

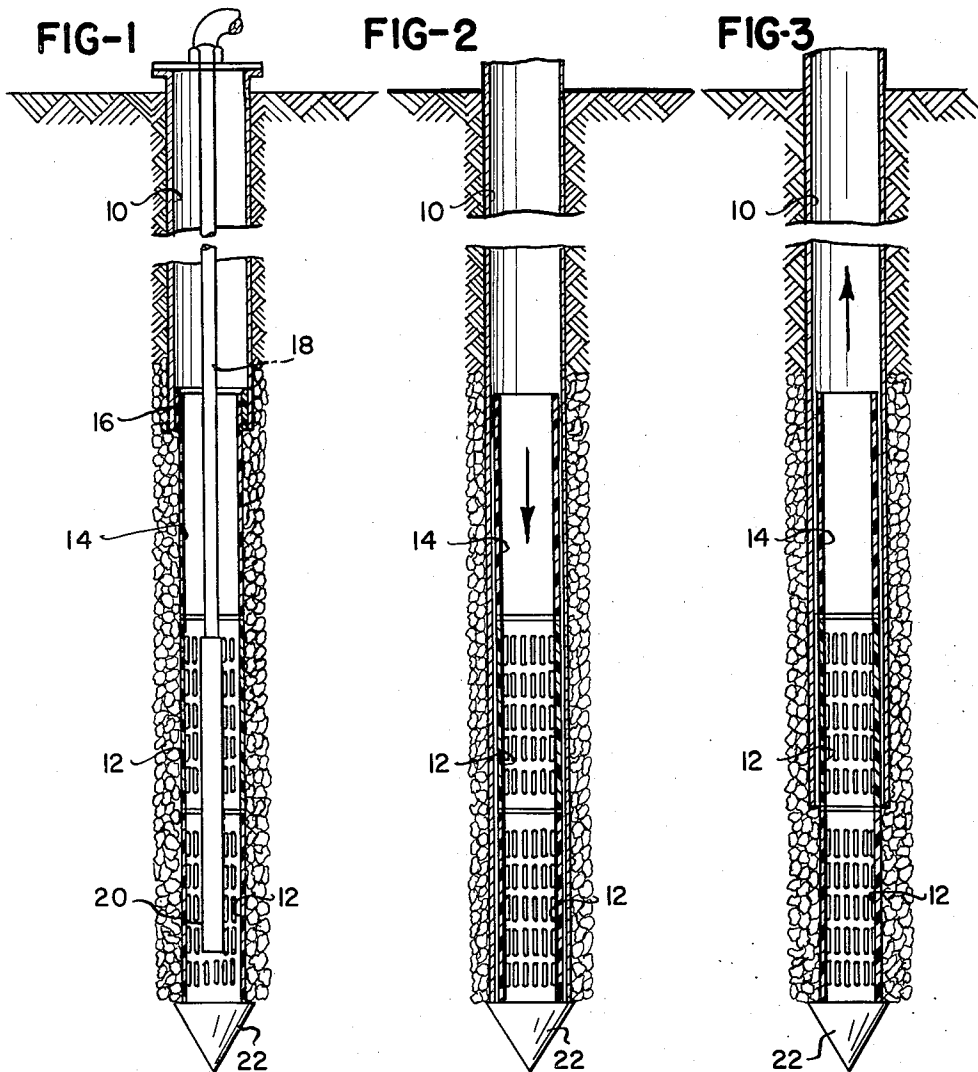
Jan. 31, 1961

A. A. D'AUDIFFRET ET AL
PLASTIC WELL SCREEN AND WELLS UTILIZING
THE SCREENS AND METHOD OF OPERATION

2,969,840

Filed April 10, 1957

