

Feb. 20, 1940.

M. O. JOHNSTON

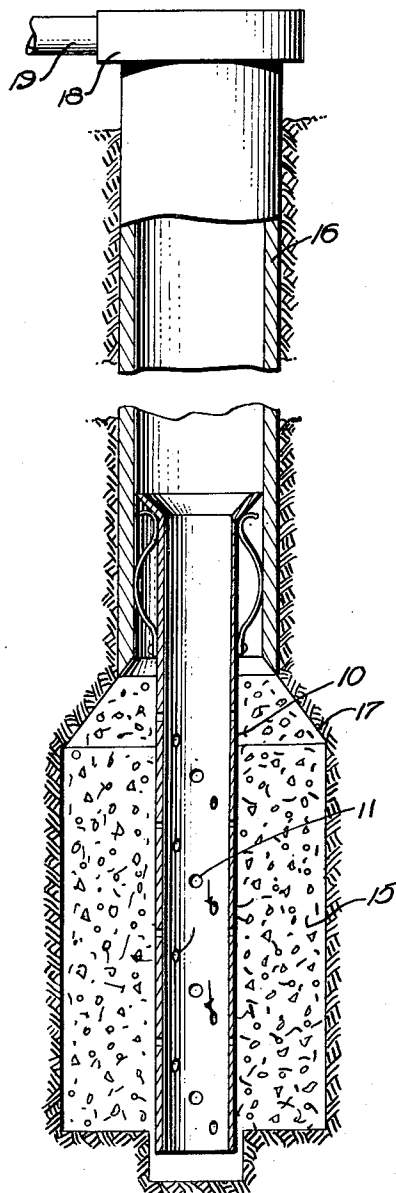
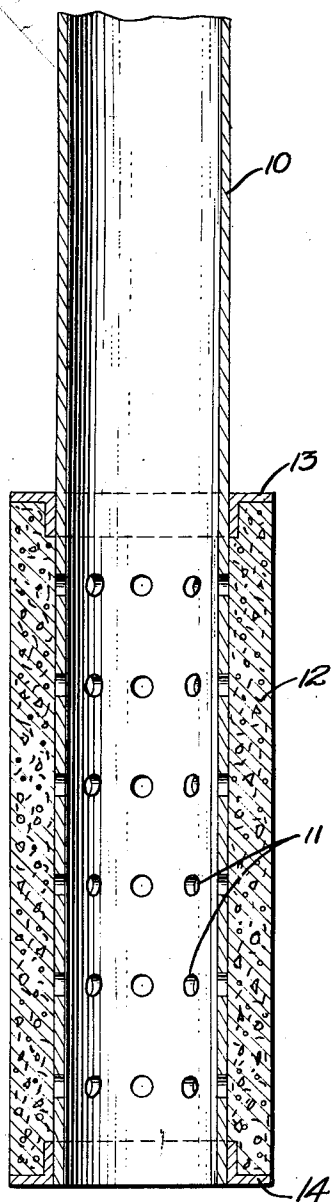
2,190,989

METHOD OF PREPARING AN OIL WELL FOR PRODUCTION

Filed Dec. 13, 1937

Fig. 1.

Fig. 2.



1040
X 1048

INVENTOR
MORDICA O. JOHNSTON.

BY James M. Abbott
ATTORNEY

Patented Feb. 20, 1940

2,190,989

UNITED STATES PATENT OFFICE

2,190,989

METHOD OF PREPARING AN OIL WELL FOR PRODUCTION

Mordica O. Johnston, Los Angeles, Calif.

Application December 13, 1937, Serial No. 179,575

3 Claims. (Cl. 166—21)

This invention relates to the problems of oil well production, and particularly pertains to a method of preparing an oil well for production.

