To all whom it may concern:

Be it known that I, Benjamin K. Stroud, a citizen of the United States, and residing at Los Angeles, county of Los Angeles, State of California, have invented the new and useful Improvement in Application of Mud-Laden Fluids to Oil or Gas Wells, of which the following is a specification.

This invention relates to mud-laden fluids, and more particularly to their application to oil or gas wells. This application is a continuation in part of my application Serial Number 530,399, filed April 6, 1923, as to subject matter common therewith.

In the drilling and control of oil and gas wells mud-laden fluids are used. In rotary drilling the fluid is introduced through the drill stem to the bit and there issues to rise in the bore hole. The fluid performs not only the function of a lubricant in maintaining the bit itself as well as the stem lubricated, but it also serves to carry off the cuttings and so prevents the bit and stem from sticking or “freezing” in the bore-hole; the agitation causes the cuttings to become and remain suspended in the fluid so as to rise therewith in the bore-hole. The mud-laden fluid is introduced into the well by a slush pump while the fluid (carrying the cuttings) issuing from the bore hole is discharged into a settling ditch where the cuttings settle out while the fluid is again passed to the well to complete another circuit.

The mud-laden fluid also performs other useful functions even in rotary drilling operations, namely, that of “mudding off” and holding down heavy pressures. The passage of the fluid in contact with the unlined walls of the bore-hole and under the hydrostatic pressure of the fluid column, causes the fluid to penetrate the walls and thereby form in fact a distinct mud wall which seals or “muds off” the surrounding region. Moreover the weight or head of the mud column serves to hold down heavy pressures so that control of the well may be retained even when the pressures become high.

Mud-laden fluids are also employed to control wells generally. For this purpose the fluid is introduced into the well in any suitable manner, as for instance with a device known as a lubricator, so that the bore-hole (or even the casing) will become filled with the fluid so as to over-balance the gas pressures. In this way the well may be maintained under control, either temporarily or permanently, or even “killed”.

The ordinary mud-laden fluid obtained at or from a well does not have the required characteristics to render it satisfactory. One of the important, if not the most important one, is that the specific gravity of the mud-laden fluid be not only sufficiently high to overcome the gas pressures, but this specific gravity must be maintained. Muds mixed from a clay or a shaly clay may be of such consistency that they can hardly be pumped and yet their specific gravity may not run over 1.3, i. e., eleven pounds to the gallon. Such a thick mud will, however, become “gas cut”, i. e., the gas aerating or working on the mud lightens the mud column to such an extent as to become overbalanced by the gas pressure so that the mud column will be expelled from the well; accordingly the well is liable to pass beyond control resulting in great damage to property and loss of life or limb, and even causing craters and preventing proper finishing of the well.

