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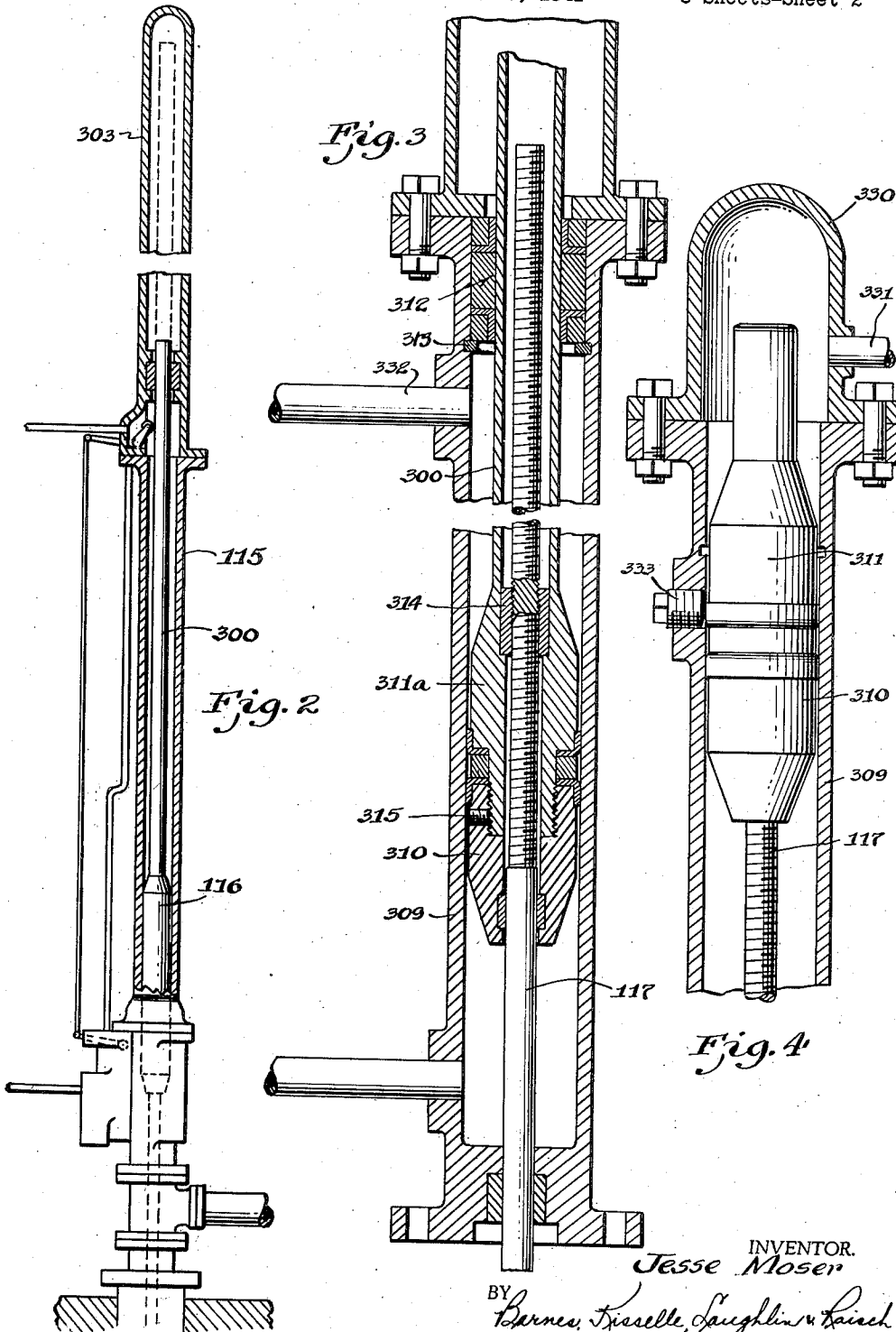
J. MOSER

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OPERATING PISTON FOR OIL WELLS

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3 Sheets-Sheet 2



INVENTOR.