In placing oil wells on production, and in maintaining them in a producing condition, it is common practice to lower a perforated length of casing into the producing area and to condition this casing for production by perforating the wall of the casing, after it is set, by mechanical means, or by the use of perforating guns. It is also common practice to prepare a perforate well screen or liner which is formed with slotted perforations having straight or undercut side walls, or which may be formed by making relatively large openings through the wall of the liner section and fitting grid members in place over the openings so that the fluid passageways through the liner will be relatively small and will tend to withhold the sand and silt from the interior of the liner. Such previously prepared liner sections are lowered into the well and under certain conditions prove satisfactory. When, however, there is present in the oil producing area a large quantity of finely divided matter, such as fine sand and silt, it is difficult to screen out or exclude this matter which is suspended within the fluid passing through the perforate liner of the producing well. Attempts have been made to create a filter area around the perforate liner by filling around this liner with gravel of a substantially uniform size and degree of hardness so that a filter wall will be created and interposed between the liner and the formation. Even under such circumstances it is not always possible to create and maintain a filter barrier which will effectually exclude fine suspended matter from the fluids which pass through the liner wall and into the well. It is the principal object of the present invention therefore to provide a filter mass which may be placed in the well after the liner has been set, or which may be preformed and applied to the liner before it is set, the principal characteristic of the filter mass being that it will form a permanent filter structure, foraminous in character, the body of which is formed with interconnecting pores throughout the structure which are of a fineness in size to permit the flow of fluids therethrough while acting as a barrier to exclude the suspended solids carried by the fluids and which would otherwise pass in suspension with the fluids as they flow through the walls of the liner and to the producing equipment.

The present invention contemplates the preparation of a mass including a binder and other

ingredients mixed with it, and by which a porous filter wall may be created and preserved in fixed form and structure when either preformed and applied directly to the liner before it is placed in the well, or applied to the outer surface of the liner after the liner has been set in the well, and at which time the material is pumped into the well to fill the well bore cavity surrounding the liner. The ingredients, which it is contemplated shall be used in forming the filter mass, may include a binder, such as cement and aggregate material which may have an individual porous cellular structure, such for example as diatomaceous earth, coke, and the like, of a relatively non-porous structure, such for example as pumice stone, gravel, and slag. In some instances a fibrous material might be used. It is also within the contemplation of the present invention to provide a binder or mass of material which may be mixed with or without the aggregate ingredients, of which the foregoing are an example, but which binder may be mixed with an agent acting to create a porous structure by chemical reaction to produce effervescence or the like, or agents which will act to produce a foaming or frothing action in the mass previous to the time the binder sets and whereby the action of the gases or air present will cause intercommunicating voids to be formed through the mass to render it porous and of cellular structure when finally set and in place within the well.

In some formations the suspended solids within the fluids of the well is sand of a particular degree of fineness and in order to produce a filter mass structure which will effectively act to filter out granular material suspended in the particular well to be treated, this type of material is pumped from the well, thereafter recovered, and used as the aggregate material in the mix from which the filter pack is made. This will produce a filter pack around the perforate liner which will remain permanently and which will have a texture and structure agreeing substantially with that of the geological formation through which the material flows to the well bore.

The invention is illustrated by way of example in the accompanying drawing in which:

Figure 1 is a view in central vertical section showing a precast filter pack embodying the features of the present invention as mounted upon a perforate liner or well screen.

Fig. 2 is a view showing another form of the invention in which the filter pack material is

poured into the well bore and forms a filter pack therearound.

Referring more particularly to the drawing 10 indicates an oil well liner or screen here shown as formed with perforations 11. These perforations may be made in any suitable manner, such for example as boring holes through the wall of the member 10 or cutting slots in the same. In some instances it may be desirable to move screen inserts over the perforations. The present invention is not particularly concerned with the construction of the liner or its perforations, but is especially concerned with a filter pack disposed therearound and over the perforations to act as a filter barrier through which native fluids from the geological formation penetrated by a well bore may percolate. As shown in Fig. 1 of the drawing this filter pack is indicated at 12 and is in the form of a cylindrical shell. The shell is precast in its tubular shape and has an inside diameter which will fit snugly around the liner 10. It may be desirable to provide projecting rings 13 and 14 at the opposite ends of the shell 12 to project the material from which it is made so that it will not be crushed or broken away as the liner is moved to its proper position within the well. As here shown the members 13 and 14 are of angle section. These members may be fastened to the liner if desired.

