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**HUMBERTO RUBIO & CIA.
ABOGADOS**

Carrera 7 No. 74-64 Oficina 506
Teléfono 313 24 08 - 313 24 10 - 313 24 23 - 313 17 99
Fax: (571) 313 16 - 47 - (571) 313 23 67

Email: rubiolaw@unecic.com

Apartado Aéreo 21848
Bogotá, D.C. - Colombia

Señor
SUPERINTENDENTE DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES

E. S. D.

SUPERINDUSTRIA Y COMERCIO
Modificación : 01062411 00000001 Folios: 36
Fecha (AÑO): 2001-10-30 12:43:29
Trámite : 002 PATENTES D 1 REGISTRADO/ 329 CANCELADO
Dependencia: 2820 DIVISION DE NUEVAS CREACIONES

REF. Expediente: 01-062.411
Patente de Invención: **PERFORACIÓN DE POZOS Y
FLUIDOS DE SERVICIO, Y
METODOS DE REMOCIÓN DE
AGLUTINANTES EN FILTROS
DEPOSITADOS EN ESTOS.**
Titular: **HALLIBURTON ENERGY
SERVICES, INC.**

DESTINO: 09

HUMBERTO RUBIO CAMACHO, mayor de edad, vecino de Bogotá, D.C., identificado con la cédula de ciudadanía número 17'192.062 de Bogotá, abogado en ejercicio portador de la Tarjeta Profesional No. 50.007, expedida por el Consejo Superior de la Judicatura, en carácter de apoderado de la Sociedad **HALLIBURTON ENERGY SERVICES, INC.**; encontrándome dentro del término legal establecido por los Artículos 10 y 39 de la Decisión 486 de la Comunidad Andina, me permito anexar los siguientes documentos:

- 1.- Copia certificada de la Solicitud No. 09/629,959 del 01 de Agosto de 2.000, de Estados Unidos de América, expedida por la Autoridad Competente, junto con su respectiva traducción al Castellano; base de la prioridad reivindicada en la solicitud de registro de la Patente de Invención citada en la referencia; todo de conformidad con el Artículo 4º del Convenio de la Unión de París y el Concepto 5 de enero de 1.999 de la SIC.

Teniendo en cuenta lo anterior, solicito se continúe con su respectivo trámite.

Atentamente,


HUMBERTO RUBIO CAMACHO
C.C. 17'192.062 de Bogotá
T.P. 50.007 Consejo Superior
de la Judicatura
COD 4134

01/448-05/PI

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THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

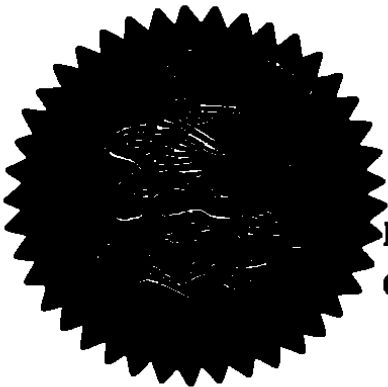
United States Patent and Trademark Office

August 09, 2001

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 09/629,959

FILING DATE: August 01, 2000



**By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS**

E. Bornett
E. BORNETT

Certifying Officer

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PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

PTO-1556
(5/87)

*U.S. GPO: 1979-432-082/19144

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Express Mailing Label: EJ 261445180 US
Mailing Date: August 1, 2000

PATENT HES 99.0371 U1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Bradley L. Todd) Atty Docket: HES .99.0371 U1
B. Raghava Reddy)
James V. Fisk, Jr.) Art Group Unit:
James D. Kercheville)
Serial No.: Unknown) Examiner: Unknown
Filed: August 1, 2000) Date: August 1, 2000
For: " Well Drilling And Servicing)
Fluids And Methods Of)
Filter Cake Deposited)
Thereby")

TRANSMITTAL LETTER

Box Patent Application
Assistant Commissioner
For Patents
Washington, D. C. 20231

Sir:

Attached hereto for filing in the United States Patent and Trademark Office is the patent application identified above, comprising:

1. Specification (with 32 claims)
2. Declaration, Power of Attorney and Petition
3. Information Disclosure Statement with PTO-1449 and Copies of References
4. Assignment and Assignment Transmittal
5. Temporary Filing Receipt

The filing fee has been computed as follows:

Basic Fee: \$ 690.00
Additional Fees:

Total number of claims (32)
(whether independent or

dependent) 12 in excess of 20,
12 X \$18.00 \$ 216.00

Number of independent claims,
0 minus 03 0 X 78.00 = \$ 00.00
TOTAL \$ 906.00

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HALLIBURTON ENERGY SERVICES, INC.

