Our invention relates to well pumps, and more particularly to a combined motor and reciprocating pump submersible in a fluid which may be injurious to the working parts of the motor should it enter therein.

Deep wells, whether of the water or oil type, are usually pumped by lowering a suitable pump to a point below the fluid-level of the well. The plunger of this pump is reciprocated by the operation of a string of sucker rods, these sucker rods extending upward to the surface of the ground where they are connected to a suitable prime mover.

Such installations are expensive, both with respect to first cost and subsequent operation. The sucker rods of such pump installations are subjected to large stresses, and if the well is an extremely deep one, the stretch of these sucker rods becomes excessive and a large movement of the rods at the surface of the ground effects only a small movement of the pump plunger.

We have found that large economies may be effected by directly connecting a pump to a prime mover and lowering the whole unit into the well, inasmuch as no sucker rods with their inevitable drawbacks are then required.

It is an object of our invention to provide a pump unit which comprises a pump directly connected to a prime mover, both the pump and the prime mover being adapted to operate submerged in a fluid.

We have found it desirable to exclude all of the well fluid from the motor in order that the windings and bearings thereof may not be injured. This is very necessary when the motor is operated submerged in a fluid which might be injurious to the working parts of the motor should it enter therein.

It is an object of our invention to provide a motor the internal parts of which are effectively separated from any fluid in which the motor is submerged.

It is, of course, necessary that some type of motion be transmitted from the motor to the pump in order to actuate the latter. Such a motion may be either rotary or reciprocatory. We have found it advisable to operate the pump by a reciprocating motion, this motion being transmitted from the motor to the pump through a flexible member which is secured both to the reciprocating member which actuates the pump and to the stationary walls of the motor.

It is an object of our invention to provide a submersible motor in which the working parts are separated from an external fluid by a flexible member, this flexible member allowing the transmission of a reciprocating motion from the motor to a suitable means for utilizing this reciprocating motion.

When using such a flexible member, there is a tendency for the volume of the motor chamber to change as the reciprocating movement takes place. We prefer to operate the motor in a motor chamber substantially filled with a neutral fluid which is not injurious to the working parts of the motor. Inasmuch as the neutral fluid is relatively incompressible, we have found it necessary to provide some means to compensate for this change in volume when using a motor chamber substantially filled with neutral fluid.

This may most conveniently be accomplished by another flexible member, the interior of this second flexible member communicating with the motor shell and the exterior being in contact with the well fluid.

It is an object of our invention to provide a submersible motor adapted to produce a reciprocating motion, the volume of the chamber in which the motor operates being held substantially constant.

Another object of our invention is to provide a fluid-filled submersible motor in which the fluid pressures on the interior and exterior of the motor are substantially equal.

Still a further object of our invention is to provide a novel means of circulating and cooling a fluid in a submersible motor.

Further objects and advantages of our invention will be made evident hereinafter.

Referring to the drawings,—

Fig. 1 is a utility view of our invention, illustrating its use in the deep well pumping art.

Fig. 2 is a vertical sectional view of the combined motor and pump of our invention.

Fig. 3 is a view of the lower end of the
motor of our invention taken along the line 3–3 of Fig. 2.

Fig. 4 is a horizontal sectional view taken on the line 4–4 of Fig. 2.

Fig. 5 is a horizontal sectional view taken along the line 5–5 of Fig. 2.

Fig. 6 is a horizontal sectional view taken along the line 6–6 of Fig. 2.

Fig. 7 is an alternative form of our invention.

Our invention finds numerous applications in numerous industries. A particularly valuable application of the invention is in the deep-well pumping art, and it is in this relation that it will be described, it being understood that we are not limited to this use.

Referring particularly to Fig. 1, a casing 10 is set in a well 11, this casing extending from the surface of the ground to a point some distance below a fluid-level 13 in the well. Extending downward in the casing 10 is a discharge pipe 15, carrying at its lower end a pumping unit 16. The pumping unit 16 comprises a motor unit 17 directly connected to a reciprocating pump 18. When the motor 17 is energized, the pump 18 forces the well fluid through the discharge pipe to the surface of the ground, this well fluid being discharged through a suitable elbow 18a.