Jesse Moser

BY

Barnes, Kisselle, Laughlin & Laisch

ATTORNEYS

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J. MOSER

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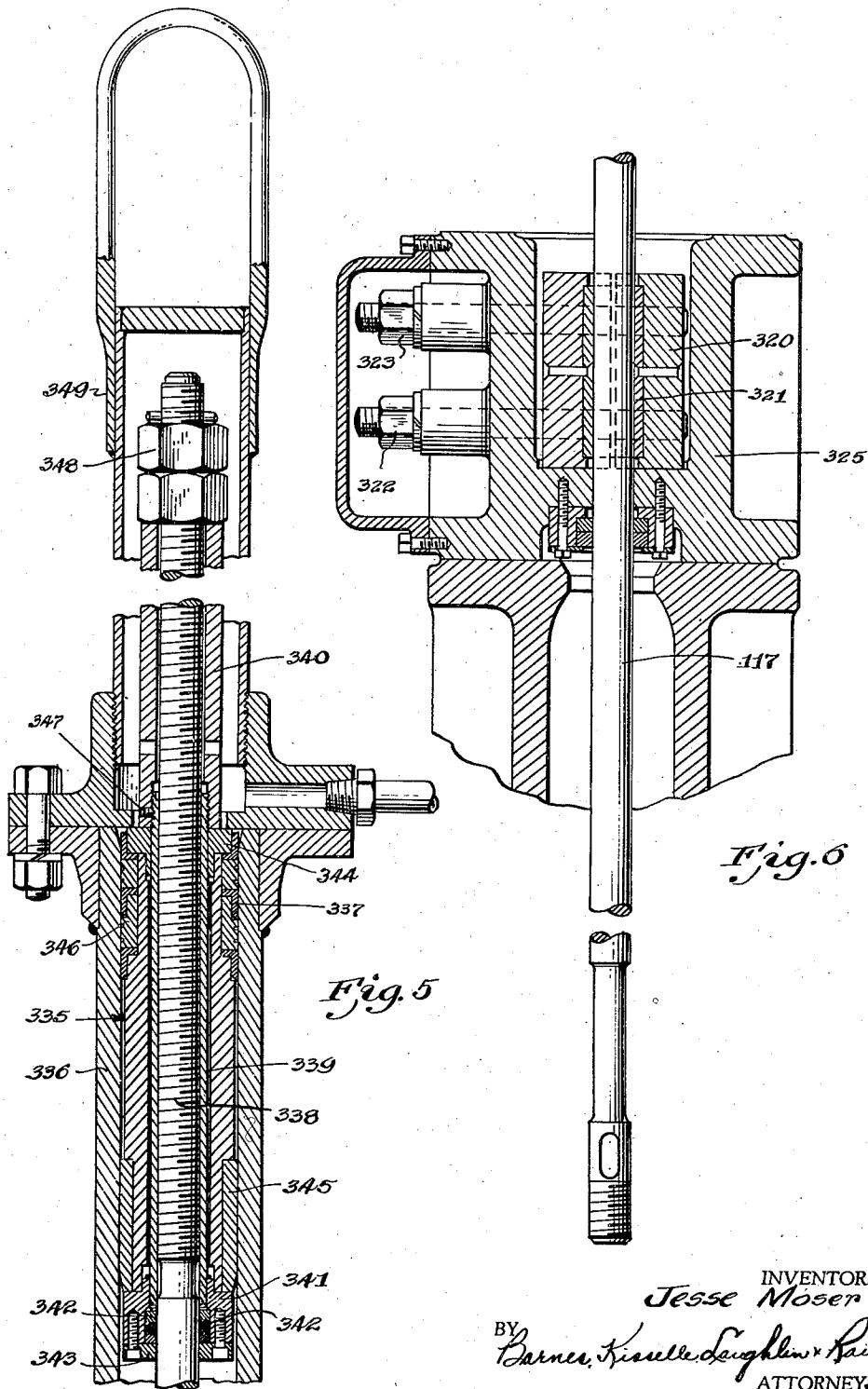