ROBERT A. KENT
Registration No: 28,626
P. O. Drawer 1431
Duncan, Oklahoma 73536-0102

Express Mail: EJ 261445180 US
Deposited: August 1, 2000

CERTIFICATE OF MAILING BY EXPRESS MAIL

I hereby certify that all of the documents listed in the foregoing Transmittal Letter are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Box Patent Application, Assistant Commissioner For Patents and Trademarks, Washington, D. C. 20231.

Beth Johnson
Beth Johnson

RAK:b7

33 37
HES 99.0371U1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Bradley L. Todd et al.

Serial No.: Unknown

Filed: Concurrently Herewith

For: WELL DRILLING AND
SERVICING FLUIDS AND
METHODS OF REMOVING
FILTER CAKE DEPOSITED
THEREBY

Art Unit: Unknown

Examiner: Unknown

INFORMATION DISCLOSURE STATEMENT

COMMISSIONER FOR PATENTS
Washington, D.C. 20231

Sir:

The following prior art is known to Applicants or Applicants' attorneys and is submitted for the Examiner to consider in the above-captioned application.

U.S. PATENTS

U.S. Patent No. 5,238,065 issued on August 24, 1993 to Thomas C. Mondshine et al.

FOREIGN PATENT APPLICATION

European Patent Application No. EP 0 672 740 A1 filed March 14, 1995 and published on September 20, 1995.

Copies of the aforementioned references and Form PTO-1449 are submitted herewith.

Respectfully submitted,

C. Clark Dougherty Jr.

C. Clark Dougherty, Jr.
Registration No. 24,208
McAFEE & TAFT

Two Leadership Square
211 N. Robinson, Tenth Floor
Oklahoma City, Oklahoma 73102
(405) 235-9621

ATTORNEY FOR APPLICANTS

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FORM PTO-1449 (Modified) LIST OF PATENTS AND PUBLICATIONS FOR APPLICANT'S INFORMATION DISCLOSURE STATEMENT (Use several sheets if necessary)	ATTY. DOCKET NO. HES 99.0371U1	SERIAL NO. Unknown
	APPLICANTS Bradley L. Todd et al.	
	FILING DATE Concurrently Herewith	GROUP Unknown

35326 U.S. PTO
09/62999
66629/68
08/24/93
08/24/93

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		Document No.	Date	Name	Class	Subclass	Filing Date if Appropriate
	AA	5,238,065	08/24/93	Mondshine et al.	166	300	
	AB						
	AC						
	AD						
	AE						
	AF						
	AG						
	AH						
	AI						
	AJ						
	AK						

FOREIGN PATENT DOCUMENTS

		Document No.	Date	Country	Class	Subclass	Translation	
							Yes	No
	AL	EP 0672740A1	09/20/95	European				
	AM							
	AN							
	AO							
	AP							

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)

	AR	
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EXAMINER	DATE CONSIDERED
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

5 **WELL DRILLING AND SERVICING FLUIDS AND
METHODS OF REMOVING FILTER CAKE DEPOSITED THEREBY**

Background of the Invention

10 **1. Field of the Invention.**

The present invention relates to well drilling and servicing fluids utilized in producing formations and the removal of filter cake deposited by the fluids in the formations.

2. Description of the Prior Art.

15 The use of special fluids for drilling or servicing hydrocarbon producing formations penetrated by well bores is well known. The drilling fluids are utilized when well bores are drilled into producing formations to minimize damage to the permeability of the formations and their ability to produce hydrocarbons. Servicing fluids are utilized when completion operations are conducted in producing formations and when conducting
20 work-over operations in the formations. The drilling and servicing fluids deposit filter cake on the walls of the well bores within the producing formations which prevents the drilling and servicing fluids from being lost into the formations and prevents solids from entering the porosities of the producing formations. After the drilling or servicing of a producing formation has been completed, the filter cake is removed prior to placing the
25 formation on production.

The removal of the filter cake has heretofore been accomplished by including a particulate solid bridging agent in the drilling or servicing fluid for bridging over the

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formation pores which is acid soluble. The filter cake formed by the drilling or servicing fluid which includes the bridging agent and a polymeric suspending agent has been contacted with a strongly acidic solution, and the acidic solution has been allowed to remain in contact with the filter cake for a period of time sufficient to dissolve the bridging particles and polymer. In spite of efforts to avoid it, the strongly acidic solution has often corroded metallic surfaces and completion equipment such as sand screens which caused their early failure. The acidic solution may also be incompatible with the producing formation and cause damage thereto.