The motor unit 17 of our invention may best be understood by reference to Figs. 2, 3, and 6. Referring to these figures, a shell 19 provides a motor chamber 20 which encloses the working parts of the motor. This shell comprises a cylindrical portion 21, this cylindrical portion being shaped so as to form ribs 22 at the lower part thereof, these ribs being adapted to hold the cylindrical portion 21 a distance away from the well casing 10 when the motor is lowered therein. The central portion of each of these ribs 22 is hollow, as best shown in Figs. 2 and 5, these ribs defining longitudinal channels 23 therein.

The lower portion of the shell 19 has a bore 24 extending therethrough. Secured in the bore 24 is a stator 25 of the motor unit 17. This stator comprises laminations 26 which are encased in a sleeve 27, this sleeve 27 engaging the walls of the bore 24 to hold the stator in place. Windings 28 are placed on the laminations 26. Openings 29 are formed longitudinally through the sleeve 27, these openings forming cooling ducts for the purpose of allowing a passage of a fluid from the upper portion of the motor to the lower portion thereof. The stator 25 has an opening 30 in which a rotor 31 is adapted to rotate, there being an air gap between the rotor and the stator. The rotor 31 is suitably journalled in bearings 32 and 33, these bearings being mounted respectively in upper and lower bearing members 35 and 36 which are suitably secured in the shell 19. Holes 38 are formed in the upper bearing member 35.

Mounted on the upper end of a shaft 40 of the rotor 31 is a worm 41. This worm is adapted to engage a worm gear 43 which is keyed to a shaft 44. The shaft 44 is pivoted in a pair of bosses 46 which are formed at the upper end of a plate 47 extending upward from the upper bearing member 35. Also keyed to the shaft 44 is a pair of arms 49, one of these arms being outside of each of the bosses 46. The arms 49 are adapted to rotate with the worm gear 43, these arms when in a horizontal position pointing away from the worm 41, extending into one of the longitudinal channels 23.

Pivoted to the outer end of each arm 49 is an arm 51 of a connecting yoke 52. The upper end of the connecting yoke 52 is attached by means of a pin 53 to a yoke 54 of a reciprocating member 55. This reciprocating member is circular in cross-section and is adapted to slide vertically in a boss 56 of an intermediate wall 57 extending across the cylindrical portion 21 at the upper end of the motor chamber 20.

A primary flexible member 60 in the form of a collapsible bellows is secured to the upper face of the intermediate wall 57. This flexible member has a thin corrugated wall 62 closed at its upper end by a plate 63. The plate 63 is connected in fluid-tight relationship with the reciprocating member 55 and is thus reciprocated with the member 55 when the motor 17 is energized. As the plate 63 moves downward from the position shown in Fig. 2, the corrugations of the wall 62 are folded one another in a manner similar to the action of any well known bellows. The corrugated wall 62 and the plate 63 define a primary fluid-chamber 65 in communication with the motor chamber 20 through openings 66 in the intermediate wall 57.

The upper portion of the cylindrical portion 21 of the shell 19 forms an upper hub 71 to which is threadedly attached a cylinder sleeve 72 of a cylinder 73. The cylinder 73 is lined with a suitable wear-resisting lining 74. To the upper end of the cylinder sleeve 72 is secured a standing valve 76.

This standing valve may be of any well known construction, the type illustrated in Fig. 2 being particularly adapted to this form of pump. An opening 77 is formed centrally through a body 78 of the standing valve 76. Closing the top of the opening 77 is a ball 79, the maximum upward position of this ball being determined by a cage 80 of conventional design. This standing valve is adapted to allow a passage of fluid upward therethrough in the direction of an arrow 81, as indicated in Fig. 2. The ball 79, however, will seat in the top of the opening 77 to prevent any reverse flow of fluid therethrough.

