquid is drawn, and particularly to means and methods for so placing the aggregate that it will be graduated progressively in size from the strainer outward to the surrounding liquid bearing sands to effect this accomplishment.

Much difficulty has been encountered in well building in that ordinarily the strata, from which the liquid desired is to be drawn, is a very fine sand, which will flow freely with the liquid through the openings of the usual screen unless such openings are so restricted as to seriously affect the well capacity. In combating this difficulty well builders have made extensive use of gravel as a supplementary screening medium around a coarse strainer or screen in the well to assist in retarding the passage of the fine sand or similar materials with the liquid into the pump suction pipe. The gravel or other aggregate of such medium should be largest adjacent the screen and should decrease in size progressively outward toward the sands, but great difficulty has been encountered in even approximating the desired structure, and even where it has been accomplished in part there is greatly undesired variation along the length of the strainer and at the best much uncertainty during construction as to what is being accomplished and thereafter as to what has been accomplished.

In usual "gravel well" practice a typical well is bored from the surface with a desired diameter, as say forty-two inches, and ordinarily cased to the level of the sand. When this bore reaches the liquid bearing sand a chamber is reamed out in the sand to an enlarged diameter, as say sixty inches. It is the walls of this liquid bearing sand chamber which present the difficulties in the art, as this sand must be held back away from the screen. After the chamber has been reamed, it is customary to lower into the bore an inner casing having a diameter of say eighteen inches, this casing having one or more sections of screen of the same diameter depending therefrom. The sections are ordinarily twenty feet long and are connected by short pipe sections or collars which are screwed or welded to rigidly connect the sections.

A sleeve, say twenty-eight inches in diameter and of sufficient length to extend from top to bottom of the screen is lowered therearound, and coarse gravel is fed from the surface through a pipe into the space between the sleeve and the screen until this space is substantially filled and packed. A second sleeve, of, say, thirty-eight inches in diameter and of length equal to that of the first sleeve, is then lowered around the first sleeve and a somewhat finer gravel is similarly fed into the space between the sleeves. If the size of the well bore permits, an additional sleeve or sleeves may be added, and each succeeding sleeve filled with a gravel finer than that used in the preceding sleeve. The remaining space in the bearing sand chamber outside the last sleeve is then filled preferably with a still finer gravel, this gravel extending a short distance upward between the two well casings above the screen to take up settlement and voids and subsequently the sleeves are removed.

In the use of this method several objectionable features have been disclosed which impair the effectiveness of the gravel protection and impede the efficiency of the construction. Among these are the fact that a substantial void is created between the strata of gravel upon removal of the sleeves causing slumping of the gravel strata which is often so uneven as to defeat the systematic graduation of gravel size outwardly through the successive strata and to large extent reduces the efficiency of the structure. The lowering of successive sleeves around the screen is a slow and laborious process and obviously requires a multiplicity of operations which can only be effected after the primary well bore has been completed. Ordinarily accurate centering of the sleeves around the strainer is to say the least difficult, resulting in irregularities and variations of thickness in the gravel strata. If to avoid this result spacing means are employed, the packing and weight of the gravel in the space between sleeves or between screen and sleeve makes the removal of the sleeve more difficult, creates additional void spaces, and usually disrupts the desired stratification of the sized materials.

This invention, therefore, has for its principal object the solution of these problems in the method of enclosing a well screen in gravel or other aggregate to accomplish a well strainer.

A further object is to provide a method of enclosing a well screen in aggregate, which enclosure will be completed upon the surface and prior to lowering the screen into the well.

A further object is to provide a method of accurately determining and fixing the aggregate

strata to protect and supplement a well screen.

A further object is to provide a method of creating of such aggregate strata and well screen a unitary strainer assembly, adapted for placing in position in a well; and

A further object is to provide a method of producing an aggregate protection for a well screen in which the aggregate is in strata of accurately determined size and content, around the well screen, when the strainer unit is completed in the well.

The means by which the foregoing and other objects of the invention are accomplished includes using a soluble bonding agent with which the aggregate is fixed around the screen, and also includes the casting around the screen of one or more annular shells, consisting of the aggregate and the soluble bonding agent, before positioning of such screen for use.