Water soluble particulate solid bridging agent has also been utilized in drilling or servicing fluids, and the filter cake containing the water soluble bridging agent has been contacted with an aqueous salt solution which is undersaturated with respect to the water soluble bridging particles. However, such undersaturated aqueous solutions require a relatively long period of time to dissolve the particles primarily due to the polymeric suspending agents included in the drilling or servicing fluids. That is, the polymer or polymers present in the filter cake shield the water soluble bridging particles from the aqueous solution.

In order to remove the polymeric materials in the filter cake and thereby allow the bridging agent in the filter cake to be dissolved by aqueous solutions, the filter cake has heretofore been contacted with an aqueous salt solution containing a peroxide such as alkaline earth metal peroxides, zinc peroxides and the like. An acid has also been included in the aqueous solution containing the metal peroxide to activate the peroxide. The aqueous solution has been maintained in contact with the filter cake for a period of time such that the polymers in the filter cake are decomposed and the bridging agent

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dissolved. Thereafter, the walls of the well bore are contacted with a wash solution to remove the remaining filter cake therefrom. Generally, the time required for the solution containing the metal peroxide and acid to break-up polymers and dissolve the bridging agent has been relatively long making the process expensive and subjecting metal tools and parts in contact with the solution to acid corrosion.

Thus, there are continuing needs for improved drilling and servicing fluids and methods of removing filter cake deposited by the fluids from producing formations.

Summary of the Invention

The present invention provides improved well drilling and servicing fluids for use in producing formations which meet the needs described above and overcome the deficiencies of the prior art. The drilling and servicing fluids of this invention are basically comprised of water, a density increasing water soluble salt, a fluid loss control agent, a hydratable polymer solids suspending agent and a particulate solid bridging agent comprised of an inorganic compound which is dissolvable by a clean-up solution comprised of water and an ammonium salt. In a preferred embodiment, the inorganic bridging agent is magnesium oxide and the ammonium salt in the clean-up solution is ammonium chloride. A chelating agent such as citric acid and its salts is also preferably included in the clean-up solution. The well drilling and servicing fluid additionally can include a metal peroxide or other oxidizer or breaker which is activated by the ammonium salt in the clean-up solution and functions to oxidize and break-up polymer in the filter cake deposited by the fluid.

The present invention also provides methods of removing filter cake from the walls of well bores penetrating producing formations deposited therein by drilling or

servicing fluids. The methods include utilizing, as the particulate solid bridging agent in the drilling or servicing fluid, an inorganic compound which is dissolvable in a clean-up solution comprised of water and an ammonium salt. The filter cake formed by the drilling or servicing fluid is contacted with the clean-up solution comprised of water and an ammonium salt for a period of time such that the bridging agent is dissolved thereby. In a preferred method, the bridging agent is magnesium oxide and the ammonium salt in the clean-up solution is ammonium chloride. The clean-up solution also preferably includes a chelating agent.

In addition to the bridging agent, the drilling or servicing fluid can also include an oxidizer or other breaker which is deposited in the filter cake and is activated by the ammonium chloride in the cleaning solution to break-up polymer in the filter cake.

It is, therefore, a general object of the present invention to provide improved well drilling and servicing fluids for use in producing formations and methods of removing filter cake therefrom.

Other and further objects, features and advantages of the present invention will be readily apparent to those skilled in the art upon a reading of the description of preferred embodiments which follows.

Description of Preferred Embodiments

The present invention provides improved well drilling and servicing fluids for use in producing formations which deposit filter cake that can be readily removed without the use of acids or other hazardous chemicals. The well drilling and servicing fluids of this invention are basically comprised of water, a density increasing water soluble salt, a fluid loss control agent, a hydratable polymer solids suspending agent and a particulate solid

bridging agent which is soluble in a clean-up solution comprised of an aqueous ammonium salt solution. The density increasing water soluble salt can be one or more of sodium chloride, sodium bromide, sodium acetate, sodium formate, sodium citrate, potassium chloride, calcium chloride and calcium bromide. Common oilfield brines can be utilized and are preferred due to their ready availability in the oilfield.

A variety of fluid loss control agents can be utilized in the well drilling or servicing fluids of this invention, including, but not limited to, starch, starch ether derivatives, hydroxyethylcellulose, cross-linked hydroxyethylcellulose and mixtures thereof. Of these, starch is the most preferred. The fluid loss control agent is generally included in the salt solution or brine in an amount in the range of from about 0% to about 2% by weight of the salt solution or brine, more preferably in the range of from about 1% to about 1.3% and most preferably about 1.3%.