Fig. 6

Fig. 5

INVENTOR
Jesse Moser
BY *Barner, Kinsella, Laughlin & Riesel*
ATTORNEYS

UNITED STATES PATENT OFFICE

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OPERATING PISTON FOR OIL WELLS

Jesse Moser, Detroit, Mich., assignor to Vickers, Incorporated, Detroit, Mich., a corporation of Michigan

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5 Claims. (Cl. 309-4)

This invention relates to an operating piston for oil wells.

It is an object of the present invention to provide an oil well pumping apparatus which may be operated at relatively high stroke speed without increasing the normal capacity of the pumps ordinarily used in these circuits. The invention is particularly adapted to what is known as the top control circuit, that is, a circuit in which a body of liquid connects the bottom sides of the balance cylinder and the motor cylinder directly while the operating pressure is introduced into the tops of the cylinders.

A further object of the invention is to provide a means for regulating the relative position of the pistons on the piston or polish rods to permit compensation for stretching of the sucker rods over a period of use.

Another object of the invention relates to a novel means of providing the extension in cooperation with the ordinary piston construction whereby an ordinary normally operating oil well circuit can be changed to a high speed circuit by changing the piston construction and utilizing the same pressure source.

Other objects and features of the invention relating to details of construction and operation will be brought out in the following description and claims.

In the drawings:

Fig. 1 is a circuit drawing illustrating what has been referred to as the top control circuit.

Fig. 2 illustrates a complete power cylinder constructed in accordance with the present invention.

Fig. 3 is a sectional view of a piston and tail pipe showing the change-over construction.

Fig. 4 illustrates the piston of Fig. 3 prior to the change-over.

Fig. 5 is a modification of the device shown in Fig. 3 showing a manner of obtaining the axial shifting between the polish rod and the piston.

Fig. 6 illustrates a polished rod clamp which may be utilized during the adjustment of the piston or during the change-over construction.

Referring to Fig. 1, a motor cylinder 115 has a piston 116 connected to a rod 117 leading into a well pipe 118. The liquid delivered from the well passes through a conduit 119. An accumulator cylinder 120 is provided with a piston 121 connected to a rod 122 on which is supported a weight 123. At the bottom of piston 115 is a housing 125 and at the bottom of piston 120 is a housing 126. These two housings are connected by a pipe 127. The control unit for the appara-

tus is shown generally at 235 and this unit is connected to the top end of piston 116 by a pipe 136a and to the top end of cylinder 120 by a pipe 137a. Referring to this unit in detail, a main pump 236 is driven by a motor 237 and delivers liquid under pressure through a conduit 238 to a port 239 in a housing 240 surrounding a pilot operated valve 241. The valve 241 is adapted to be shifted to connect conduit 238 either to a conduit 137a leading to the top of cylinder 120 or conduit 136a leading to the top of cylinder 115. A conduit 242 leads from valve 241 back to an inlet 243 of pump 236. When valve 241 connects conduit 238 with either conduit 136a or 137a, the other of the conduits will be connected to return conduit 242. Check valve 242a is provided to permit filling of the lines prior to starting the operation. A spring 241a acting on valve 241 serves to cause filling of the lines in the proper sequence.

Opposite ends of valve piston 241 are connected by conduits 244 and 245 respectively, to a lever actuated valve 246. Valve 246 is connected by a bell crank 247 and link 248 to contact members 139a and 139. The valve 246 is a simple pilot valve connected by a conduit 250 to a pilot pump 251. When valve 246 is in the position shown, pressure from the pump 251 will be connected to conduit 245 and will pass to the valve 241 to shift it to the position shown. When piston 116 reaches its uppermost position, the contact member 139 will effect the shifting of valve 246 to a position where conduit 250 will be connected to the conduit 244 to cause shifting of the valve 241 to the right as viewed in the drawing. The rate of shifting of valve 241 is controlled by suitable needle valves. In normal operation, therefore, there will be a shifting of valve 246 at each end of the stroke of the piston and which will cause a shifting of the valve 241 and a change in the direction of shifting of the pistons.

