

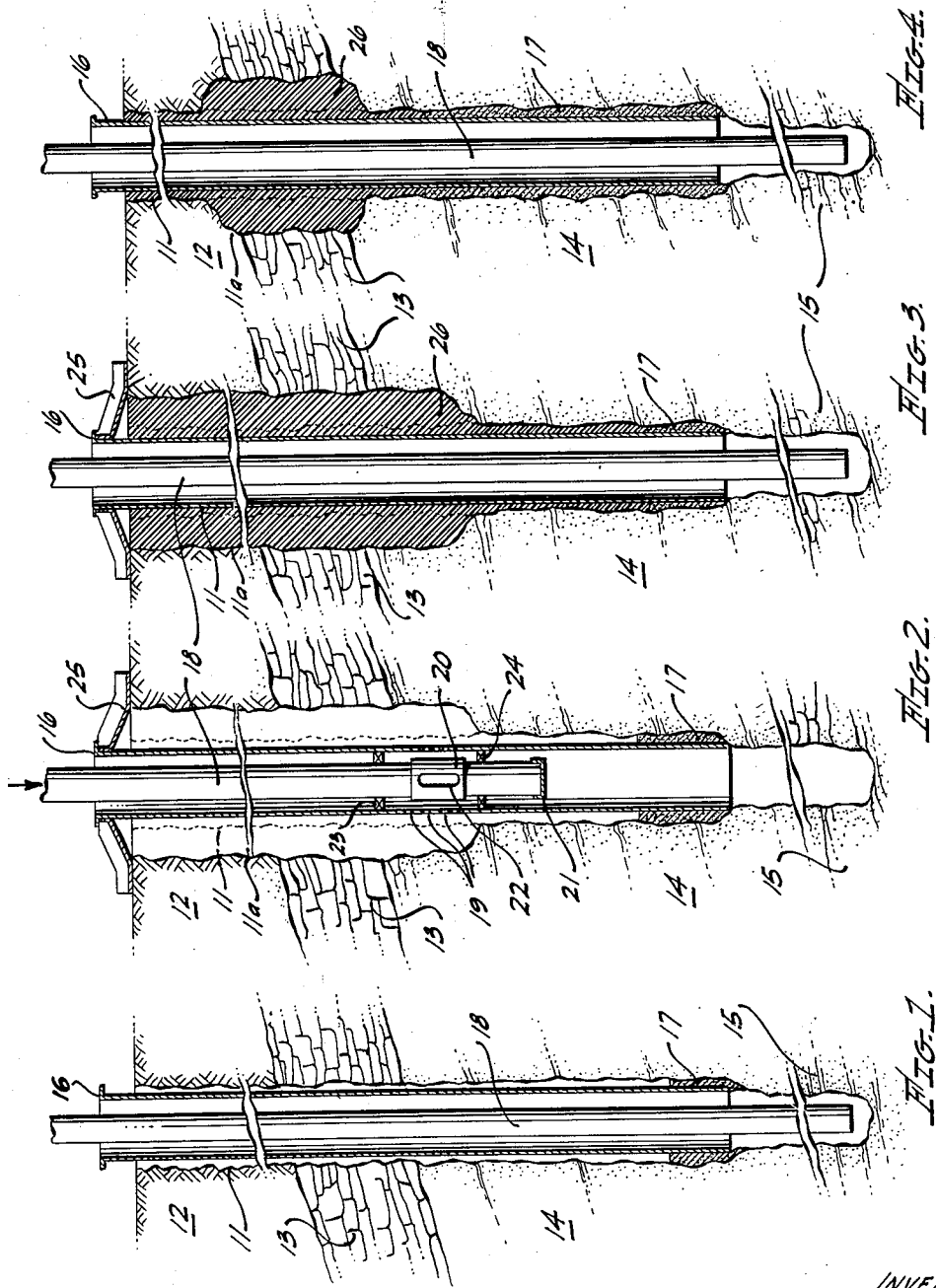
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METHOD AND COMPOSITION FOR PROTECTING WELL CASINGS

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METHOD AND COMPOSITION FOR
PROTECTING WELL CASINGS

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This invention relates to the protection of well casings from mechanical damage caused by land subsidence or shifting and/or from damage caused by corrosion, and in particular concerns new methods and compositions for providing such protection.