A variety of hydratable polymer solid suspending agents can be utilized, including, but not limited to, biopolymers such as xanthan and succinoglycon, cellulose derivatives such as hydroxyethylcellulose and guar and its derivatives such as hydroxypropyl guar. Of these, xanthan is preferred. The hydratable polymer is generally included in the drilling or servicing fluid in an amount in the range of from about 0% to about 0.6% by weight of the salt solution or brine, more preferably in the range of from about 0.13% to about 0.16% and most preferably about 0.13%.

In accordance with this invention, the particulate solid bridging agent is an inorganic compound that is substantially insoluble in water, but which is substantially soluble in aqueous ammonium salt clean-up solutions. Examples of such compounds include, but are not limited to, metal oxides, metal hydroxides, metal carbonates, metal

sulfates, metal tungstates, metal fluorides, metal phosphates, metal peroxides, metal fluosilicates and the like. Examples of suitable metal oxides which can be used include, but are not limited to, magnesium oxide, manganese oxide, calcium oxide, lanthanum oxide, cupric oxide and zinc oxide. Of these, magnesium oxide is preferred. The
5 bridging agent utilized in the drilling or servicing fluid is generally included therein in the amount of from about 5% to about 60% by weight of the aqueous salt solution or brine, more preferably in the range of from about 10% to about 27% and most preferably about 14%.

As will be understood by those skilled in the art, the particulate solid bridging
10 agent is deposited by the drilling or servicing fluid on the walls of the well bore in the producing zone being drilled or serviced along with other solid particles and gelled suspending agent polymer. Upon completion of the drilling or servicing operation, a clean-up solution comprised of water and an ammonium salt is introduced into the well bore whereby the particulate solid bridging agent in the filter cake is dissolved.

15 In addition to the bridging agent, the drilling or servicing fluid can also contain an oxidizer or other breaker which is activated by the ammonium salt in the clean-up solution and functions to oxidize and break up gelled polymeric suspending agents and fluid loss control additives in the filter cake. The breaking up of the polymeric materials allows the particulate solid bridging agent to be dissolved by the clean-up solution in a
20 shorter period of time. Generally, any oxidizer or other breaker that can be deposited with the filter cake and is substantially inactive until contacted with an aqueous ammonium salt solution can be utilized. For example, oxidizers that are substantially insoluble in water but are soluble in an aqueous ammonium salt solution can be utilized.

Oxidizers or other breakers that can be encapsulated with a material that is insoluble in water but soluble in aqueous ammonium salt solutions can also be used.

Various unencapsulated oxidizers and breakers that can be utilized in accordance with this invention include, but are not limited to, magnesium peroxide, magnesium peroxydiphosphate, strontium peroxide, barium peroxide, calcium peroxide, magnesium perborate, barium bromate and mixtures thereof. Of these, magnesium peroxide is preferred. The oxidizer or breaker utilized is generally included in the drilling or servicing fluid in an amount in the range of from about 0.1% to about 6% by weight of the aqueous salt solution or brine, more preferably in the range of from about 0.3% to about 3% and most preferably about 0.3%.

The ammonium salt utilized in the clean-up solution can be one or more ammonium salts having the following formula:



wherein R is an alkyl group having from 1 to 6 carbon atoms, n is an integer from 0 to 3
15 and X is an anionic radical selected from halogens, nitrate, citrate, acetate, sulfate,
phosphate and hydrogen sulfate.

Examples of suitable such ammonium salts include, but are not limited to, ammonium chloride, ammonium bromide, ammonium nitrate, ammonium citrate, ammonium acetate and mixtures thereof. Of these, ammonium chloride is preferred. The ammonium salt utilized is generally included in the clean-up solution in an amount in the range of from about 3% to about 25% by weight of water therein, more preferably in the range of from about 5% to about 14% and most preferably about 5%.

15 As mentioned above, after the drilling or servicing of a producing formation has been completed, the clean-up solution is introduced into the producing formation into contact with the filter cake deposited therein. The clean-up solution is allowed to remain in contact with the filter cake for a period of time sufficient for gelled polymer in the filter cake to be broken up and the bridging agent to be dissolved. Thereafter, the
20 formation can be produced to remove the remaining filter cake.

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adversely affect the permeability of the hydrocarbon containing producing formation. Thus, the cleaning solution can be an aqueous solution containing one or more salts which inhibit the swelling and/or dispersion of particles within the formation such as potassium chloride, sodium chloride, ammonium chloride and tetramethyl ammonium chloride. Of the above salts, ammonium chloride is preferred.

As will also be understood, the ammonium salt or mixtures of ammonium salts utilized in the clean-up solution can be delivered in solution as described above or the ammonium salt or salts can be encapsulated to delay the dissolution of the bridging solids until the clean-up of the filter cake is desired. Another similar technique for delivering the ammonium salt is to generate it in-situ, e.g., reacting urea with urease to form ammonium carbonate. When a chelating agent or mixture of chelating agents are used, the agent or agents can be delivered in solution, or encapsulated or generated in-situ.