The replenishing in this system is effected by a pump 252 which receives liquid from a conduit 253 open to the outlet of pilot pump 251 and directs liquid to a conduit 254 leading to a conduit 127. The pump 252 is a plunger pump driven by the motor 237 and by its operation, there will be a constant replenishing of the body of liquid passing between cylinders 115 and 120. The relief of the upper control circuit is effected by a shuttle valve 210. This valve has a central port 212 which connects to a conduit 212a leading to a low pressure relief valve 255. The conduit 136a is always connected by a conduit 256 to one end of the shuttle valve 210 and to a port 257 adja-

cent the port 212. The conduit 137a is always connected to the other end of valve 210 and a port 258 on the other side of port 212. When pressure is being directed from pump 236 to conduit 137a, the valve 210 will be shifted to the left as shown, so that supply conduit 136a is connected not only to conduit 242 but to low pressure relief valve 255. During replenishment of the body of liquid passing between the lower ends of the cylinders 115 and 120, relief of the upper system is permitted through valve 255. Similarly, if the system is reversed, conduit 136a will be under pressure so that valve 210 will shift to connect conduit 137a to the relief valve 255. A relief valve 259 in conduit 250 is arranged to spill liquid into relief valve 255 at a more or less constant rate. This is possible since the pump 251 has a capacity which is quite adequate for the shifting of valve 241 and when the valve 241 is not being shifted, there will be a bypassing through the valve 259 to valve 255; there will thus always be a supercharging of the upper circuit control by the low pressure setting of valve 255. This will follow from the fact that conduit 212a is always connected to the inlet or supply conduit to the main pump 236.

The valve 150, Fig. 1, in the base of cylinder 120 will serve to bypass excessive liquid in the lower circuit. The operating circuit of Fig. 1 could be varied by changing it from a closed to an open circuit. If this were done, check valve 242a would be dispensed with and conduit 242 would be cut and the free ends dropped to the bottom of the tank.

Under ideal conditions, it would be possible to have the diameters of cylinders 115 and 120 exactly equal and the length the same so that the same quantity of liquid will be required to effect stroke of equal length in each cylinder. However, manufacturing tolerances in honing or finishing these cylinders result in a small variation in diameter. Due to the length of these cylinders, this small variation in diameter results in a considerable variation in the volume of the cylinders. It is necessary, therefore, to provide means for compensating for different volume requirements of the cylinders for the strokes of the piston. In the circuit of Fig. 1 the variations in the cylinder diameters are compensated for by the bypass or spilling valve 150 and the shuttle valves 210. The valve 210 automatically causes that pressure line connecting the cylinder whose piston is being moved downward to be open to either pilot pressure, that is, super-charging pressure, or to relief valve pressure.

The pistons 116 and 121 are each provided with extensions which may be referred to, respectively, as 300 and 301. These extensions or tail pipes, as they may be called, pass through packing 302 at the top of the cylinders. The extensions have a length slightly greater than the stroke of the pistons in the cylinders so that at the lower extremity of the piston travel, the extension will still be through the packing 302. This condition is shown in cylinder 115 at the right hand side of Fig. 1. A dust cap 303 is provided above each of the cylinders, as shown in Fig. 2. It will thus be seen that the extensions 300 and 301 always fill the space above the pistons in the cylinders 115 and 120, thus reducing considerably the volume necessary to actuate the pistons. Since the working area above the pistons is reduced, the operating pressure will be higher. However, the speed at which an ordinary pump can stroke the apparatus is greatly increased because of the reduced volume requirement. For example, if the

circuit of Fig. 1 is used with an ordinary piston, as shown in Fig. 4, with a sixty gallon vane pump, the pressure range would be from approximately 200 pounds to 450 pounds per square inch with a speed of 4 to 5 cycles per minute. Using the same pump, however, with the extensions 300 and 301, as shown in Fig. 1, the operating pressure would be from 400 pounds to 900 pounds per square inch and the speed would be 8 to 10 cycles per minute. The vane type pump is well adapted to the higher pressures and because of the low volume requirements, can increase the number of cycles considerably.