It may also be desirable to cast a filter pack directly around the liner after the liner has been lowered into the well. Such a filter pack is indicated at 15 in the drawing. The method of depositing the material on which the filter pack is formed may be any suitable method, such as now used in well cementing or in depositing gravel and the like within the well bore. The details of such method will be explained by way of example hereafter. The filter pack shell 12 or the placed filter pack 15 may be made from suitable ingredients, it being preferable which when mixed and set will form a permanent porous structure formed with intercommunicating voids throughout. It is desirable that the set structure shall be of a degree of porosity which will agree with that of the geological formation yielding the fluids flowing through the filter pack and into the liner. In order to control the formation of the porous mass it is desirable to make an analysis of the solid material occurring in the well bore in the area of the fluid production yield. It may also be desirable to ascertain definitely by cores and otherwise the angle of repose of the filter material in the area of fluid yield, after which a filter pack is formed. The filter pack when precast to form a shell indicated at 12 may be formed of various material. It may be constructed of materials including a binder having a gypsum base, such as plaster of Paris, Portland cement, or an equivalent binder with which is mixed an effervescing, foaming, or frothing agent. In the event that an effervescent material is used, the same such material, such as calcium carbonate and a reacting agent, such as aluminum sulfate, may be employed. In that event the two agents will react to produce a gas which will percolate through the mass as the mass sets and will cause a foraminous structure to be created. This structure will be permanent in form when it sets and will thus provide a porous filter medium for the fluids of a well. It will be understood that the sizes of the voids formed through the mass may be controlled by selectively determining the relative proportion of the effervescing ingredients with relation to each other and the binder. This will make it possible to

determine the degree of violence of the effervescing action and the sizes of the pores in the cellular structure which results. It may also be desirable to add an aggregate material to the mix. This material may be diatomaceous earth, coke, slag, pumice stone, gravel, or sand, and in some instances might be a fibrous material, such as mineral wool. The uses of such materials may have one of two effects, that of providing an additional porous structure when such materials, as diatomaceous earth, coke and the like are used, and that of determining the sizes of the interstices which will occur between the aggregate particles when they are held together by the binder and when the effervescing agent has acted to create voids between certain faces of the aggregate. The size and character of these aggregate particles is determined preferably by a careful examination of the geological formation within which the fluid yield occurs, and an examination of the suspended solids in the fluid yield, as well as the waxes and gums which might be present in the liquid. It is also desirable to determine the character of the transporting fluid itself with reference to its viscosity under well temperatures, and its possible reaction with well fluids which might cause insolubles to be formed.

As previously explained a desirable porous filter mass may be made by the use of a binder, an aggregate, and an effervescing agent. In some instances it might be desirable to eliminate the use of chemical ingredients which would react to produce a gas in effervescence and to substitute therefor ingredients which would act to cause air to become entrained in the mass and to be liberated therefrom as the mix sets. Such ingredients create a condition of effervescence, frothing, foaming or the like, which cause the formation of intercommunicating voids throughout the structure, making it uniformly porous. Ingredients for this purpose may be albuminous material, such as egg or blood albumen. In some instances glue may be used as a colloidal agent to aid in entrapping air in the mixture, after which it will gradually work out through the mixture to leave intercommunicating voids between the aggregate particles and the binder. With the use of any type of agent by which a condition of porosity may be imparted to the mass forming the filter pack it is understood that this agent is used in such proportions as to determine and control the general size of the interstices occurring throughout the mass and that these sizes have a direct relation to the character of the fluid yield, its porosity, capabilities for chemical reaction, and the sizes and character of the suspended solids carried by it.

In operation of the present invention when precast filter shells 12 are used a mixture may be made and cast in a mold. If effervescing material is employed the mix can be produced for example by mixing two cubic feet of plaster of Paris, or other suitable cementitious binder to three cubic feet of aggregate material and then adding equal proportions of aluminum sulfate and calcium carbonate. These last named ingredients may be used in the amounts of four and three-quarter pounds of each to the mixture of aggregate and the binder. Water is then added and the entire batch of material is thoroughly mixed and then poured into a suitable mold where it is allowed to set. As it sets the chemical reaction between the two effervescing agents creates a gas which percolates through a mass of material and becomes liberated as the material