A delayed break of the filter cake can also be achieved by utilizing a chelating agent that does not dissolve the bridging agent particles out of the presence of the ammonium salt or salts. The chelating agent can be included in the drilling or servicing fluid and the ammonium salt utilized can be delivered in encapsulated form or generated in-situ. Various other techniques known to those skilled in the art for providing delays can also be utilized such as delivering the chelating agent as an ester that slowly hydrolyzes to the acid chelating form, utilizing an ammonium salt that is not effective at a particular pH and introducing a second agent to change the pH to a level where the ammonium salt dissolves bridging particles, and other similar variations.

In accordance with the methods of this invention, filter cake is removed from the walls of a well bore penetrating a producing formation. The filter cake is deposited in the

A particularly suitable method of this invention for removing filter cake from the walls of a well bore penetrating a producing formation deposited therein by a drilling or servicing fluid is comprised of the following steps. A drilling or servicing fluid is utilized comprised of water, a density increasing water soluble salt selected from the group consisting of sodium chloride, sodium bromide, potassium chloride, calcium chloride and mixtures thereof or one or more brines containing such salts, a fluid loss

control agent comprised of starch, a hydratable polymer solid suspending agent comprised of xanthan, a particulate solid magnesium oxide bridging agent which is soluble in an aqueous ammonium salt solution and a particulate solid magnesium peroxide oxidizing agent which is activated by the ammonium salt to oxidize and break up gelled polymer in the filter cake. Thereafter, the filter cake produced by the drilling or servicing fluid is contacted with a clean-up solution comprised of water, ammonium chloride and a chelating agent such as citric acid for a time period such that gelled polymer in the filter cake is oxidized and broken up by the magnesium peroxide and the magnesium oxide bridging agent is dissolved by the clean-up solution. A wash solution can next be utilized to contact the walls of the well bore and wash away any remaining filter cake thereon or the remaining filter cake can be removed by producing the formation. As mentioned above, various components of the drilling or servicing fluid and/or the cleaning solution can be delivered to the producing formation in encapsulated form or generated in-situ, etc.

In order to further illustrate the drilling and servicing fluids and methods of this invention, the following examples are given.

Example 1

Horizontal wells are often completed utilizing servicing fluids which include particulate solid bridging agents that are deposited as a part of the filter cake on the walls of the well bores. The wells are completed by placing gravel packs in the producing zones and clean-up solution is placed in the gravel packs and left to soak so that the filter cake is dissolved and removed. In a typical horizontal well completed with a gravel pack in an 8 1/2" diameter well bore with 5 1/2" diameter screens, the solubility of the bridging

particles in the filter cake should be in the range of from about 1.5 to about 3 grams of filter cake per 100 cubic centimeters of clean-up solution.

A procedure for testing clean-up solutions for dissolving various particulate bridging agent was developed as follows: 1.5 grams of the particulate bridging agent tested are added to a 50 milliliter vial. The vial is then filled with clean-up solution, capped and placed in a 150° water bath for 24 hours. Thereafter, the solids in the vial are filtered using a preweighed filter. The filter with the solids thereon is dried and weighed to determine the weight of the undissolved solids. The solubility of the particulate bridging agent is then calculated in grams of bridging agent dissolved per 100 cubic centimeters of clean-up solution used.

A variety of particulate bridging agents and clean-up solutions were tested using the above described procedure, and the results of the testing are given in the Table below.

TABLE
Dissolution Of Particulate Solid
Bridging Agents With Ammonium Salt Solutions

Particulate Bridging Agent	Aqueous Ammonium Salt Clean-Up Solution	Solubility, grams per 100 cubic centimeter
Magnesium Oxide	4 M Ammonium Chloride	1.6
Magnesium Oxide	8 M Ammonium Acetate	2.8
Magnesium Oxide	1.3 M Ammonium Chloride plus 1 M Sodium Citrate	2.8
Magnesium Carbonate	8 M Ammonium Acetate	2.2
Magnesium Carbonate	4 M Ammonium Chloride plus 0.4 M Trisodium Salt of Nitrilotriacetic Acid (NTA)	2.9
Anhydrite (CaSO ₄)	4 M Ammonium Chloride	1.7
Anhydrite (CaSO ₄)	8 M Ammonium Acetate	2.9
Lime (CaOH)	1.3 M Ammonium Chloride	3
Zinc Oxide	4 M Ammonium Chloride	3
Zinc Oxide	1.3 M Ammonium Chloride plus 0.8 M Sodium Citrate	2.9
Zinc Carbonate	4 M Ammonium Chloride	2.4
Lanthanum Oxide	0.36 M Diammonium Salt of Ethylenediaminetetraacetic Acid (EDTA)	2.2
Manganese Hydroxide	4 M Ammonium Chloride	1.5

From the test results set forth in the Table, it can be seen that ammonium salt
5 clean-up solutions of this invention are effective in dissolving a variety of inorganic
bridging agent particles.