Attached to the upper end of the recipro-
cating member 55 is a piston 83 of the pump 18. This piston is adapted to reciprocate in the cylinder 73 when the member 55 is reciprocated. The piston 83 has a central longitudinal opening 84 therethrough, this opening communicating with the fluid in which the pump is submerged through the ports 85 formed in the shell 19 just below the hub 71. Screwed into the upper end of the piston 83 is a working valve 86 having an opening 87 formed therethrough, this opening 87 is adapted to be closed by a ball valve 88, this ball being held in position by means of a cage 89. The working valve 86 is adapted to allow passage of well fluid through the opening 87 in a direction indicated by the arrow 90 of Fig. 2, but any reverse flow will be immediately checked by the seating of the ball 88 in the top of the opening 87. The lower portion of the standing valve 76 is shaped to conform to the upper end of the cage 89, there being a small clearance space 92 above the working valve 86 when the piston 83 is in its uppermost position. We prefer to operate the motor unit 17 of our invention substantially filled with a neutral fluid which is non-injurious to the windings of the motor and which will at the same time act as a lubricating medium for the bearings 32 and 33 and the crank mechanism previously described. This neutral fluid may be supplied through a pipe 100 extending upward in the well to a point above the surface of the liquid 13 therein. In most instances, it is preferable to extend this pipe 100 to the surface of the ground. This pipe 100 is in open communication with the motor chamber 20, this motor chamber including that portion of the shell 19 between the lower bearing member 36 and the intermediate wall 57. The pipe 100 also forms a convenient means of supplying energy to the motor unit 17, this energy being supplied through wires 103 which are preferably joined together in a lead cable 104. This lead cable extends from a suitable electrical source at the surface of the ground downward through the pipe 100 and through a passage 106 in the cylindrical portion 21, the lead cable 104 then passing through the upper portion of the motor chamber 20 and entering one of the openings 38 in the bearing member 35, finally being connected to the windings 28 of the motor.

Inasmuch as the neutral fluid filling the chamber 63 and the motor chamber 20 is relatively incompressible, it is necessary that some means be provided for disposing of the neutral fluid discharged from the chamber 65 when the plate 63 is lowered from its uppermost position indicated in Fig. 2. Such a means is most conveniently provided by a secondary flexible member 112 which is secured to the lower face of the lower bearing member 96. This secondary flexible member may conveniently be of the same design as the primary flexible member 60, in which case it will have thin corrugated side walls 113 closed at the bottom by a plate 114. The side walls 113 and the plate 114 define a secondary fluid-chamber 116, the volume of which is variable by changing the vertical position of the plate 114. The chamber 116 communicates with the motor chamber 20 through the air gap, the openings 29, and through holes 118 formed in the lower bearing member 36. The cylindrical portion 21 has ports 120 formed in the lower end thereof, these ports allowing the external surface of the flexible member 112 to communicate with the fluid in the well, the interior of this flexible member being, of course, filled with neutral fluid. A guard 121 is formed on the extreme lower end of the shell 19, this guard protecting the lower flexible member 112 from injury.

The operation of our invention is as follows: In installing the unit of our invention, we prefer to fill the motor chamber 20 and the chambers 65 and 116 with neutral fluid before the motor is submerged. The correct amount of neutral fluid may best be determined by compressing the flexible member 112 into a position shown in Fig. 3 and turning the motor until the plate 63 of the primary flexible member 60 is in its uppermost position. These positions of the flexible members are clearly shown in Figs. 2 and 3. When in this position, the chambers 65, 20 and 116 are filled with neutral fluid. Then the motor and attached pump are then lowered to a point below the level 13 of the fluid in the well 11. When submerged, the fluid in the well comes into contact with the exterior surface of the plates 63 and 114 of the flexible members, and will force these plates toward each other until a pressure, equal to the pressure of a surrounding well fluid, builds up in the chambers 65, 20, and 116. When this occurs, the internal and external surfaces of the flexible members are under equal pressures so that there is no tendency for these members to be deformed, thus allowing the use of very thin material in forming these flexible members.

In as much as the pipe 100 communicates with the chamber 20, it should be apparent that as the unit is being lowered, and as the internal pressure is being built up to correspond to the external pressure, the neutral fluid will be forced upward in this pipe 100 until the pressure-head of this neutral fluid equals the pressure of the well fluid. The neutral fluid will then have an upper surface level such as indicated by the numeral 132 of Fig. 1, and, inasmuch as the densities of the well fluid and the neutral fluid are usually nearly the same, this level 132 will be substantially the same as the level 13 at all times, the only difference existing being due to the difference in density of the two...
fluids. Inasmuch as the diameter of the pipe 100 is relatively small, a very slight decrease in volume of the chambers 65 and 116 will cause a large movement of the level 192, so that no additional neutral fluid need be added through the pipe 100 unless the unit is installed at a great distance below the surface of the well fluid.