In drilling oil and gas wells it is customary to case in the well for at least part of its depth by inserting into the bore a relatively large diameter pipe which is known as the "well casing." Such casing usually extends for a distance of several thousand feet into the bore, and at its lower end is sealed to the walls of the bore by means of a cement plug. The various underground formations traversed by the bore are thus isolated by the casing and the cement plug, and undesirable water or other liquid or gas discharged from such formations is prevented from entering the bore and contaminating the oil produced from the bottom of the well. The casing also serves to support the walls of the bore and to prevent their collapse into the hole. In some instances the diameter of the bore is decreased in steps as the depth is increased and is lined with casings of decreasing diameter. Inasmuch as the uppermost and largest of such casings is subjected to the least external stress, the upper casing is usually constructed with relatively thin walls in order to reduce internal stresses which are dependent upon the weight of the casing itself.

Within recent years in certain producing fields, particularly those located near the sea or in localities subject to earthquakes, considerable difficulty has been encountered in the way of well casings being ruptured or otherwise damaged as a result of the subsidence or shifting of the strata surrounding the bore. Such land movement is more or less confined to the upper strata and seldom extends below a depth of about 2000 feet. However, since there is usually very little if any space between the casing and the walls of the bore, even a slight transverse movement of the latter brought about by land subsidence or other shifting will impose great external stresses on the upper part of the casing where it is least capable of resisting such stresses, thereby causing the casing to rupture or collapse. When this occurs it is necessary to remove and replace the damaged casing, which operation is both time-consuming and expensive and does not afford permanent protection of the casing against a recurrence of the same difficulty.

Well casings are also subject to corrosion damage caused by salt brines and the like seeping

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into the bore hole from subterranean brine strata traversed by the bore. In most instances such corrosion damage occurs on the outside of the casing by reason of the corrosive brine seeping into and occupying the annular space between the casing and the walls of the bore. In certain localities, particularly in mid-continent oil fields, there are encountered subterranean brines and connate waters which are so corrosive that well casings become completely corroded through and must be replaced in as little as 24 months. In other instances corrosion of well casings is caused by bacterial action or by electrolysis.

It is accordingly an object of the present invention to provide means for preventing damage to well casings by land subsidence or shifting and/or by corrosion.

Another object is to provide methods and compositions which afford substantially permanent protection of well casings against damage caused by land subsidence or shifting and/or by corrosion.

A further object is to provide compositions suitable for use in protecting well casings against damage caused by land subsidence or shifting.

A still further object is to provide compositions suitable for use in protecting well casings against damage caused by corrosive fluids occupying the space between the casing and the walls of the bore.

Other objects will be apparent from the following detailed description of the invention, and various advantages not specifically referred to herein will occur to those skilled in the art upon employment of the invention in practice.

I have now found that the above and related objects may be realized by surrounding the casing with a semi-solid plastic composition having certain specific properties. More particularly, I have found that well casings may be protected from mechanical damage caused by land subsidence or shifting by enlarging the size of the bore along that portion of its length which is subject to transverse or lateral movement of the earth or substrata, installing the casing in the bore in the conventional manner, and thereafter packing the enlarged annular space between the casing and the walls of the bore with a composition which has sufficient consistency to provide support for the casing and at the same time is sufficiently plastic to absorb lateral or transverse movements of the strata traversed by the bore. I have further found that well casings may be protected against corrosion damage caused by brines or other corrosive influences occupying

the annular space between the casing and the walls of the bore by packing such space with a similar semi-solid plastic composition. In addition to possessing the proper ultimate consistency and plasticity, the composition which is packed around the casing must have a relatively low initial viscosity in order that it may readily be handled and pumped into the well bore. It must be water-insoluble and not adversely affected by brines or other liquids with which it may come in contact during use, and should not be subject to fermentation. It must be substantially non-corrosive towards the casing, and should comprise cheap and readily available ingredients. Preferably it should be preparable at or near the well site without the use of special equipment.

The manner in which the compositions provided by the invention are employed for the protection of well casings against mechanical damage caused by land subsidence or shifting in accordance with the invention may readily be understood by reference to the accompanying drawing which forms a part of this specification.

In said drawing:

Figure 1 diagrammatically represents a well bore which has been completed and cased in the conventional manner;

Figure 2 shows the well of Figure 1 prepared for treatment with a semi-solid plastic composition in accordance with one embodiment of the invention;

Figure 3 shows the well of Figure 2 upon completion of treatment according to the invention; and

Figure 4 illustrates an alternative embodiment of the principle of the invention.