3 Sheets-Sheet 1



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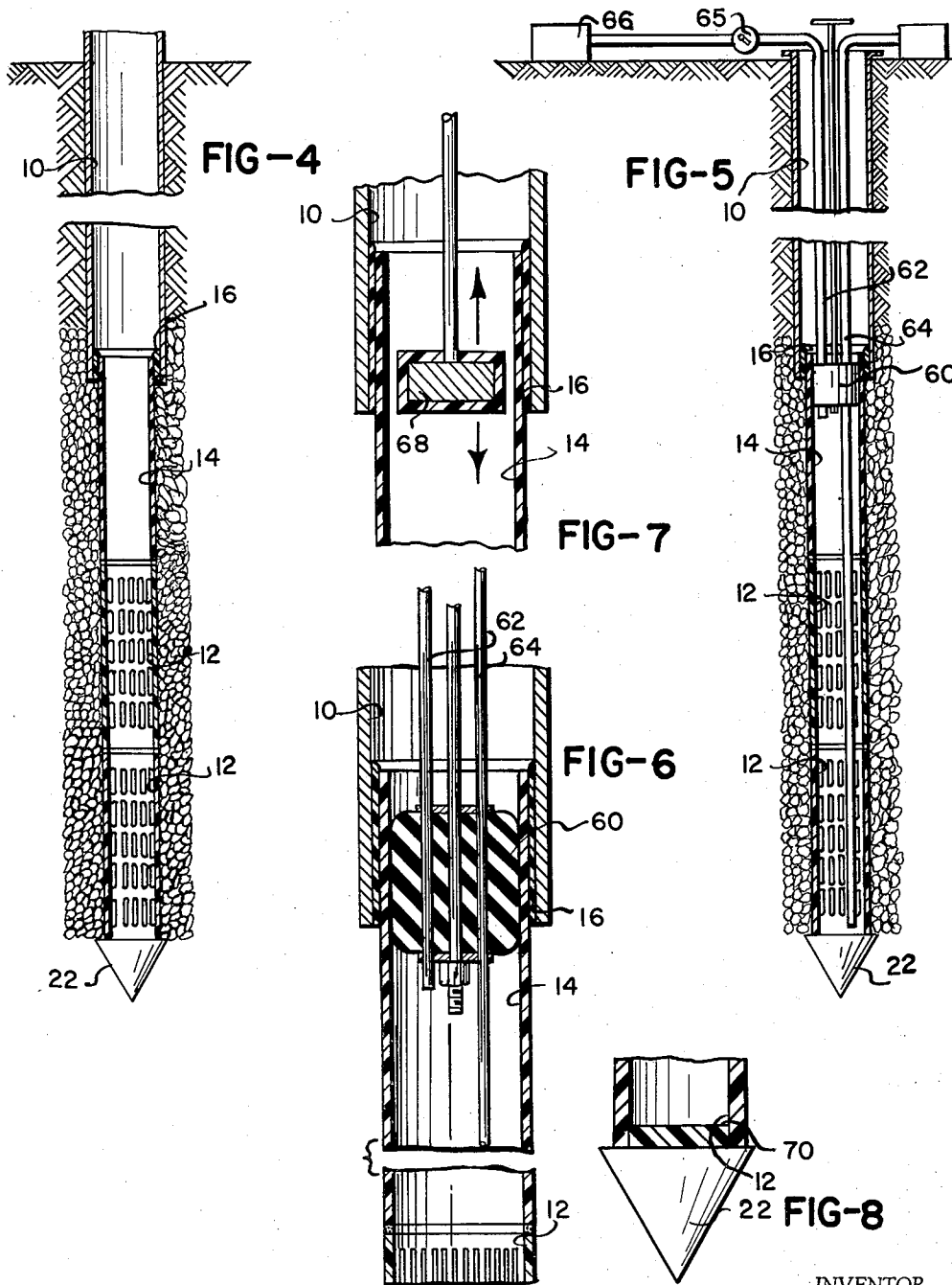
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3 Sheets-Sheet 3