Example 2

A drilling or servicing fluid was prepared comprised of 350 milliliters of water containing 3% potassium chloride by weight of water, 4 grams of starch fluid loss control additive, 2 grams of xanthan polymer suspending agent and 3 grams of particulate solid magnesium oxide bridging agent. The fluid was placed in two fluid loss cells wherein it

[illegible]

was heated to 150°F and pressured to 500 psi with nitrogen. The total filtrate loss in 30 minutes from the cells through porous media containing 10 micron pores was 26 milliliters. The fluid was then poured off leaving filter cake produced by the fluid on the porous media. To one cell a 3% by weight calcium chloride brine was added as a control.

- 5 To the second cell a 7% ammonium chloride solution was added. The cells were heated to 150°F, pressured to 500 psi and allowed to remain static for 8 hours after which the filtrate rate was measured. The cell containing the 3% potassium chloride brine had a filtrate loss rate of 0.4 milliliters per minute. The cell containing the ammonium chloride solution had a filtrate loss rate of 428 milliliters per minute.

- 10 The foregoing tests clearly show that an aqueous ammonium chloride clean-up solution effectively removes filter cake containing magnesium oxide bridging agent.

- Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned as well as those which are inherent therein. While numerous changes can be made by those skilled in the art, such changes are encompassed
15 within the spirit of this invention as defined by the appended claims.

What is claimed is:

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4. The fluid of claim 1 wherein said bridging agent is magnesium oxide.

5. The fluid of claim 1 which further comprises an oxidizer or other breaker

6. The fluid of claim 5 wherein said oxidizer or other breaker is selected from the group consisting of magnesium peroxide, magnesium peroxydiphosphate, strontium peroxide, barium peroxide, calcium peroxide, magnesium perborate, barium bromate and mixtures thereof.

5

7. The fluid of claim 5 wherein said oxidizer or other breaker is magnesium peroxide.

8. The fluid of claim 1 wherein said density increasing water soluble salt is selected from the group consisting of sodium chloride, sodium bromide, sodium acetate, sodium formate, sodium citrate, potassium chloride, calcium chloride, calcium bromide and mixtures thereof.

9. The fluid of claim 1 wherein said fluid loss control agent is selected from the group consisting of starch, starch ether derivatives, hydroxyethylcellulose, cross-linked hydroxyethylcellulose and mixtures thereof.

10. The fluid of claim 1 wherein said hydratable polymer solids suspending agent is selected from the group consisting of xanthan, succinoglycon, cellulose derivatives, guar, guar derivatives and mixtures thereof.

11. The fluid of claim 1 wherein said ammonium salt in said clean-up solution has the formula



wherein R is an alkyl radical having from 1 to 6 carbon atoms, n is an integer from 0 to 3
5 and X is an anionic radical selected from halogens, nitrate, citrate, acetate, sulfate, phosphate and hydrogen sulfate.

12. The fluid of claim 1 wherein said ammonium salt in said clean-up solution is selected from the group consisting of ammonium chloride, ammonium bromide,
10 ammonium nitrate, ammonium citrate, ammonium acetate and mixtures thereof.

13. The fluid of claim 1 wherein said ammonium salt in said clean-up solution is ammonium chloride.

14. The fluid of claim 11 wherein said clean-up solution further comprises a
15 chelating agent selected from the group consisting of ethylenediaminetetraacetic acid and salts thereof, diaminocyclohexanetetraacetic acid and salts thereof, nitrilotriacetic acid and salts thereof, citric acid and salts thereof, diglycolic acid and salts thereof, phosphoric acid and salts thereof, aspartic acid and its polymers and mixtures thereof.

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15. The fluid of claim 14 wherein said chelating agent in said clean-up solution is citric acid.

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16. A method of removing filter cake from the walls of a well bore penetrating a producing formation deposited therein by a drilling or servicing fluid comprised of water, a density increasing water soluble salt, a fluid loss control agent, a hydratable polymer solids suspending agent and a particulate solid bridging agent comprising the

5 steps of:

(a) utilizing as the particulate solid bridging agent in said drilling or servicing fluid an inorganic compound which is dissolvable in a clean-up solution comprised of water and an ammonium salt; and

(b) contacting said filter cake with a clean-up solution comprised of water

10 and an ammonium salt for a period of time such that said metal oxide bridging agent is dissolved thereby.