Referring now to Figure 1 of said drawing, bore hole 11 is shown penetrating a surface stratum 12, subsurface strata 13 and 14, and producing formation 15. Well casing 16 extends within the bore hole for a portion of its length, usually 1500 feet or more, and serves to prevent collapse of the walls of the bore into the hole as well as to prevent sub-surface fluids such as water or brine from entering the bore. Casing 16 is supported at its lower end by cement plug 17, which also serves to seal off the annular space between the casing and the walls of the bore. Well tubing 18 extends through the casing and the uncased portion of the bore into the producing formation 15, and serves for the withdrawal of the well fluids therefrom. It will readily be seen that any subsidence of surface stratum 12, or lateral shifting of sub-surface strata 13 or 14 will cause rupture or collapse of the casing 16 and possibly also of tubing 18.

Referring now to Figure 2, upper portion of the original well bore 11, shown by means of broken lines, which traverses stratum 13 subject to lateral shifting, has been enlarged and now appears designated by 11a. The diameter of the enlarged portion of the bore 11a should be as large as is conveniently and economically possible in order to allow for a maximum amount of lateral shifting of the subterranean formation. Usually such diameter will be from 24 to 36 inches depending upon the size of the casing employed. Various means of drilling or reaming out large diameter bores of this nature are known in the art, and special drilling tools are available for this purpose. The depth to which the enlarged bore extends depends upon the nature of the sub-surface strata, and should extend through those strata subject to shifting. In most loca-

tions such depth will usually not be greater than about 2500 feet. Casing 16 is supported at its lower end by cement plug 17, and has been provided with perforations 19 located adjacent the lower end of enlarged bore 11a. Tubing 18 has been withdrawn, fitted with a port-collar 20, capped at its lower end with cap 21, and reinserted in the casing so that port-collar 20 is positioned opposite casing perforations 19. Port-collar 20 is provided with an opening 22 through which any fluid material which is forced down through the tubing will flow into the casing. Tubing 18 carries upper and lower packing rings 23 and 24, respectively, which extend to the inner walls of the casing and thus confine any liquid forced into the casing through port-collar 20 to the immediate vicinity of perforations 19. Casing 16 is supported at the surface by foundation ring 25 and/or by the casing head and associated piping. When a liquid or semi-liquid is forced into tubing 18 at the surface, as shown, such liquid will pass down the tubing, out through opening 22 in port-collar 20 and into casing 16, and thence through perforations 19 into the annular space between casing 16 and the walls of the bore 11a.

Figure 3 shows the same well upon completion of the treatment, after sufficient of the composition has been forced down the tubing and out through the casing perforations to fill entirely the annular space between the casing and the walls of the bore, 26. Port-collar 20, cap 21, and packing rings 23 and 24 have been removed from tubing 18, and the latter has been run back into the bore to serve its usual function. As will readily be seen, considerable lateral shifting of the formation surrounding the bore can occur without damage to the casing or tubing since the plastic composition forms a cushion-like packing around the casing, which packing is capable of yielding and giving way to the shifting strata but at the same time has sufficient consistency or "body" to provide support for the casing and to avoid being lost into permeable formations or strata. In contrast, in the well shown in Figure 1 even slight lateral movement of the sub-surface strata will cause serious damage to the casing.

Figure 4 illustrates an alternative embodiment of the principle of the invention which is particularly suitable for use in the construction of new wells in fields where probable shifting of sub-surface strata is confined to a more or less definite location. In such cases a bore 11 of conventional size is drilled down to sub-surface stratum 13 which is known to be subject to shifting. By means of special tools well known in the art, the bore is then enlarged and drilled through stratum 13 into underlying strata 14 by an operation known as "under-cutting" or "bell-holing." The enlarged bore is designated 11a. The bore is then narrowed to its original diameter and is drilled through stratum 14 to the producing formation 15 in the conventional manner. Casing 16 is set as usual and is secured at its lower end by cement plug 17, the cement being allowed to rise behind the casing to a point somewhat below the enlarged section of the bore 11a. The annular space between the walls of the bore 11 and 11a and the casing 16 is then packed with the herein described plastic composition 26 which serves to absorb any subsequent lateral movement of stratum 13. The well is then completed in the customary manner

and tubing 18 is run into to serve its usual purpose.