In some instances it is desirable to be able to change the slow type of job to the fast type of job or vice versa. In Figs. 3 and 4, a construction which greatly facilitates this change-over is shown. This construction also discloses the feature which permits compensation for change in sucker rod length. In Fig. 4, within a cylinder 309, a piston is shown in two portions, a lower portion 310 and an upper portion 311. The construction of this piston is shown in detail in Fig. 3 where it will be seen that the lower portion 310 has a threaded axial opening to receive a threaded extension on the top portion. Packing for the piston is arranged between the two parts. In Fig. 3, however, the top portion of the piston 311a is shown with the extension 300 which passes through a packing arrangement 312 held in place by a split ring 313. The polished rod 117 is threaded in its upper end into a locknut 314. A set screw 315 may be used to lock the two portions of the piston together. To facilitate the change-over, a clamp should be provided for the polished rod, as shown in Fig. 6. This clamp is located at the lower portion of the cylinder and consists of a split collar 320 with a suitable gripping surface 321. This split ring may be brought tightly around the polished rod 117 by tightening the two nuts 322 and 323. The clamp 320 will rest on the lower portion of the cylinder housing indicated at 325 and thereby hold the weight of the sucker rods while the pistons are being either adjusted on the sucker rod or changed from the common slow speed type of Fig. 4, to the high speed type of Fig. 3. The cylinders 309 of Figs. 3 and 4 are identical and, to change to the slow speed operation, the split ring 313 is removed along with the packing 312 and a new and shorter dust cap 330 is used. The pressure entrance in this case is through a pipe 331 in the dust cap, the previous entrance of 332 being plugged at 333.

Another type of change-over piston is shown at 335 in a cylinder 336 in Fig. 5. This piston has packing 337 at the top portion thereof. In the center of the piston surrounding rod 338 is a sleeve 339 which projects through the piston and above it for a certain distance. This sleeve is threaded on its inner surface to permit adjustment on the threaded polished rod 338 and is threaded on the outer surface of the upper end to cooperate with a lower end of a tube 340. At the lower end of sleeve 339 is welded a ring 341. Packing 342 is provided in this ring held in place by a retaining ring 343. A ring 344 surrounds the upper portion of the sleeve 339 and between these rings, the piston proper 335 is found. A sealing band 345 surrounds the piston at the lower end and similar material is provided at the upper end, shown generally at 346. When the extension 340 is screwed down on the top end of sleeve 339, it compresses ring 344 against the packing material 346 and also moves piston 335 downwardly toward ring 341 thereby placing all

of the sealing material under the proper compression. A set screw 341 may be used to lock the extension 340 in place. If used, the set screw may be put in place by lifting the piston assembly to the point shown in Fig. 5 and prior to the application of the top connection plate and dust cap. The extension 340 is also held in place against turning by lock nuts 348. The extension 340 is provided so that the lock nuts will be easily accessible without removing the piston from the cylinder. When adjustment is desired, the lock nuts are loosened and the extension 340 turned so that the sleeve 339 will move upwardly or downwardly on the rod 338. During this movement there is no disturbing of the relative positions of the extension 340 and the sleeve 339. When the piston is properly adjusted on the rod, the lock nuts are again tightened. A dust cap 349 is provided, as is customary, on the top of the cylinder.