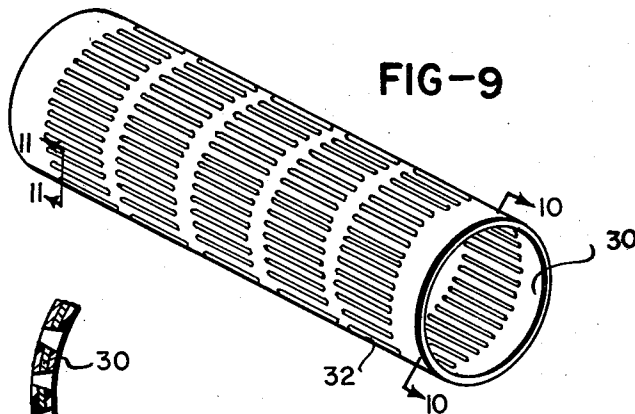


FIG-9

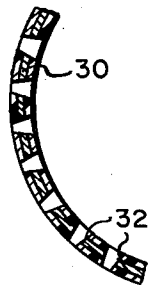


FIG-II

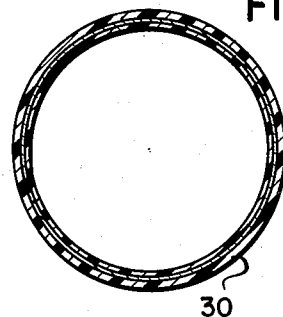


FIG-10

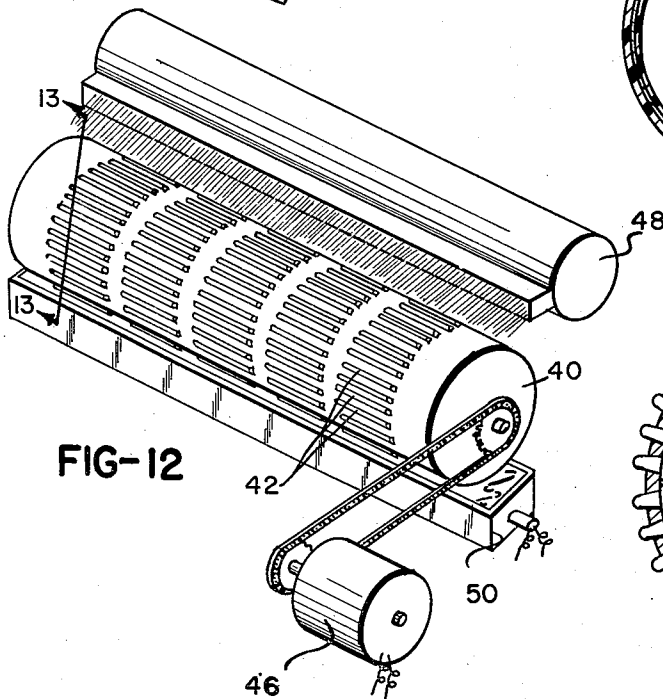


FIG-12

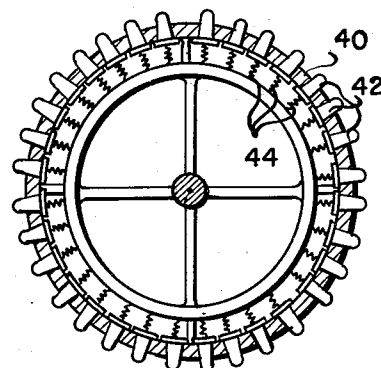


FIG-13

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PLASTIC WELL SCREEN AND WELLS UTILIZING THE SCREENS AND METHOD OF OPERATION

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2 Claims. (Cl. 166—205)

This invention relates to wells, particularly to water wells and is particularly concerned with a vertical type well, and to an improved screen structure for such a well.

Vertical wells are wells in which a well casing is driven vertically downwardly into the earth until it traverses a water-bearing stratum whereupon the casing is provided with a screen at the lower end and a pumping device is then inserted in the casing to pump water therefrom.

The installing of a well of this nature, where it is of substantial capacity, as occurs in connection with industrial installations, is quite an extensive operation and involves not only the driving of a well casing which may be up to eight or ten inches or more in diameter, but also calls for the development of an aquifer bed surrounding at least the screen portion of the casing so that there will be a relatively free supply of water into the casing to be pumped therefrom.

Due to the nature of such a well, however, it naturally occurs that the rate of fluid flow of the water into the casing increases as the water approaches the casing and this leads to turbulence and to loss of head, the gradient of which increases as the well screen is approached. The effect of the turbulence and loss in head of the water is deposition of solids from the water, particularly insoluble carbonates which precipitate due to the release of carbon dioxide from the water by the turbulence set up therein.

The insoluble carbonates tend to form deposits, particularly in the immediate vicinity of the well screen and on the screen itself where the water passes into the casing through small passages and flows about relatively sharp corners. This sedimentation then tends to become cemented together by colloidal iron, alumina, and silicates in the water and this cementing together of the carbonates fixes them in place and forms a hard encrustation that gives rise to serious decrease in efficiency of the well.

When the efficiency of a well of this nature drops a predetermined amount, the encrustation is treated by acidifying the well through the addition thereto of an acid, usually about 15% muriatic acid, which dissolves or loosens a considerable amount of the encrustation. The amount of such encrustation, however, that can be released or removed in this manner is extremely limited because only a relatively weak acid concentration can be employed without damaging the well screen. For this reason, no conventional well having a metal screen is ever restored to complete operating efficiency and sometimes acid treatment of a well becomes ineffective after the second or third application. Such a well might have to be abandoned due to inefficiency.