The above described method for packing the annular space between the casing and the walls of the bore with the semi-solid plastic composition is generally applicable to all wells and represents a preferred technique. In some instances, however, it is possible to force the composition directly from the surface into the annular space behind the casing. The invention is not limited to any particular method for placing the composition in the desired position.

When the principle of the invention is applied to the protection of well casings from corrosion damage caused by corrosive influences occupying the space between the casing and the walls of the bore it is usually not necessary that the diameter of the bore hole be enlarged prior to application of the packing composition. In other respects, however, the methods employed are the same as those previously described.

It will be readily apparent that, among other properties, the packing composition must initially be sufficiently fluid to be readily handled and forced either directly or indirectly via the tubing, into the annular space behind the casing. On the other hand, the composition should have sufficient consistency or "body" to provide some support for the tubing and/or to prevent its being lost into permeable formations traversed by the bore. In general, when the composition is employed to protect the casing against corrosion damage it should have an ultimate consistency corresponding to an API Shearometer value of at least about 20 lbs./100 sq. ft. The determination of the API Shearometer value is described in "API Recommended Practice, Code 29," 3rd edition, May 1950. Somewhat heavier or thicker compositions should be employed for protecting the casing against mechanical damage caused by land subsidence or shifting. Such compositions should have a consistency corresponding to an API Shearometer value of at least about 30 lbs./100 sq. ft., and preferably at least about 40 lbs./100 sq. ft.

It will be apparent to those skilled in the art that compositions having API Shearometer values above about 20 lbs./100 sq. ft. are far too thick to permit their being pumped down a well tubing or bore to any considerable depth without the use of exceptionally powerful pumps. Even unusually heavy oil-base drilling fluids seldom have Shearometer values above about 10 lbs./100 sq. ft. Accordingly, any composition suitable for use in accordance with the well treating methods described above must have the unusual property of initially being sufficiently fluid to permit its ready handling and pumping but ultimately setting up to form a plastic semi-solid having a Shearometer value above about 20 lbs./100 sq. ft. The time required for the composition to set up into such a plastic semi-solid should be at least about 1 hour in order to provide time for its proper positioning around the casing in the well bore, and is preferably at least about 3 hours.

I have found that compositions having the aforementioned requisite and desirable properties, including that of being initially relatively fluid but ultimately taking the form of a plastic semi-solid, may be obtained by dispersing an alkali-metal soap of disproportionated rosin and an alkaline-earth metal base in a major proportion of mineral oil. The disproportionated rosin soap and the alkaline-earth metal base react by

metathesis to form the corresponding alkaline-earth metal soap which is oil-dispersible and which serves to thicken the mineral oil base to the requisite consistency. The particular soap employed, in contrast to other rosin soaps, has the peculiar property of reacting but slowly with the alkaline-earth metal base at ordinary temperatures thereby giving the composition the requisite "slow-sett" characteristics. It is essential that the disproportionated rosin be employed in the form of an alkali-metal soap so that the alkaline-earth metal soap is formed in situ by metathesis. If it is attempted to form the alkaline-earth metal soap by direct neutralization of disproportionated rosin with the alkaline-earth metal base it is found that the neutralization reaction takes place relatively rapidly, and the composition sets up to a semi-solid in a very few minutes. Such a composition has "quick-sett" characteristics rather than the requisite "slow-sett" characteristics.

The mineral oil which constitutes the major proportion of the well-packing compositions provided by the invention most suitably has an API gravity below about 30° and a viscosity greater than about 25 SSF at 122° F. Preferably an oil having an API gravity of about 8°-18°, and a viscosity of about 35-65 SSF at 122° F. is employed. Such oil may be crude petroleum or a distillate or residuum material. Relatively heavy materials such as light tars, cracked residua, heavy extracts and the like are also well suited, particularly when blended with a light distillate such as gas oil, diesel fuel, etc. Domestic fuel oils which meet the specifications designated PS-300 and PS-400 are particularly well adapted. The invention, however, is not limited to any particular types of oil or mixtures thereof.