17. The method of claim 16 wherein said bridging agent is selected from the group consisting of magnesium oxide, manganese oxide, calcium oxide, lanthanum

15 oxide, cupric oxide and zinc oxide.

18. The method of claim 16 wherein said bridging agent is magnesium oxide.

19. The method of claim 16 wherein said drilling or servicing fluid further

20 comprises an oxidizer or other breaker which is activated by said ammonium salt in said clean-up solution to oxidize and break-up gelled polymer in said filter cake deposited by said fluid.



20. The method of claim 19 wherein said oxidizer or other breaker is selected from the group consisting of magnesium peroxide, magnesium peroxydiphosphate, strontium peroxide, barium peroxide, calcium peroxide, magnesium perborate, barium bromate and mixtures thereof.

5

21. The method of claim 19 wherein said oxidizer or other breaker is magnesium peroxide.

22. The method of claim 16 wherein said density increasing water soluble salt
10 in said drilling or servicing fluid is selected from the group consisting of sodium chloride, sodium bromide, sodium acetate, sodium formate, sodium citrate, potassium chloride, calcium chloride, calcium bromide and mixtures thereof.

23. The method of claim 16 wherein said fluid loss control agent in said
15 drilling or servicing fluid is selected from the group consisting of starch, starch ether derivatives, hydroxyethylcellulose, cross-linked hydroxyethylcellulose and mixtures thereof.

24. The method of claim 16 wherein said hydratable polymer solids
20 suspending agent in said drilling or servicing fluid is selected from the group consisting of xanthan, succinoglycon, cellulose derivatives, guar, guar derivatives and mixtures thereof.

25. The method of claim 16 wherein said ammonium salt in said clean-up solution has the formula



wherein R is an alkyl radical having from 1 to 6 carbon atoms, n is an integer from 0 to 3
5 and X is an anionic radical selected from halogens, nitrate, citrate, acetate, sulfate, phosphate and hydrogen sulfate.

26. The method of claim 16 wherein said ammonium salt in said clean-up solution is selected from the group consisting of ammonium chloride, ammonium
10 bromide, ammonium nitrate, ammonium citrate, ammonium acetate and mixtures thereof.

27. The method of claim 16 wherein said ammonium salt in said clean-up solution is ammonium chloride.

15 28. The method of claim 25 wherein said clean-up solution further comprises a chelating agent selected from the group consisting of ethylenediaminetetraacetic acid and salts thereof, diaminocyclohexanetetraacetic acid and salts thereof, nitrilotriacetic acid and salts thereof, citric acid and salts thereof, diglycolic acid and salts thereof, phosphoric acid and salts thereof, aspartic acid and its polymers and mixtures thereof.

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29. The method of claim 28 wherein said chelating agent in said clean-up solution is citric acid.

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30. A method of removing filter cake from the walls of a well bore penetrating a producing formation deposited therein by a drilling or servicing fluid comprising the steps of:

(a) using as the drilling or servicing fluid, a fluid comprised of water, a density increasing water soluble salt selected from the group consisting of sodium chloride, sodium bromide, potassium chloride, calcium chloride, calcium bromide and mixtures thereof, a fluid loss control agent comprised of starch, a hydratable polymer solids suspending agent comprised of xanthan and a particulate solid metal oxide bridging agent which is soluble in an aqueous ammonium salt solution; and

(b) contacting said filter cake with a clean-up solution comprised of water and an ammonium salt for a period of time such that said metal oxide bridging agent is dissolved thereby.

31. The method of claim 30 wherein said metal oxide bridging agent is selected from the group consisting of magnesium oxide, manganese oxide, calcium oxide, lanthanum oxide, cupric oxide and zinc oxide.

32. The method of claim 30 wherein said metal oxide bridging agent is magnesium oxide.

33. The method of claim 30 wherein said drilling or servicing fluid further comprises an oxidizer or other breaker which is activated by said ammonium salt in said clean-up solution to oxidize and break-up polymer in the filter cake deposited by said fluid.

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34. The method of claim 33 wherein said oxidizer or other breaker is selected from the group consisting of magnesium peroxide, magnesium peroxydiphosphate, strontium peroxide, barium peroxide, calcium peroxide, magnesium perborate, barium bromate and mixtures thereof.

10

35. The method of claim 33 wherein said oxidizer or other breaker is magnesium peroxide.

15

36. The method of claim 30 wherein said ammonium salt in said clean-up solution has the formula



wherein R is an alkyl radical having from 1 to 6 carbon atoms, n is an integer from 0 to 3 and X is an anionic radical selected from halogens, nitrate, citrate, acetate, sulfate, phosphate and hydrogen sulfate.