In severe cases, it might be necessary to treat a well with acid as often as once a year and it will be evident, therefore, that the problem of encrustation of a well screen and the surrounding aquifer can be an extremely serious matter.

Having the foregoing in mind, it is a primary object

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of the present invention to provide a well structure which eliminates the drawbacks and difficulties referred to above that are encountered in conventional type vertical wells.

A particular object of this invention is the provision of a well structure which will permit removing substantially the entire encrusted deposit that builds up in the well during the use thereof.

A still further object of this invention is the provision of a novel type well screen that overcomes or permits overcoming the principal drawbacks occurring in connection with conventional type vertical wells.

These and other objects and advantages of this invention will become more apparent upon reference to the following specification, taken in connection with the accompanying drawings, wherein:

Figure 1 is a vertical cross section through a well according to the present invention showing, rather diagrammatically, a finished installation;

Figure 2 is a view of the well showing the casing driven to its most advanced position and a well screen according to the present invention inserted therein;

Figure 3 is a view like Figure 2, but shows the well casing retracted upwardly to expose the screen;

Figure 4 is a view like Figure 3, but shows the well casing in its fully retracted position and with a seal in place between the lower end of the casing and the upper end of a blank pipe positioned at the top of the upper section of the screen pipe;

Figure 5 is a view showing the manner in which a well according to the present invention is treated to remove built-up deposits or encrustations therefrom;

Figure 6 is a view drawn at somewhat larger scale than Figure 5 showing the construction that might be employed for the packer forming a part of the structure utilized in treating the well;

Figure 7 is a fragmentary view showing the use of a plastic-covered surge block to force the acidified solution in the well throughout the aquifer bed surrounding the screen pipe;

Figure 8 is a fragmentary view showing a manner in which the lowermost end of the lowermost screen pipe could be sealed if so desired, thereby facilitating the forcing of the acid through the screen pipe during the aforementioned treatment;

Figure 9 is a perspective view showing one of the screen pipe sections according to this invention;

Figure 10 is a cross sectional view through the screen pipe indicated by line 10—10 on Figure 9;

Figure 11 is a fragmentary sectional view indicated by line 11—11 on Figure 9 showing the shape of the slots in the screen pipe;

Figure 12 is a diagrammatic representation of one manner in which the screen pipe might be manufactured; and

Fig. 13 is a sectional view indicated by line 13—13 on Figure 12 showing the mandrel on which the screen pipe might be manufactured showing retractable plungers for forming the inlet openings in the screen pipe.

Referring to the drawings somewhat more in detail, the well installation disclosed in Figure 1 comprises a conventional metal well casing 10 extending downwardly into the earth through a water-bearing stratum. According to the present invention the lower end of casing 10 carries a screen section 12 which may consist of one or more screen pipe sections fitted together in end to end relation and rigidly connected. Between the upper end of the screen section and the lower end of casing 10 is a blank pipe 14 also joined to the screen pipe and sealed within the well casing by sealing means indicated at 16.

Extending downwardly into the well casing is a pipe 18 and this pipe may carry at its lower end a pump 20 of a conventional type.

According to the present invention the screen sections of the screen pipe and the blank pipe 14 are made of a reinforced acid resistant plastic material. In particular, reinforced polyester resins are known to be satisfactory because of the great strength of reinforced polyester resin and its great resistance to corrosion, including resistance to strong acids with which the wells are to be treated. Furthermore, polyester resin is of a non-electrolytic nature and thus discourages the deposition of insoluble carbonates. This probably comes about because of the lack of static electricity generated by the passage of water into the polyester screens as opposed to what occurs when water passes through a metallic screen.

For the reinforcement, a material, such as fiber glass, nylon or Orlon, in the form of either a woven fabric, or a felted fabric, or flock, can be employed with satisfactory results. These materials all have high strength and can be made extremely resistant to any chemical that might be encountered in the wells either during normal use or during treatment thereof. It will be understood, however, that substantially any material could be employed as a reinforcing means merely by making certain that all exposed surfaces of the screen elements were completely covered with polyester resin.

In installing a well according to the present invention a casing 10 is first driven downwardly to the desired depth and preferably with a detachable driving head 22 associated therewith. When the casing has reached the proper depth, the screen pipe section with the attached blank pipe section is then lowered into the well. At this time the installation appears as it does in Figure 2.

Thereafter, the well casing is retracted upwardly and the well screen and the driving point or driving head 22 remain in position.