The rosin soaps employed in the new compositions provided by the invention are alkali-metal soaps of disproportionated rosin. Such soaps are obtained by saponifying with an alkali-metal alkali wood or gum rosin which has been treated at an elevated temperature with an active hydrogenation catalyst in the absence of added hydrogen. The reaction effected by such treatment is termed "disproportionation" since it involves the simultaneous hydrogenation and dehydrogenation of abietic-type acids with the consequent formation of dihydro-abietic and dehydro-abietic acids and their analogues, and the resulting product is referred to as "disproportionated rosin." In general, the disproportionation treatment is carried out at temperatures between about 150° C. and about 300° C. for a period of time such that the disproportionated rosin product contains at least about 40 per cent by weight of dehydro-abietic acid. Suitable catalysts include metallic palladium, platinum, and nickel, and may be supported on a carrier such as asbestos, activated charcoal, or the like. Usually the disproportionated rosin product is purified by fractional distillation prior to its saponification to form an alkali-metal soap. Procedure for carrying out the saponification reaction is well known in the art, and in general consists merely in adding the disproportionated rosin in the solid or molten state to a hot aqueous solution of the desired alkali-metal alkali, e. g., sodium hydroxide, potassium hydroxide, sodium carbonate, etc., and thereafter heating the mixture until the reaction is complete and the product contains the desired amount, e. g., 5-30 per cent, of water. Further details concerning the disproportiona-

tion treatment and saponification are set forth in U. S. 2,154,629 and U. S. 2,485,616.

While any alkali-metal soap of disproportionated rosin may be employed in preparing the compositions of the invention, I have found that the desired plasticity and consistency is most readily attained when the soap component is predominantly that obtained by heating rosin at a temperature of about 225°–300° C. for about 15–60 minutes in contact with a hydrogenation catalyst, e. g., a palladium catalyst, in the absence of added hydrogen, distilling the resulting product and collecting a middle fraction distilling at about 210°–275° C. under about 5–10 mm. pressure, and thereafter saponifying such fraction with aqueous sodium hydroxide in the known manner. Such a product is available commercially under the trade name "Dresinate 731."

The alkaline-earth metal base component of the new composition may be any oxide, hydroxide, or basic salt of any of the alkaline-earth metals, e. g., calcium oxide, calcium hydroxide, barium hydroxide, strontium hydroxide, magnesium oxide, calcium acetate, etc. Mixtures of such bases may also be employed. Calcium hydroxide and calcium oxide form a preferred group of alkaline-earth metal bases by reason of their low cost and general availability.

As previously stated, the compositions of the invention derive their physical properties from the fact that the disproportionated rosin soap and the alkaline-earth metal base slowly react by metathesis to form the corresponding alkaline-earth metal soap dispersed in the base oil, said dispersed soap imparting to the oil the desired consistency. In almost all instances sufficient water is present as an impurity in the alkali-metal disproportionated rosin soap and in the base oil to insure that the metathesis reaction readily occurs. If desired, however, a small amount of water, e. g., 0.1–10 per cent by weight of the composition, may be included as an optional component.

An inert mineral filter may also optionally be provided in the interests of reducing the amount of disproportionated rosin soap required to form a composition of the desired consistency. Porous materials, such as diatomaceous earth, cellite, kieselguhr and the like are especially suitable for such purpose, as are clays such as bentonite and alkaline-earth metal oxides such as calcium or magnesium oxide. The latter are often preferred since they may also be employed as the alkaline-earth metal base component.

Free alkali-metal base is formed as a by-product of the metathesis reaction. I have found that such free base has a somewhat deleterious action on the gel strength of the composition and that the amount of soap required to impart a given consistency to the composition may be appreciably reduced if there is provided in the composition an agent capable of neutralizing the free base. Such agent is suitably a weak acid, e. g., acetic acid, and is usually employed in an amount approximately chemically equivalent to the amount of the alkali-metal soap. If desired, such agent may be employed in smaller amounts or it may be omitted entirely. A small quantity of a bactericide may be included for the purpose of inhibiting bacterially-induced corrosion of the well casing.