I claim:

1. In an oil well pumping apparatus of the type having a motor cylinder and a counterbalance cylinder, a piston in said motor cylinder, a piston rod extending into said cylinder, means connecting said piston rod and said piston whereby the relative axial relationship between the two may be altered, said means comprising a sleeve threaded on said rod, a flange projection rigidly fastened at one end of said sleeve, a retaining ring 344 at the other end slidable on said sleeve, and means for locking said piston between said flanged end and said retaining ring.

2. In an oil well pumping apparatus of the type having a motor cylinder and a counterbalance cylinder, a piston in said motor cylinder, a piston rod extending into said cylinder, means connecting said piston rod and said piston whereby the relative axial relationship between the two may be altered, said means comprising a sleeve threaded on said rod, a flange projection rigidly fastened at one end of said sleeve, a retaining ring at the other end slidable on said sleeve, and means for locking the piston between said flanged end and said retaining ring comprising a tubular extension threaded at one end of said sleeve and lock nuts for preventing the turning of said extension on said rod except during adjustment.

3. In a reciprocating motor for a hydraulic system, a cylinder, a piston therein, means for the inlet and outlet of pressure liquid at the ends of the cylinder for reciprocating the piston in the cylinder, a piston rod extending through one end of the cylinder, a first piston part in the cylinder, a second piston part in the cylinder, sealing means for wiping the cylinder walls disposed between the piston parts, screw thread means for connecting the two piston parts and for clamping the sealing means therebetween, said piston parts having aligned axial openings therethrough for receiving the piston rod, means detachably connecting the piston rod with the

second piston part, a hollow extension on the second piston part of less diameter than the piston and extending out through the end of the cylinder opposite the piston rod, packing means through which the hollow extension projects, said hollow extension having a length at least equal to the length of the stroke of the piston, the hollow extension serving to reduce the volumetric capacity of the cylinder on one side of the piston, and means in the hollow extension for locking the connection between the second piston part and the piston rod.

4. In a reciprocating motor for a hydraulic system, a cylinder, a piston therein, means for the inlet and outlet of pressure liquid at the ends of the cylinder for reciprocating the piston in the cylinder, a piston rod extending through one end of the cylinder, a first piston part, a second piston part, sealing means for wiping the cylinder walls disposed between the piston parts, screw thread means for connecting the two piston parts and clamping the wiping means therebetween, said piston parts having aligned axial openings therethrough for receiving the piston rod, said piston rod being threaded at its end, cooperating threaded means associated with the second piston part for uniting the piston rod and the second piston part, a hollow extension on the second piston part of less diameter than the piston and extending out through the end of the cylinder, packing means at the last mentioned end of the cylinder, the hollow extension having a length at least equal to that of the stroke of the piston and serving to reduce the volumetric capacity of the cylinder on one side of the piston, and screw threaded means in the hollow extension for locking the threaded connection between the piston rod and the second piston part.

5. In a reciprocating motor for a hydraulic system, a cylinder, a piston therein, means for the inlet and outlet of pressure liquid at the ends of the cylinder for reciprocating the piston in the cylinder, a piston rod extending through one end of the cylinder and provided with screw threads, the piston comprising separable portions with sealing means therebetween for wiping the cylinder walls, a hollow extension constituting a part of the piston and having a diameter less than that of the piston and extending through the end of the cylinder and serving to reduce the volumetric capacity of the cylinder on one side of the piston, screw thread means for connecting the piston parts and clamping the wiping means between said portions, said piston having an axial opening therethrough for accommodating the piston rod, and screw threaded means in abutting relation with a part of the piston and engaging the threads of the piston rods for connecting the piston rod to the piston.

JESSE MOSER.

CERTIFICATE OF CORRECTION.

Patent No. 2,355,669.

August 15, 1944.

JESSE MOSER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 31, claim 1, after "ring" strike out the numeral "344"; 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 21st day of November, A. D. 1944.

Leslie Frazer

(Seal)

Acting Commissioner of Patents.