After the well casing has been retracted to the proper point, the seal 16 is put in place. This can be done by pouring polyester resin into the space between the lower end of the well casing and the upper end of blank pipe 14. This will form a fluid-tight seal of great strength between the casing and the blank pipe.

Thereafter, the aquifer bed can be developed according to well-known practice by removing the fines therefrom and the casing can then be capped and a pump placed therein.

In making the well screen sections or the blank pipe, any conventional methods may be employed for insuring a substantially solid mass of reinforced plastic in the wall of the said sections. This is important in order to provide for the maximum strength and also to insure a smooth and continuous surface.

The strength is important because according to the present invention relatively larger screen holes are employed whereby considerable material is either removed from the circumference of the screen or is left out at the time the screen is manufactured. A typical screen section according to the present invention showing the distribution of holes therein is illustrated in Figure 9. In this view the pipe 30 is about eight to 12 inches in diameter and may be from four to twelve feet in length.

The holes in the screen illustrated are about $\frac{3}{16}$ " wide by $3\frac{1}{2}$ " long and are about $\frac{1}{16}$ " wider on the inside of the screen than on the outside as indicated at 32 in Figure 11. The thickness of the wall of such a screen may be as little as $\frac{3}{16}$ " and sufficient strength will be had for the purposes of the present invention.

The manufacture of the screen may be carried out by forming tubular sections and thereafter cutting the holes therein. Such sections might be formed by winding fabric on a mandrel while simultaneously spraying the plastic material thereon, thus to build up the required thickness of reinforced wall. Also, as mentioned above, a flock filled plastic might be sprayed on the mandrel or the plastic and flock separately sprayed. In any case, a reinforced pipe section having a continuous plastic surface will be had.

It is also conceivable that the screen pipe sections could be formed with the holes or slots integral therein, thus eliminating a cutting operation to form the said holes. This might be done on an apparatus as disclosed in Figures 12 and 13 wherein a mandrel 40 has tapered pins 42 therein pressed outwardly by springs 44. This mandrel is arranged for being driven in rotation by a motor 46 and as the mandrel rotates a spray head 48 supplies the resinous material while a heat lamp 50 at least initiates the curing thereof whereby the pipe section built up on the mandrel can be removed therefrom for being cured under the proper temperature conditions. The retractable pins 42 permit the pipe section easily to be stripped from the mandrel, particularly where the mandrel is provided with a slight draft.

It will be evident that sheet fabric material could be employed with the Figures 12 and 13 fabricating arrangement merely by having the fabric punched so that the pins 42 would extend through the holes in the fabric as the material was wound up thereon.

Returning now to Figures 5, 6 and 7, upon a well installation according to the present invention becoming inefficient due to encrustation of the screen pipe and the surrounding aquifer, the pump 20 is withdrawn from the well and there is inserted into the well a packer 60 adapted for engaging the inside of the blank pipe 14 in sealing relation thereto. The packer may be of the expandable type illustrated or may be of a type utilizing resilient annular rings or cups. In any case, the packer forms a seal within plastic pipe 14 which prevents any communication between the water in the well and the metal well casing 10.

The packer 60 has plastic pipes 62 and 64 extending therethrough and pipe 62 has a check valve 65 therein and is adapted for receiving a supply of acid from a source 66. Due to the acid-resistant nature of the packer and the pipes at the lower end of the well, a full strength acid can be employed and will also permit the use of acids other than muriatic. For example, hydrofluoric acid may be used and this will permit elimination of silicate encrustations which are not effected by muriatic or hydrochloric acid of any concentration.

The pipe 64 preferably leads away from the well to a remote location or through a discharge pump and will convey away any foam or gases generated in the well by the acid supplied thereto.

After the acid has been supplied to the well, it may be caused to surge through the gravel pack surrounding the screen pipe by the introduction of compressed air through one or the other of pipes 62, 64 if so desired. This would facilitate in distributing the acid through the gravel pack so that more acid could be added in order to bring the concentration of acid in the body of water about the lower end of the well to the desired level.

It may also be desirable after the concentration referred to has been reached, to remove the packer, and insert a plastic-covered surge block 68 as illustrated in Figure 7, which could be employed for working the concentrated acid throughout the entire gravel pack area and thus promote extremely efficient removal of encrustation from the entire region effected thereby.

After the treatment with the surge block, the packer is then preferably replaced in the well and the acid is drawn therefrom so that when the pump 20 is again restored to the well pure water will be supplied thereto.