20

37. The method of claim 30 wherein said ammonium salt in said clean-up solution is selected from the group consisting of ammonium chloride, ammonium bromide, ammonium nitrate, ammonium citrate, ammonium acetate and mixtures thereof.

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38. The method of claim 30 wherein said ammonium salt in said clean-up solution is ammonium chloride.

39. The method of claim 36 wherein said clean-up solution further comprises
5 a chelating agent selected from the group consisting of ethylenediaminetetraacetic acid and salts thereof, diaminocyclohexanetetraacetic acid and salts thereof, nitrilotriacetic acid and salts thereof, citric acid and salts thereof, diglycolic acid and salts thereof, phosphoric acid and salts thereof, aspartic acid and its polymers, and mixtures thereof.

10 40. The method of claim 30 wherein said ammonium salt is ammonium chloride and said clean-up solution further comprises a citric acid chelating agent.

Abstract of the Disclosure

5 Well drilling and servicing fluids for use in producing formations and methods of removing filter cake therefrom are provided. The methods basically comprise using a drilling or servicing fluid comprised of water, a density increasing water soluble salt, a fluid loss control agent, a hydratable polymer solid suspending agent and a particulate solid bridging agent which is soluble in an aqueous ammonium salt solution. Thereafter, 10 the filter cake deposited by the drilling or servicing fluid is contacted with a clean-up solution comprised of water and an ammonium salt for a period of time such that the bridging agent is dissolved thereby.

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Attorney Docket No: HES 99.0371 U1

DECLARATION AND POWER OF ATTORNEY - ORIGINAL APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name,

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

"Well Drilling And Servicing Fluids And Methods"

the specification of which:

(check one)

☒ (x) is attached hereto.

☐ () was filed on _____ as Application Serial No. _____ and was amended on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

<u>Number</u>	<u>Country</u>	<u>Day/Month/Year Filed</u>	<u>Priority Claimed</u>
None			☐ () Yes ☐ () No ☐ () Yes ☐ () No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title

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35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status Patented/Pending/Abandoned</u>
None		

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. C. Clark Dougherty, Jr., Registration No. 24,208; E. Harrison Gilbert, III, Registration No. 29,156; Clifford C. Dougherty, III, Registration No. 31,607; Robert A. Kent, Registration No. 28,626; William E. Shull, Registration No. 29,438; Craig W. Roddy, Registration No. 36,256; Eugene R. Montalvo, Registration No. 32,790; Paul I. Herman, Registration No. 37,349 and William M. Imwalle, Registration No. 35,904.

SEND ALL FURTHER COMMUNICATIONS TO:

ROBERT A. KENT
HALLIBURTON ENERGY SERVICES INC.
P.O. DRAWER 1431
DUNCAN, OK 73536-0440
(580) 251-3125

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

I further declare that I hereby assign and transfer the entire right, title and interest in and to the said invention or discovery to Halliburton Energy Services, Inc., a corporation organized and existing under the laws of the State of Delaware, and domiciled and having an office at Dallas, Texas and I pray that Letters Patent be granted to the said Halliburton Energy Services, Inc. as assignee for the invention described and claimed in the foregoing specification and claims and

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I hereby subscribe my name to the foregoing specification and claims, Declaration, and Power of Attorney.

Bradley L. Todd
Name of First Inventor

Bradley L. Todd
Signature of 1st Inventor

July 26, 2000
Date

1810 Windsor Drive
Duncan, OK 73533
Residence

United States Of America
Citizenship

1810 Windsor Drive
Duncan, OK 73533
Post Office Address

James V. Fisk, Jr.
Name of Third Inventor

James V. Fisk Jr.
Signature of 3rd Inventor

7/31/2000
Date

8906 Brookwolf
Houston, TX 77099
Residence

United States Of America
Citizenship

8906 Brookwolf
Duncan, OK 77099
Post Office Address

B. Raghava Reddy
Name of Second Inventor

B. Raghava Reddy
Signature of 2nd Inventor

July 26, 2000
Date

2013 Waverly Drive
Duncan, OK 73533
Residence

India
Citizenship

2013 Waverly Drive
Duncan, OK 73533
Post Office Address

James D. Kercheville
Name of Fourth Inventor

James D. Kercheville
Signature of 4th Inventor

July 31, 2000
Date

505 Wells Fargo
Houston, TX 77040
Residence

United States Of America
Citizenship

505 Wells Fargo
Houston, TX 77040
Post Office Address