The quantity of the alkali-metal disproportionated rosin soap employed depends upon the

viscosity of the base oil, the presence or absence of inert filler, and the desired ultimate consistency of the composition. As previously stated, when the composition is to be employed for protecting well casings against mechanical damage caused by land subsidence or shifting, it should have a semi-solid consistency represented by an API Shearometer value of at least about 30 lbs./sq. ft., preferably at least about 40 lbs./sq. ft. In the absence of an inert filler, the amount of the soap required to attain such consistency will be between about 3 and about 10 per cent by weight of the entire composition, depending upon the viscosity of the base oil. When a filler material such as diatomaceous earth is included in the composition it is usually employed in an amount representing between about 1 and about 20 per cent by weight of the entire composition, in which case the amount of soap may be reduced to about 2–3 per cent. When the composition is to be employed for the protection of well casings against corrosion damage, it need have a consistency representing an API Shearometer value of only at least about 20 lbs./sq. ft. In such case, the soap need be employed in an amount representing only between about 1.5 and about 5 per cent by weight of the entire composition, although greater amounts may be employed if desired. In general, then, the alkali-metal disproportionated rosin soap component of the new compositions is employed in an amount sufficient to impart to the composition an API Shearometer value of at least about 20 lbs./sq. in., such amount usually representing between about 1.5 and about 10 per cent by weight of the entire composition, depending upon the viscosity of the base oil and the presence or absence of an inert mineral filler.

The alkaline-earth metal base component is employed in an amount at least equal to that chemically equivalent to the amount of disproportionated rosin soap. If desired, an excess quantity of base may be employed, in which case such excess serves as a filler as above explained. In general, the base is usually employed in an amount representing between about 0.2 and about 10 per cent by weight of the entire composition.

The exact manner and order in which the solid components are dispersed in the base oil is not of primary importance. Usually, however, it is preferred to prepare an initial concentrate composition by dispersing the soap and any filler which may be employed in a part of the base oil, and thereafter to dilute such concentrate with the remainder of the oil and add the alkaline-earth metal base to form the finished composition. For example, the soap and filler may be stirred into a small amount of a relatively light oil to form a concentrate to which the alkaline-earth metal base and a large quantity of a relatively heavy oil are subsequently added. Alternatively, the total quantity of soap and alkaline-earth metal base may be added to a portion of the oil, and the resulting mixture subsequently diluted with the remainder of the oil. If desired, a filler may be added to the diluted composition. A particularly convenient procedure consists in forming a soap concentrate by dispersing the soap in part of the oil, forming a base concentrate by dispersing the alkaline-earth metal base in part of the oil, diluting the soap concentrate with the remainder of the oil, and pumping the diluted soap concentrate and base concentrate directly down the well tubing without previous admix-

ture. The action of the pump will provide adequate mixing. If a filler is employed it may be included as part of either the soap or base concentrates or both. When a weak acid is provided for the purpose of neutralizing the free alkali-metal base as explained above, such acid may be added along with the soap. When water in excess of that normally incident with the soap and oil is incorporated in the composition it may likewise be added along with the soap.

The following examples will illustrate several ways in which the principle of the invention has been applied, but are not to be construed as limiting the same. All proportions are given in parts by weight.

Example I

	Parts
Fuel oil.....	800
Dresinate 731.....	24
Calcium oxide.....	50
Water.....	10

The Dresinate and water and about one-half of the calcium oxide are added to about 600 parts of the fuel oil, which is a light domestic grade having a gravity of about 14.5° API and a viscosity of about 36 SSF at 122° F., after which the mixture is stirred for about ½ hour. The remainder of the oil and calcium oxide are then stirred into the mixture to obtain the finished product which, after standing for several hours, takes the form of a gel-like semi-solid having an API Shearometer value of about 45 lbs./100 sq. ft. The excess calcium oxide serves as the filler.

Example II

	Parts
California crude oil, 18° API.....	600
Dresinate 731.....	40
Hydrated lime.....	40
Diatomaceous earth.....	70
Water.....	10

The Dresinate, water, and diatomaceous earth are stirred into 200 parts of the oil, and stirring is continued for about ½ hour. The resulting concentrate composition may be shipped or stored indefinitely. When it is desired to prepare the final composition, the remainder of the oil and the calcium oxide is added with stirring.

Example III

	Parts
Fuel oil.....	600
Dresinate 731.....	24
Calcium oxide.....	24
Magnesium oxide.....	85
Water.....	10
Acetic acid.....	20

The Dresinate, water, and calcium oxide are dispersed in one-half of the oil, which is the same as that employed in Example I. The mixture is stirred for about one-half hour, after which the acetic acid is added. Finally, the remainder of the oil and the magnesium oxide filler are added. The resulting composition is a thick gel-like plastic solid having an API Shearometer value of about 60 lbs./100 sq. ft.