sets. This produces a porous shell 12 which may be mounted suitably upon the well liner or used as desired. It is to be understood that the ingredients mentioned in the foregoing example need not be used in the exact proportions specified, but that they have been mentioned by way of example only, and that it is within the purview of the present invention to use other ingredients for obtaining the same results. When other agents producing effervescence, frothing, or foaming are used to give porosity to the mass, the proportion of ingredients may be approximately four parts of the aggregate to one part binder to which is added a desired proportion of albuminous material sufficient to control the rate of entrainment of the air from the mass and thus determine the relative size of the openings in the intercellular structure. When the filter pack 15 is created within the well the casing 16 is first set and the well bore is then under-reamed, as indicated at 17. A cement head 18 is mounted upon the upper end of the casing and is attached to a pipe 19 through which the material used to form the filter pack 15 is formed in a fluid state. This material will be forced downwardly under pressure through the casing and into the liner 10 after which it will flow upwardly into the space created around the liner by the under-reamed bore 17. Various methods in common practice may be employed to force the mass of material into place, such for example as imposing drilling fluid above the quantity of material placed in the casing. Care should be taken to insure that the fluid used is of a thickness in gravity which will not interfere with the action taking place in the mass of material forming the pack 15, but which will insure that the agents provided for producing porosity of the mass will have free action as the material sets. It is also to be understood as being within the scope of the present invention to provide tubular liner sections of the type here disclosed which may be used without a perforated liner or which may be used as a substitute for the usual perforate liner, or which may be disposed within a perforate liner so that it will have the same effect as a filter as though it had been placed on the outside of the liner. It is further to be pointed out that the liner or a section of it may be filled with a filter pack through which the well fluids may pass to the casing or the pumping unit of a well.

It will thus be seen that when the invention is practiced as here disclosed a predetermined selected and controlled intercellular structure will be created and will be permanently formed and placed around the well liner and within the well bore. It will be evident that this filter pack when properly selected will have substantially the same degree of physical structure and porosity as that of the surrounding geological formation and that it will be possible to effectively exclude the suspended solids which would otherwise be carried by the fluids into the liner. It will also be recognized that due to the fact that a definite set and permanent intercellular structure is created it will be possible to flush and clean the pores by the use of suitable fluids or chemical agents without destroying the structure, and while maintaining a uniform degree of porosity throughout the

life of the well. It is to be further understood that the present invention may be used in reconditioning old wells, or in preparing new wells for production.

While I have shown a preferred method of practicing my invention, and the preferred form of apparatus for carrying it out, it is to be understood that various changes in the combination, construction and arrangement of parts, and the steps of the method, may be made by those skilled in the art, without departing from the spirit of the invention as claimed.

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

1. A method of preparing oil wells for production which consists in recovering solids which have been suspended in the fluids passing from the producing area of an oil well, thereafter placing a casing screen in the well at the depth of the producing area and then interposing a foraminous filter structure between said casing screen and the well formation in the producing area, a binder, an aggregate consisting of the suspended solids which have been recovered from the producing area of the well, and means for creating intercommunicating foramina throughout said filter structure.

2. A method of preparing oil wells for production which consists in setting casing in the well, thereafter recovering solid material from the geological formation in the producing area of the well, then analyzing the same to ascertain the physical character and texture of the material in the producing area of the well, then mixing a binder and aggregate material having substantially the same characteristics as the geological formation in the oil producing area and adding thereto an agent which acts to create intercommunicating foramina throughout the filter mass agreeing with that of the geological formation of the oil bearing area, then placing a perforate liner in the well, then introducing the mixture into the well in a fluid state and placing the same around the liner to fill the space occurring between the liner and the bore of the well in the producing area, after which said mixture is permitted to set while the agent therein for creating intercommunicating foramina is active throughout the mass and whereby when the mixture has set a filter barrier will be created around the liner and within the well bore through which fluids from the producing area are filtered as they pass into the liner.

3. A method of preparing an oil well for production which consists of setting a casing in a well, thereafter setting a perforate liner within the well and the oil producing area thereof, then placing in the well around the perforate liner in between the same and the well bore in the oil producing area a cementitious mass comprising a binder, aggregate material, and an agent for forming intercommunicating foramina throughout the mass before the binder sets whereby when the binder sets a porous filter barrier will be created permanently around the filter screen and between the same and the well bore in the oil producing area.

MORDICA O. JOHNSTON.