The motor windings are then energized, thus turning the worm 41 and the worm gear 43. The shaft 44 is thus caused to slowly rotate in the bosses 46 and as it rotates it carries the arms 49 therewith. As the arms 49 turn, the member 55 is reciprocated due to the connection of the yoke 52. The reciprocation of the member 55 raises and lowers the plate 63 and the piston 65. When the mechanism is in the position shown in full lines in Fig. 2, the chamber 65 has a maximum volume, while the chamber 116 has a minimum volume. As the piston 55 moves downward, a portion of the well fluid enters the opening 84 in the piston and passes through the working valve 86, accumulating in the clearance chamber 92. At the same time, the volume of the chamber 65 begins to decrease, thus forcing some of the neutral fluid through the opening 96 into the motor chamber 65. This expended fluid causes a flow of neutral fluid through the openings 88 and 89 and the holes 118, this fluid entering the chamber 116 and forcing the plate 114 of the secondary flexible member 112 downward a sufficient distance to compensate for the downward movement of the plate 63 of the primary flexible member. When the piston is in its extreme lowermost position, the volume of the chamber 65 is a minimum, the neutral fluid displaced therefrom now causing a corresponding increase in volume of the chamber 116, a flow taking place through the stator 25. This lowermost position of the crank mechanism is indicated by dotted lines 130 of Fig. 2. When the member 55 is again pushed upward, the ball 88 seats in the opening 87 and forces the oil in the clearance chamber 92 upward through the standing valve 76 and into the discharge pipe 15 communicating therewith. At the same time the volume of the chamber 65 increases, and fluid is drawn thereinto from the motor chamber 20, the secondary flexible member 112 compressing a sufficient distance to compensate for the increase in volume of the chamber 65.

It should thus be noticed that an actual flow of the neutral fluid takes place through the stator 25. This flow of fluid has two paths, one through the air gap, and the other through the openings 29. Inasmuch as the openings 29 are of much larger cross-section than the air gap, most of the flow takes place through these openings. This flow of fluid through the stator has a decided cooling effect thereon, especially as the fluid flowing therethrough comes into contact with the walls of the shell 19. These walls are, of course, kept cool by contact with the fluid in the well, inasmuch as the fluid being pumped is drawn upward around the shell 19 between the shell and the casing 10, this well fluid usually being of a low temperature. This very efficient cooling action of our motor makes it possible to obtain an amount of power from the motor which is very considerably larger than the amount obtained through the operation of a similar air-cooled motor.

It is preferable that the clearance space 92 be made as small as is practical inasmuch as certain fluids being pumped might contain gases. If a body of gas should accumulate in the clearance space 92, and if this clearance space were sufficiently large, no pumping action would take place, inasmuch as the body of gas in the clearance chamber would simply be expanded and compressed as the piston was reciprocated.

It should be further apparent that if some obstruction should impede the downward movement of the plate 114 of the secondary flexible member 112, the pressure of the neutral fluid in the motor will be raised as the plate 63 is lowered on the downward stroke of the piston. Should this occur, neutral fluid will rise in the pipe 100 to allow for the decrease in volume of the chamber 65. It is possible, by making the pipe 100 of a size larger than that shown in Fig. 2, to entirely dispense with the secondary flexible member 112, allowing the surface 132 of the neutral fluid to be forced upward and downward in the pipe 100 as the volume of the chamber 65 is changed. This would, of course, subject the primary flexible member 60 to a difference in pressure between the interior and exterior thereof, such a difference in pressure being undesirable in most installations.

It is also possible to dispense with the secondary flexible member 112 and the pipe 100 by using an alternative form of our invention, such as shown in Fig. 7.

In this embodiment, the lead cable passes through a suitable insulator 150 in the intermediate wall 57, and from thence through the motor chamber 20 to the windings 28. So also, the lower bearing member consists of a solid bottom plate 152 closing the lower end of the shell 19. In installing the apparatus shown in Fig. 7, the motor chamber 102 is filled with neutral fluid to a level indicated by the numeral 157. Above the level 157 is a body of air or other gas 158. When the motor is set into operation, the raising and lowering of the plate 63 causes an increase and decrease in the volume of the primary chamber 65, as previously explained. Inasmuch as this chamber 65 is filled with the air 158, such a decrease in volume is possible.
by compressing the air above the level 157 of the neutral fluid. The cooling action in
this form of our invention is much less than
that shown in the preferred form, and also
the upper flexible member 60 is subjected
to differences in pressure between its external
and internal surfaces, thus requiring a more
substantial form of flexible member than that
required in the preferred form of our inven-
tion. This form has the added disadvantage
that insulators are necessary, and the insu-
lator 150, of course, must be so designed as
to prevent any escape of air or gas there-
around.