Example IV

	Parts
Fuel oil.....	600
Dresinate 731.....	40
Calcium oxide.....	10

The Dresinate and calcium oxide are each dis-

persed in 100 part portions of the oil. When it is desired to treat a well as herein described the Dresinate concentrate is diluted with the remainder of the oil, and the diluted concentrate and calcium oxide dispersion are pumped down the well tubing by means of a common pump. Mixing of the two dispersions is achieved by the action of the pump.

Example V

The method of the invention has been successfully applied to the drilling of a number of wells in the vicinity of Long Beach, California, where a stratum subject to shifting is known to lie at a depth between about 1300 and 1900 feet. These wells are drilled into the producing formation in the conventional manner with a bore diameter of 9-10 inches. By use of an under-cutting or "bell-holing" technique the bore is then enlarged to a diameter of about 20-30 inches along that portion of the bore which traverses the stratum subject to shifting. A 7- or 8-inch casing running the full depth of the bore is then set and cemented in place in the usual manner. The plastic composition employed to pack the space between the walls of the bore and the casing is prepared as follows: An initial concentrate composition is prepared by dispersing 140 lbs. of Dresinate 731 and 100 lbs. of diatomaceous earth in 26 gallons of light diesel fuel having an API gravity of about 31°. These quantities make one barrel of concentrate. Such composition is a relatively fluid liquid which is readily handled by conventional pumping equipment and which may be stored in drums until desired for use. At such time, each barrel of concentrate is diluted with 9 barrels of local crude oil having an API gravity of about 14°, and 30 lbs. of quicklime (calcium oxide) is stirred into the diluted concentrate. The resulting composition is then immediately pumped down the casing and out into the annular space between the walls of the bore and the casing through a port-collar appropriately located on the casing string. Within a short time the composition sets up into a firm plastic solid which provides support for the casing and absorbs any movement of the shiftable stratum. Approximately 600 barrels of the composition are required per well. The cement plug at the foot of the casing is then drilled out, and the well is brought into production in the usual manner.

Other modes of applying the principle of my invention may be employed instead of those explained, change being made in the methods or materials employed, provided the steps or compositions stated by any of the following claims, or the equivalent of such stated steps or compositions, be employed. In said claims, the term "ultimate API Shearometer value" refers to the API Shearometer value which the composition assumes after having been allowed to stand quiescent long enough to develop maximum consistency and/or gel strength.

This application is a continuation-in-part of my copending application, Serial No. 176,170, filed July 27, 1950 now abandoned.

I, therefore, particularly point out and distinctly claim as my invention:

1. A semi-solid plastic composition prepared by dispersing an alkali-metal soap of disproportionated rosin and an amount of an alkaline-earth metal base at least equal to that chemically equivalent to said soap in a mineral oil, the amount of said soap being correlated with the viscosity of said mineral oil to give a composi-

tion initially fluid to be readily handled and ultimately setting up to form a plastic semi-solid having an A. P. I. Shearometer value above about 20 lbs./100 sq. ft.

2. A composition according to claim 1 wherein the soap is predominantly that obtained by heating rosin at a temperature between about 225° C. and about 300° C. for from about 15 to about 60 minutes in contact with an active hydrogenation catalyst, distilling the resulting product to isolate a middle fraction distilling between about 210° C. and about 275° C. under from about 5 to 10 mm. pressure, and saponifying such fraction with sodium hydroxide.

3. A composition according to claim 1 wherein the alkaline-earth metal base is selected from the class consisting of calcium hydroxide and calcium oxide.

4. A composition according to claim 1 containing between about 1 and about 20 per cent by weight of an inert mineral filler.

5. A semi-solid plastic composition prepared by dispersing an alkali-metal soap of disproportionated rosin and an amount of an alkaline-earth metal base at least equal to that chemically equivalent to said soap in a mineral oil having an API gravity below about 30° and a viscosity greater than about 25 SSF at 122° F., said soap being employed in an amount representing between about 1.5 and about 10 per cent by weight of the entire composition the amount of said soap being correlated with the viscosity of said mineral oil to give a composition initially fluid to be readily handled and ultimately setting up to form a plastic semi-solid having an API Shearometer value about about 20 lbs./100 sq. ft.