When the mud-laden fluid is too thick the cuttings will moreover not drop or settle out in the settling ditch, or the time for settling may be so long as to render its reuse impractical. Mud made from a shale or shaly clay is moreover not sufficiently slimy as to act properly, either as a lubricating agent for the bit or stem, or as a plugging agent for penetrating or building up the walls of the bore-hole. In order to act properly in either capacity the mud-laden fluid should have sliming properties and not abrasive properties. The action of “mudding” is penetration followed by wall building upon the mud itself. The plastered wall should withstand the erosional action of the slush pumps even when clear water is pumped past it for a considerable time as is often necessary. This resistance to erosion is extremely important and it is evident that a “sandy” fluid would act in an opposite manner from a slimy fluid, i. e., a sandy fluid would hasten the process of erosion.
whether in the wall itself or whether a part of
the moving columns of fluid being circu-
lated.
One of the objects of this invention,
therefore, is to provide a mud-laden fluid for
oil or gas wells, which has the proper-
ties and characteristics desired and neces-
sary in order to adapt it for its intended
uses.
Another object is to provide a process or
method for producing such a mud-laden
fluid.
Another object is to provide a process or
method of applying such a mud-laden
fluid to the boring or control of oil or gas
wells.
Further objects will appear from the de-
tail description in which will be described a
number of embodiments of this invention;
and it will, however, be understood that this
invention is susceptible of various other em-
bediments.
In accordance with this invention the
mud-laden fluid is characterized by the fact
that it has a specific gravity considerably in
excess of that of water. This is important
because the gas pressures encountered in oil
and gas wells are usually equal to or greater
than hydrostatic, i.e., equal or greater than
the pressures of a like column of water in
the well. For safety's sake the pressure exer-
ten by the mud-laden fluid column should be
considerably greater than that of a
water column of the same height. In
accordance with this invention the specific
gravity of my mud-laden fluid is substani-
ally in excess of that of clay laden fluids of
the same and required viscosity. I have
found that a mud-laden fluid having a
specific gravity in excess of two meets the
requirements.
The mud-laden fluid embodying this in-
vention is, however, sufficiently thin, when
of the required specific gravity, as to not
only enable it to be readily pumped and as
to not only readily drop or settle the cut-
tings, while maintaining them in suspension
until out of the well; but the character of
the mud base and of the mud-laden fluid
formed therefrom is such as to not become
"gas-cut" and not cause the column to de-
crease in specific gravity enough so as to be
expelled. The base and fluid is, however,
slimy as distinguished from abrasive; ac-
cordingly not only does it perform the
function of a lubricant for the bit and drill
stem, but it is sufficiently thin to properly
penetrate the wall of the bore-hole while
building up a dense and non-erosing wall
after such penetration. The fluid is, how-
ever, non-setting, i.e., even when not agi-
tated, the fluid will not set to form a solid
mass. Moreover the base will remain in
suspension, even without agitation; it is in
fact a true suspensoid. The base, as well as
the fluid formed thereby is also inert chemi-
cally, in that it does not attack the wall of
the bore-hole or the casing and drilling
equipment.
A base which I have found especially
suitable for forming a mud-laden fluid
meeting the requirements and as possessing
the desired characteristics and properties, is
barytes barium sulphate. It has a com-
paratively high specific gravity and forms a
suspensoid which even of a specific gravity
of 2.55 (21 pounds per gallon) is thin
enough to be readily pumped; moreover even
at that high specific gravity the cuttings will
readily drop or settle out. Its sliming prop-
erties adapt it not only as a lubricant but
also as a wall builder; the fact that it is a
pigment base shows its property as a cover-
ing medium. It will remain in suspension
indefinitely, especially since it can be finely
ground, 800 mesh being easily obtained. It
will remain in a fluid condition and will
not set as is the case with other high spe-
cific gravity substances. It does not "gas-
cut" since it can be sufficiently thin while
maintaining the required specific gravity.
Barytes, even in its raw state is very pure,
the barium sulphate content running as high
as 98%; accordingly even in its crude state
it is chemically inert; moreover its purity
enables its specific gravity to be maintained
while its sliming and other properties are
maintained.
While a suitable barytes mud of even 2.5
specific gravity can be obtained, I have
found that a specific gravity of two or over
is sufficient. Accordingly in order to obtain
a sufficient thick mud-laden fluid in order to
hold the cuttings in suspension, the barytes
mud can be cut down with ordinary mud as
obtainable at the well, so as to obtain the
desired mud-laden fluid of the desired
specific gravity (2 or over) and of the de-
sired viscosity. Since barytes is white it
will serve to readily indicate the presence of
petroleum.
While I have found barytes especially
suitable, other pigment bases may be used;
one which I have found suitable is an iron
oxide, such as ferric oxide (Fe₂O₃), or red
pigment; this is commonly used in paints
and is substantially inert chemically; it can
be used in finely divided form and forms a
suspensoid, either alone or in connection
with ordinary mud as found at the wells.
While, however, iron oxide is chemically
inert, it is a good conductor of electric cur-
rents, while barytes is not; corrosion of
casings due to electrolytic action may, there-
fore, take place with iron oxide, while such
action will not take place when barytes is
used. The sealing and penetrative qualities
of iron oxide are, however, high and a mud-
laden fluid of a specific gravity of two may
be readily obtained when using a base con-
taining only 85% iron oxide; such a fluid will be sufficiently thin to be readily handled and it will not become gas-cut. The slimy lubricating, wall building and other properties of iron oxide mud are also desirable.

Another suitable substance or compound which may be used in an oxide of lead, such as plumbic oxide (PbO) or litharge; this compound is also commonly used in paints, is substantially inert chemically, and can be used in finely divided form and forms a suspensoid either alone or in connection with ordinary mud as found at the wells.

It will, therefore, be seen that the invention accomplishes its objects. A mud-laden fluid is obtained which will meet the conditions encountered in the drilling and control of oil and gas wells. The fluid may be used as usual in drilling, control and even in the killing of wells, without being subject to the disadvantageous features of ordinary mud. The mud may be used over and over again and may be used to increase the specific gravity and improve the properties of mud available at the wells.