The manner of the accomplishment of the objects of the invention will be readily understood upon consideration of the accompanying drawing, in which:

Fig. 1 is a sectional elevation of the liquid bearing strata of a well, with a well screen, and unitary structure of protecting and graduated aggregate therearound in use-position in the well.

Fig. 2 is an enlarged sectional elevation of a fragmentary portion of a well screen with unitary aggregate protection shells of graduated aggregate concrete bonded in place, the outer metal form used in construction being shown prior to removal.

Fig. 3 is a sectional plan view taken as on the line III—III of Fig. 2; and

Fig. 4 is a section of a fragment of a strainer screen, having a protective coating surface.

Referring now to the drawing in which the parts are indicated by numerals:

11 is a well bore of desired diameter lined with an outer casing 12, extending to the liquid bearing sands, in which a chamber 13, of diameter greater than that of the well bore 11, has been reamed out. 15 is an inner casing which has been lowered into the well.

Depending from the inner casing 15, is a well screen 17 which is secured thereto by a collar 21, adapted to fit around the lower portion of the casing and a sleeve extension 18 of the upper end of the screen 17, to each of which it is rigidly secured by suitable means, such as welding.

In preferred form well screen 17 is formed from a sheet of metal, in which a plurality of cuts are made. The metal is uniformly pushed outwardly adjacent and above the cuts to form shutter-like flanges 26, with liquid receiving openings 27 therebetween. The sheet is then integrally covered with a substantially uniform protective coating 28 of rubber, japan or other suitable material, adapted to resist corrosion of screen 17 by the passage therethrough of corrosive solvents, the use of which is hereinafter described. The screen 17 is then rolled into desired shape. It will be understood that while the openings 27 are described as being between flanges 26, they may be formed by perforation or in other manner as desired. In any event the screen 17 should be coated against corrosive elements, although this coating is also optional.

Additional screen sections may be depended below this first section as needed or desired, the upper portion of an additional screen 23 being shown similarly secured to the lower end of screen 17 as by collar 25.

In Figs. 2 and 3 a substantially completed gravel wall strainer structure is shown in which 31, 33 and 35 are annular shells of gravel concrete cast concentrically around the screen 17. The gravel used in shell 33 is somewhat finer than that employed in shell 31, and that in shell 35 still smaller than that in shell 33, the gravel in each shell being bonded together by a soluble cement or other bonding agent.

In the stage shown the form 37 for the outer shell 35 is shown in position around that shell. This form 37 is shown halved for easy removal after hardening of the shell cast therein, and is adapted to be clamped in shaping position as by ears 38 carried by form 37 and adapted to receive bolts 40. Spacing pins 45, which are adapted to maintain form 37 concentric with strata 33, and to maintain the desired uniformity throughout of shell 33 may be used.

In producing the unitary gravel wall strainer illustrated, a halved form similar to form 37, but of smaller diameter is secured in forming position around screen 17, and preferably maintained in concentric position as by spacing pins similar to pins 45. The annular space is then filled with concrete consisting of a coarse gravel or other suitable aggregate and a soluble bonding agent, which may be a cement of known type containing an excess of calcium carbonate and which is readily attacked as by hydrochloric acid. The concrete is allowed to set up or harden and forms a shell of uniform thickness around screen 17. The form is then removed, a larger form, similar to that previously used and described is centered around and spaced away from shell 31, and in similar manner an annular space of uniform thickness is created and maintained, which space is filled with similar concrete differing from that of shell 31 in that the aggregate used is finer. This shell is allowed to set up and the form removed.

Successive shells are outwardly added through similar steps, the size of the aggregate in each being successively decreased, until strainer structure of the size desired for use is built up. Preferably the successive shells are beveled at their lower ends, as at 50, but it will be understood that the structure may be formed otherwise. It will be understood that the bonding material need not be a true cement, exceptionally satisfactory results being obtained by use of lime mortar which is substantially completely destroyed by certain acids and completely frees the aggregate. Such strainer sections as are needed are made up and allowed to harden so that they are available for use.