We claim as our invention:
1. In a submersible structure, the combina-
tion of: walls forming a motor chamber; a
motor in said chamber; mechanism in said
chamber for transforming a rotary move-
ment developed by said motor into a recipro-
cating movement; a flexible member secured
to said walls, said flexible member trans-
mitting said reciprocating movement to the
exterior of said motor chamber; and means
for keeping the volume of said motor cham-
ber substantially constant.

2. In a submersible structure adapted to be
filled with a neutral fluid, the combination
of: a shell; a stator supported in said shell,
said stator being provided with longitudinal
openings communicating between spaces
above and below said stator; a rotor adapted
to rotate in said stator; and means for for-
cing a portion of said neutral fluid from one
of said spaces to the other of said spaces
and back again through said openings.

3. In a submersible structure, the combina-
tion of: walls forming a motor chamber; a
primary flexible member, said flexible mem-
ber defining a primary chamber communi-
cating with said motor chamber; a motor in
said motor chamber; mechanism in said motor
chamber for transferring the rotation of said
motor into a reciprocating motion, said recip-
crocating motion being transmitted to the ex-
eterior of said submersible motor structure
through said primary flexible member; and
a secondary flexible member, said secondary
flexible member defining a secondary cham-
ber communicating with said motor chamber,
said primary and secondary chambers and
said motor chamber being substantially
filled with a neutral fluid.

4. In a submersible structure, the combina-
tion of: walls forming a motor chamber; a
primary collapsible bellows, said collapsible
bellows defining a primary chamber com-
municating with said motor chamber; a mo-
tor in said motor chamber; mechanism in said
motor chamber for transferring the rotation
of said motor into a reciprocating motion,
said reciprocating motion being transmitted
to the exterior of said submersible motor
structure through said primary collapsible
bellows; and a secondary collapsible bellows,
said secondary collapsible bellows defining a
secondary chamber communicating with said
motor chamber, said primary and secondary
chambers and said motor chamber being sub-
stantially filled with a neutral fluid.

5. In a submersible structure, the combina-
tion of: walls forming a motor chamber; a
primary bellows above said motor chamber,
said primary bellows defining a primary
chamber in communication with said motor
chamber; a motor in said motor chamber; a
 crank mechanism operable by said motor,
said crank mechanism being connected to
said primary bellows; and a secondary bel-
lows in communication with the lower end of
said motor chamber, said secondary bellows
defining a secondary chamber in communica-
tion with said motor chamber, said primary
and secondary chambers and said motor cham-
ber being substantially filled with a neutral
fluid.

6. A combination as defined in claim 5 in
which said motor contains cooling ducts
through which said neutral fluid is forced as
said crank mechanism reciprocates said pri-
mary bellows.

7. In combination: a shell; a motor means
in said shell; a reciprocable member adapted
to be reciprocated by said motor means; and
a flexible member secured in fluid-tight rela-
tionship to said reciprocable member and to
said shell.

8. In a submersible structure, the combina-
tion of: walls forming a chamber, said walls
including a flexible member; a motor means
in said chamber, said motor means actuating
said flexible member in a manner to change
the volume of said chamber; and means into
which the fluid in said chamber may flow to
compensate for said change in volume.

9. In a submersible structure, the combina-
tion of: walls forming a motor chamber sub-
stantially filled with a neutral fluid; a motor
means in said motor chamber; a flexible mem-
ber communicating with said motor chamber;
means for for operatively connecting said motor
means and said flexible member in a manner
to reciprocate said flexible member and dis-
place said neutral fluid; and means communi-
cating with said motor chamber at the oppo-
site side of said motor means from said flex-
bile member into which said displaced neutral
fluid may flow after passing said prime mover
in cooling relationship.