It is to be understood that while a theory of operation has been advanced, it is not the only or necessary one but has only been advanced to facilitate the disclosure. It is understood, however, that this invention is not limited to any theory of operation or action. It is further obvious that various changes may be made in details without departing from the spirit of this invention; it is, therefore, to be understood that this invention is not to be limited to the specific details described.

Having thus described the invention, what is claimed is:

1. A mud-laden fluid for oil or gas wells characterized by the fact that it is slimy and has a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

2. A mud-laden fluid for oil or gas wells characterized by the fact that it is non-setting and has a specific gravity in excess of two.

3. A mud-laden fluid for oil or gas wells characterized by the fact that it is slimy and non-setting and has a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

4. A mud-laden fluid for oil or gas wells characterized by the fact that it is chemically inert and has a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

5. A mud-laden fluid for oil or gas wells comprising a pigment base suspensoid.

6. A mud-laden fluid for oil or gas wells consisting of a pigment base suspensoid and having a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

7. A mud-laden fluid for oil or gas wells comprising barytes in suspension.

8. A mud-laden fluid for oil or gas wells comprising barytes in suspension and having a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

9. A mud-laden fluid for oil or gas wells comprising a slimy substance, whose specific gravity is substantially greater than that of clay, held in suspension in a lighter suspensoid.

10. A mud-laden fluid for oil or gas wells comprising barytes suspended in an earthy suspensoid.

11. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a non-setting mud-laden fluid of a specific gravity which is substantially greater than that of clay-laden fluids of the same viscosity.

12. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a barytes-mud-laden fluid.

13. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a barytes-mud-laden fluid of a specific gravity which is substantially in excess of that of clay-laden fluids of the same viscosity.

14. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a non-setting mud-laden fluid of a specific gravity which is substantially greater than that of clay-laden fluids of the same viscosity and sufficiently thin as not to become aerated.

15. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a mud-laden fluid and controlling the density of the fluid by the addition of a slimy suspendable ingredient whose specific gravity is substantially greater than that of clay.

16. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a mud-laden fluid and controlling the density of the fluid by the addition of barytes.

17. A mud-laden fluid for oil wells characterized by the fact that it is sufficiently thick to hold the cuttings in suspension but sufficiently thin as not to become aerated and that its specific gravity is substantially in excess of that of clay-laden fluids of the same viscosity.

18. A mud-laden fluid for oil wells characterized by the fact that it is sufficiently thick to hold the cuttings in suspension but sufficiently thin as not to become aerated and that its specific gravity is sufficiently high to overbalance a gas pressure substantially in excess of hydrostatic pressure.

19. In the art of boring or controlling oil
or gas wells, the process comprising introducing into the well a mud-laden fluid, and maintaining the fluid sufficiently thin as not to become aerated and of a specific gravity sufficiently greater than that of clay-laden fluids so as to overbalance the gas pressure encountered.

20. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a mud-laden fluid, and maintaining the fluid sufficiently thin as not to become aerated, sufficiently thick to hold the cuttings in suspension and of a specific gravity sufficient to overbalance a gas pressure substantially in excess of hydrostatic pressure.

21. In the art of boring or controlling oil or gas wells, the process comprising introducing into the well a mud-laden fluid, and maintaining the fluid sufficiently thin as not to become aerated, sufficiently thick to hold the cuttings in suspension, and of a specific gravity sufficient as to overbalance the gas pressure encountered.

In testimony whereof I affix my signature this 18th day of November, 1924.

BENJAMIN K. STROUD.

Certificate of Correction.

It is hereby certified that in Letters Patent No. 1,575,945, granted March 9, 1926, upon the application of Benjamin K. Stroud, of Los Angeles, California, for an improvement in "Application of Mud-Laden Fluids to Oil or Gas Wells," errors appear in the printed specification requiring correction as follows: Page 3, lines 47 and 48, claim 2, strike out the words "in excess of two" and insert which is substantially in excess of that of clay-laden fluids of the same viscosity; same page, line 62, claim 6, for the words "consisting of" read comprising; line 76, claim 9, after the word "clay" strike out the comma and insert instead the word and; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of April, A. D. 1926.

M. J. MOORE,
Acting Commissioner of Patents.