It will be apparent that the blank pipe 14 which has been referred to could in certain circumstances be eliminated or it might be provided by making the uppermost section of the screen pipe with a blank portion thereon.

It will also be evident that the several plastic pipe sections could be connected together simply by cementing or they could be provided with sleeve-like couplings in addition to the cementing, if desired.

It will also be evident that the lower end of the screen pipe section could be enclosed by a sealing plug 70 poured

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therein if found necessary thereby to close the screen pipe in such a manner that the acids supplied thereto would be forced to flow through the screen openings and remove the encrustation referred to.

It has been mentioned that the screen pipe could be formed by cutting the slots in blank pipes but when this is done the edges of the slots should be sprayed or otherwise treated to provide them with a layer of polyester resin whereby the screen pipe is characterized, as mentioned before, by having a continuous and unbroken surface of polyester resin.

From the foregoing it will be apparent that what is provided by the present invention is a greatly improved vertical well, particularly characterized in that the well can be restored at any time to its original operating efficiency and this restoration can be accomplished many times, rather than only two or three times, as in the case of a well having a metal screen.

While the present invention is particularly concerned with vertical wells, it does not, of course, preclude the use of the plastic well screens in connection with horizontal wells. All of the same reasons for using screens would not be present in horizontal wells because wells of this nature have little or no tendency to become encrusted and thus do not require acid treatment. The advantage would obtain, however, of great strength and lightness, resistance to electrolysis and a reduced initial cost.

It will be evident that many modifications could be made in the structure and procedures illustrated and described. In particular, the manner of manufacturing the plastic well screen would be subject to considerable modification while still adhering to known practices. One such modification would consist of forming the mandrel on which the well screen is made up in three or more parts having tapered wedge members thereon for forming the screen slots. Such a mandrel would be constructed so as to be collapsible whereby it could be collapsed and the screen removed therefrom.

The material referred to in the specification for the screen is polyester, a commercial product of this nature being sold under the trade name of Mylar, but many other plastics have the quality of being acid resistant and could, in many cases, be utilized as a substitute for the polyester resin. Among such other materials are the vinyl or vinylidene plastics, such as Tygon or Saran, the epoxies, such as Araldite, and long chain polyethylene polymers or halogen substitution products thereof, particularly the fluoro or chloro derivatives.

It will be understood that this invention is susceptible to modification in order to adapt it to different usages and

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conditions; and accordingly, it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

We claim:

1. In a well installation, a metal casing extending into the ground, an acid-resistant resinous screen pipe extending from the end of the casing and having a blank portion at the casing end thereof sealed to the casing, a packer sealingly mounted in the blank portion, a first pipe extending through the packer and connected with a source of acid and having a check valve there, and a second pipe extending through the packer and leading to a point of discharge for removing acids and dissolved encrustations from the well, the arrangement being such that the acids do not directly contact any metal parts within the well thereby permitting the use of full strength acids, or acids otherwise not usable in conventional wells whereby complete removal of all well encrustations can be effected as often as necessary.
2. In a well installation; a metal casing extending into the ground, an acid-resistant resinous screen pipe extending from the end of the casing and having a blank portion at the casing end thereof sealed to the casing, a packer sealingly mounted in the blank portion, pipes extending through the packer, a source of treatment liquid for dissolving encrustations in the well connected with one of the pipes for the supply of treatment liquid to the screen pipe through the packer, and another of said pipes constituting means for withdrawing the treatment liquid and encrustations dissolved thereby, through the packer from the screen pipe.

References Cited in the file of this patent

UNITED STATES PATENTS

73,688	Arnold	Jan. 28, 1868
376,844	Appert	Jan. 24, 1888
1,657,130	McEvoy	Jan. 24, 1928
1,677,606	Thorpe et al.	July 17, 1928
1,891,667	Carr	Dec. 20, 1932
2,011,448	Kelly	Aug. 13, 1935
2,031,983	Saxe	Feb. 25, 1936
2,186,349	Simmons	Jan. 9, 1940
2,359,717	Myers	Oct. 3, 1944
2,467,999	Stephens	Apr. 19, 1949
2,578,996	Endersby	Dec. 18, 1951
2,614,058	Francis	Oct. 14, 1952
2,653,887	Slayter	Sept. 29, 1953
2,654,124	Layte	Oct. 6, 1953
2,843,209	Degen	July 15, 1958