6. A composition according to claim 5 wherein the soap is that obtained by heating rosin at a temperature between about 225° C. and about 300° C. for from about 15 to about 60 minutes in contact with an active hydrogenation catalyst, distilling the resultant product to isolate a middle fraction distilling between about 210° C. and about 275° C. under from about 5 to about 10 mm. pressure, and saponifying such fraction with sodium hydroxide; and the alkaline-earth metal base is selected from the class consisting of calcium hydroxide and calcium oxide.

7. A composition according to claim 5 containing between about 1 and about 20 per cent of an inert mineral filler.

8. A semi-solid plastic composition prepared by dispersing an alkali-metal soap of disproportionated rosin and an amount of an alkaline-earth metal base at least equal to that chemically equivalent to said soap in a mineral oil having an API gravity below about 30° and a viscosity greater than about 25 SSF at 122° F., said soap being employed in an amount representing between about 3 and about 10 per cent by weight of the entire composition the amount of said soap being correlated with the viscosity of said mineral oil to give a composition initially fluid to be readily handled and ultimately setting up to form a plastic semi-solid having an API Shearometer value above about 30 lbs./100 sq. ft.

9. A composition according to claim 8 wherein the soap is that obtained by heating rosin at a temperature between about 225° C. and about 300° C. for from about 15 to about 60 minutes in contact with an active hydrogenation catalyst, distilling the resultant product to isolate a middle fraction distilling between about 210° C. and about 275° C. under from about 5 to about 10

mm. pressure, and saponifying such fraction with sodium hydroxide; and the alkaline-earth metal base is selected from the class consisting of calcium hydroxide and calcium oxide.

10. A composition according to claim 9 containing between about 1 and about 20 per cent by weight of an inert mineral filler comprising diatomaceous earth.

11. A semi-solid plastic composition prepared by dispersing in a mineral oil having an API gravity of about 8°-18° and a viscosity of about 35-65 SSF at 122° F.: (1) between about 2 and about 10 per cent, based on the weight of the entire composition, of a sodium soap of disproportionated rosin obtained by heating rosin at a temperature between about 225° C. and about 300° C. for from about 15 to about 60 minutes in contact with an active hydrogenation catalyst, distilling the resulting product to isolate a middle fraction distilling between about 210° C. and about 275° C. under from about 5 to about 10 mm. pressure, and saponifying such fraction with sodium hydroxide; (2) between about 0.2 and about 5 per cent, based on the weight of the entire composition, of an alkaline-earth metal base selected from the class consisting of calcium hydroxide and calcium oxide; (3) between about 0.1 and about 10 per cent, based on the weight of the entire composition, of water; and (4) between about 1 and about 20 per cent by weight of a mineral filler comprising diatomaceous earth; to give a composition initially fluid to be readily handled and ultimately setting up to form a plastic semi-solid having an API Shearometer value above about 40 lbs./100 sq. ft.

12. The method of protecting well casings which comprises filling the annular space between the walls of the bore and the casing with the composition defined by claim 1.

13. The method of protecting well casings which comprises filling the annular space between the walls of the bore and the casing with the composition defined by claim 2.

14. The method of protecting well casings which comprises filling the annular space between the walls of the bore and the casing with the composition defined by claim 6.

15. The method of protecting well casings from damage caused by movement of earth formations surrounding the well bore which comprises enlarging the diameter of the well bore so as to provide an enlarged annular space between the walls of the bore and the well casing extending through said formation subject to movement, and filling said enlarged annular space with the composition defined by claim 8.

16. The method of protecting well casings from damage caused by movement of earth formations surrounding the well bore which comprises enlarging the diameter of the well bore so as to provide an enlarged annular space between the walls of the bore and the well casing extending through said formations subject to movement, and filling said enlarged annular space with the composition defined by claim 11.

17. The method of drilling a well traversing formations subject to movement which comprises drilling a bore hole of conventional diameter, enlarging said bore hole along that portion of its length which traverses said formations subject to movement, setting a well casing within the bore hole, cementing the lower end of said casing and filling the annular space between said casing and

the enlarged portion of the bore hole with the composition defined by claim 8.

18. The method of drilling a well traversing formations subject to movement which comprises drilling a bore hole of conventional diameter, enlarging said bore hole along that portion of its length which traverses said formations subject to movement, setting a well casing within the bore hole, cementing the lower end of said casing and filling the annular space between said casing and the enlarged portion of the bore hole with the composition defined by claim 11.

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