Well bore 11 is formed from the surface into the liquid bearing sands, and casing 12 is positioned in well bore in usual manner, and chamber 13 is under-reamed in these bearing sands to desired diameter. In such condition the well is ready for the lowering of the strainer structure therein. A section of screen is lowered until a minor portion only extends above the surface where it is supported while a second section is placed thereover and secured thereto in manner described. The lowering is resumed and additional structures are added in similar manner as required, and lowering into the well completed.

After the strainer structure and inner casing is lowered into the well, aggregate, preferably finer than that used in the outer shell of the strainers, is introduced to fill the remaining space in chamber 13. In this step the bevel 50 permits

this final gravel to more readily fill the space or void existing around collar **25**.

Thereafter the soluble bonding agent is leached out of the concrete of the shells and the aggregate freed, leaving a protection screen in which the aggregate strata are definitely and accurately determined, and positioned without substantial variations, in desired graduation outward from the strainer.

In ordinary practice gravel is found to be the best aggregate, but any suitable aggregate may be used provided that it not be attacked by the leaching agent. In the specification and claims the term "gravel" is intended to be synonymous with the term "aggregate."

I claim:

1. The method of enclosing a well screen in aggregate which includes the steps, prior to lowering said screen into a well, of positioning a form around and spaced away from the surface of said screen, casting in said form, in uninterrupted association with said screen surface, a first shell of substantially imperforate concrete comprising said aggregate bonded together by a soluble bonding agent, said first shell upon setting being bonded to said screen surface by said association and said agent, removing said form after setting to free the outer surface of said first shell, and repeating said steps to cast about said screen a plurality of shells each of successively smaller aggregate, each said shell having uninterrupted association with a contiguous shell surface and being bonded thereto to form of said screen and said shells a unitary assembly; subsequently lowering said assembly into a well and destroying said bonding by passing a solvent outward through said screen to form independent aggregate strata of predetermined content surrounding and successively decreasing outward from said screen.

2. The method of enclosing a well screen in aggregate which includes the steps, prior to lowering said screen into a well, of positioning a form around and spaced away from the surface of said screen, casting in said form, in uninterrupted association with said screen surface, a first shell of substantially imperforate concrete comprising said aggregate bonded together by a soluble bonding agent, said first shell upon setting being bonded to said screen surface by said association and said agent, removing said form after setting to free the outer surface of said first shell, and repeating said steps to cast about said screen a plurality of shells each of successively smaller aggregate, each said shell having uninterrupted association with a contiguous shell surface and being bonded thereto to form of said screen and said shells a unitary assembly; subsequently lowering said assembly into a well, introducing loose aggregate around said assembly to fill spaces between said assembly and said well, and destroying said bonding by passing a solvent outward through said screen, to form aggregate strata of predetermined content surrounding said screen said strata being supported by said loose aggregate.

3. A preformed unitary assembly adapted to be lowered into a well, comprising a foraminated well screen and a shell around said screen, said shell consisting of aggregate and a bonding agent, said shell comprising a plurality of annular sections in integrated association, the sizes of the aggregate in said sections progressively decreasing outward from said screen, said shell being bonded by said agent to said screen, and said bonding agent being soluble to permit freeing of said aggregate.

4. A preformed unitary assembly adapted to be lowered into a well, comprising a foraminated well screen and a substantially imperforate shell of concrete around said screen, said concrete consisting of graded aggregate and a bonding agent, said shell comprising a plurality of annular sections in uninterruptedly integrated association, the sizes of the aggregate in said sections being graded and progressively decreasing outward from said screen, said shell being bonded by said agent to said screen in uninterrupted contact, said bonding agent being soluble to free said aggregate.

5. A preformed assembly for use in a well, comprising a foraminated well screen and a plurality of substantially imperforate shells secured around said screen, said shells each consisting of aggregate and a bonding agent, the size of the aggregate in said shells progressively decreasing outward from said screens, each said shell lying in uninterrupted association with a contiguous shell surface and being homogeneously integrated therewith, the first said shell being bonded by said agent to said screen in uninterrupted contact, to form of said shells and said screen a unitary assembly adapted to be lowered into a well, said assembly being externally unconfined, said bonding agent being soluble to free said aggregate.

ROBERT S. CHARLES.