10. In a submersible structure, the combi-
nation of: walls forming a motor chamber
substantially filled with a neutral fluid; a mo-
tor means in said motor chamber; a pair of
flexible members communicating with said
motor chamber on opposite sides of said mo-
tor means; and means for operatively con-
necting one of said flexible members and said
motor means whereby this flexible member is
reciprocated in a manner to alternately ex-
pand and contract the other of said flexible
members in a manner to circulate said neutral fluid in cooling relationship with said motor means.

11. A combination as defined in claim 8 including a pipe in open communication with the interior of said shell and extending upward to a point above the level of the fluid in which said motor is submerged.

12. In a submersible structure, the combination of: a shell adapted to be submerged in an external fluid; a rotor rotatably mounted within said shell; mechanism for converting the rotation of said rotor into a reciprocating movement; and a flexible member adapted to be reciprocated by said reciprocating movement, said flexible member separating said external fluid from the fluid in said shell.

13. In a submersible structure, the combination of: a shell; a rotor rotatably mounted within said shell; mechanism for converting the rotation of said motor into a reciprocating movement; a flexible member secured to said shell and adapted to be reciprocated by said reciprocating movement, and means for substantially equalizing the internal and external pressures on said shell.

14. In a submersible structure, the combination of: a shell; a rotor rotatably mounted in said shell; a member reciprocable in said shell; mechanism for operatively connecting said rotor and said member; and a flexible member adapted to said member, said flexible member closing a portion of said shell.

15. In a submersible structure, the combination of: a shell; motor means in said shell and having a rotatably mounted rotor; mechanism for converting the rotation of said rotor into a reciprocating movement; and a collapsible bellows mounted in fluid-tight relationship with said shell, said reciprocating movement being transmitted through said bellows to a point outside of said shell.

16. In a submersible structure, the combination of: a shell; a rotor rotatably mounted within said shell; mechanism for converting the rotation of said rotor into a reciprocating movement; a collapsible bellows mounted in fluid-tight relationship with said shell, said reciprocating movement being transmitted through said bellows; and means for equalizing the internal and external pressures on said shell.

17. In a submersible structure, the combination of: a shell; a rotor rotatably mounted within said shell; mechanism for converting the rotation of said rotor into a reciprocating movement; a primary flexible member mounted in fluid-tight relationship with said shell, said reciprocating movement being transmitted through said primary member to a point outside said shell; and a secondary flexible member separating the interior and the exterior of said shell.

18. In a submersible structure, the combination of: a shell; a rotor rotatably mounted within said shell; mechanism for converting the rotation of said rotor into a reciprocating movement; a flexible member adapted to be reciprocated by said reciprocating movement; and a pipe communicating with the interior of said shell and extending upward to a point above the surface of the fluid in which said motor is submerged.

19. In combination: a fluid-filled shell surrounded by an external fluid; deformable means secured in fluid-tight relationship to said shell and adapted when reciprocated to maintain the volume of said shell substantially constant; and a reciprocating member secured in fluid-tight relationship with a portion of said deformable means.

20. In combination: a shell; deformable means completely closing said shell, said shell and said deformable means being substantially filled with a relatively incompressible neutral fluid; an electric motor in said shell and comprising a rotor and a stator operating in said neutral fluid; and means in said shell for converting a rotary motion of said rotor into a reciprocating movement, said means imparting said reciprocating movement directly to a portion of said deformable means.

21. In a submersible structure, the combination of: walls providing a motor chamber completely filled with a substantially incompressible neutral fluid; a collapsible bellows forming a part of said walls and being contacted on the exterior by the fluid in which said structure is submerged and on the inside by said internal fluid whereby a pressure transfer between said fluids takes place through said bellows; a motor in said chamber and transmitting motion to a position beyond said walls; and a pipe means in open communication with said motor chamber the internal fluid extending upward therein until a static balance is obtained, said pipe means serving to supply additional neutral fluid to said motor chamber to control the amount of expansion of said bellows:

In testimony whereof, we have hereunto set our hands at Los Angeles, California, this 5th day of December, 1927.

EARL MENDENHALL,
JUNIUS B. VAN HORN.
CERTIFICATE OF CORRECTION.

Patent No. 1,842,457. 

EARL MENDENHALL ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, line 4, claim 11, for the numeral "8" read 20; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of March, A. D. 1932.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)