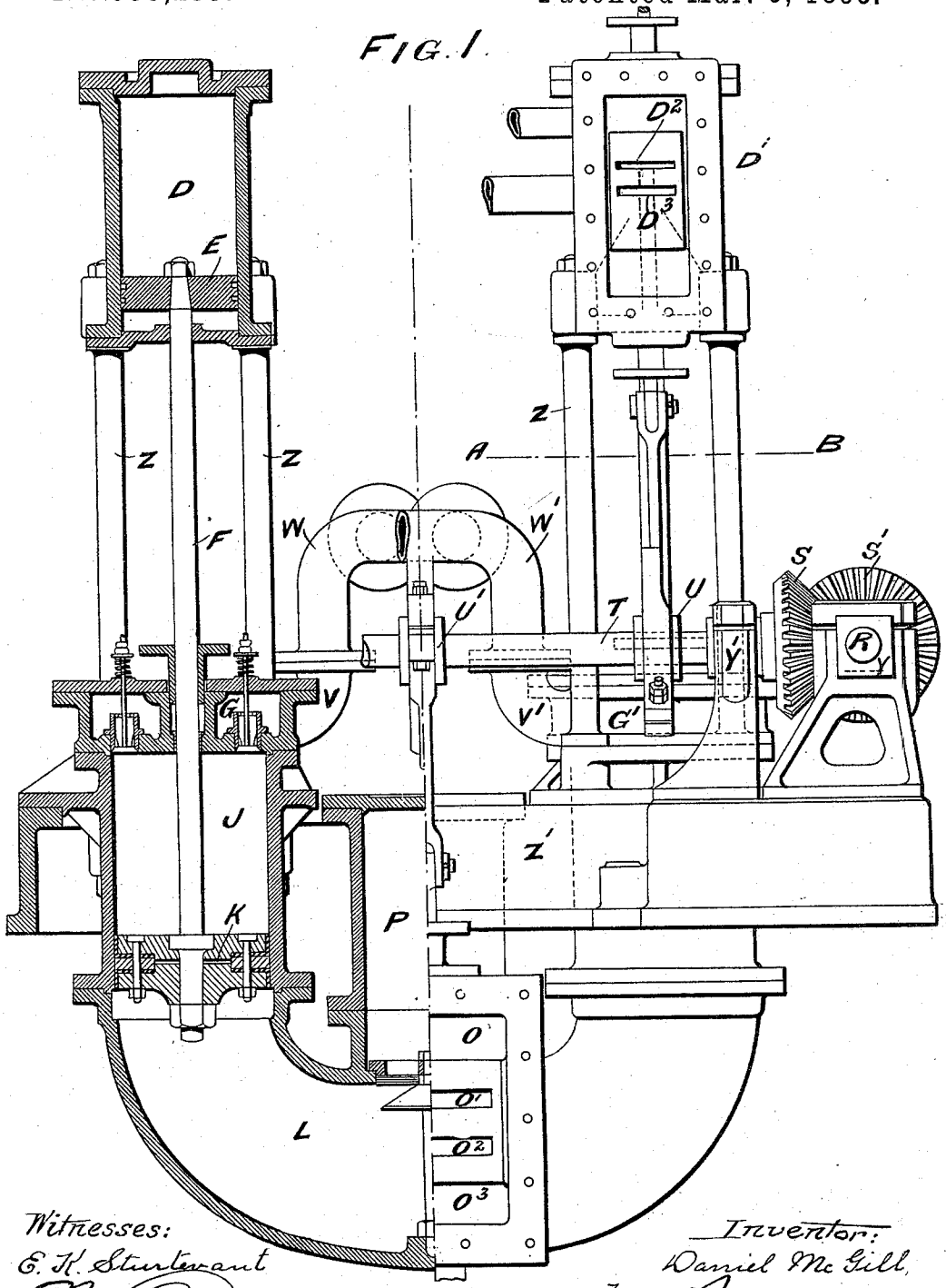
(No Model.) 4 Sheets—Sheet 1.

D. McGILL.

MEANS FOR COMPRESSION OF AIR.

No. 535,259. Patented Mar. 5, 1895.

FIG. 1.



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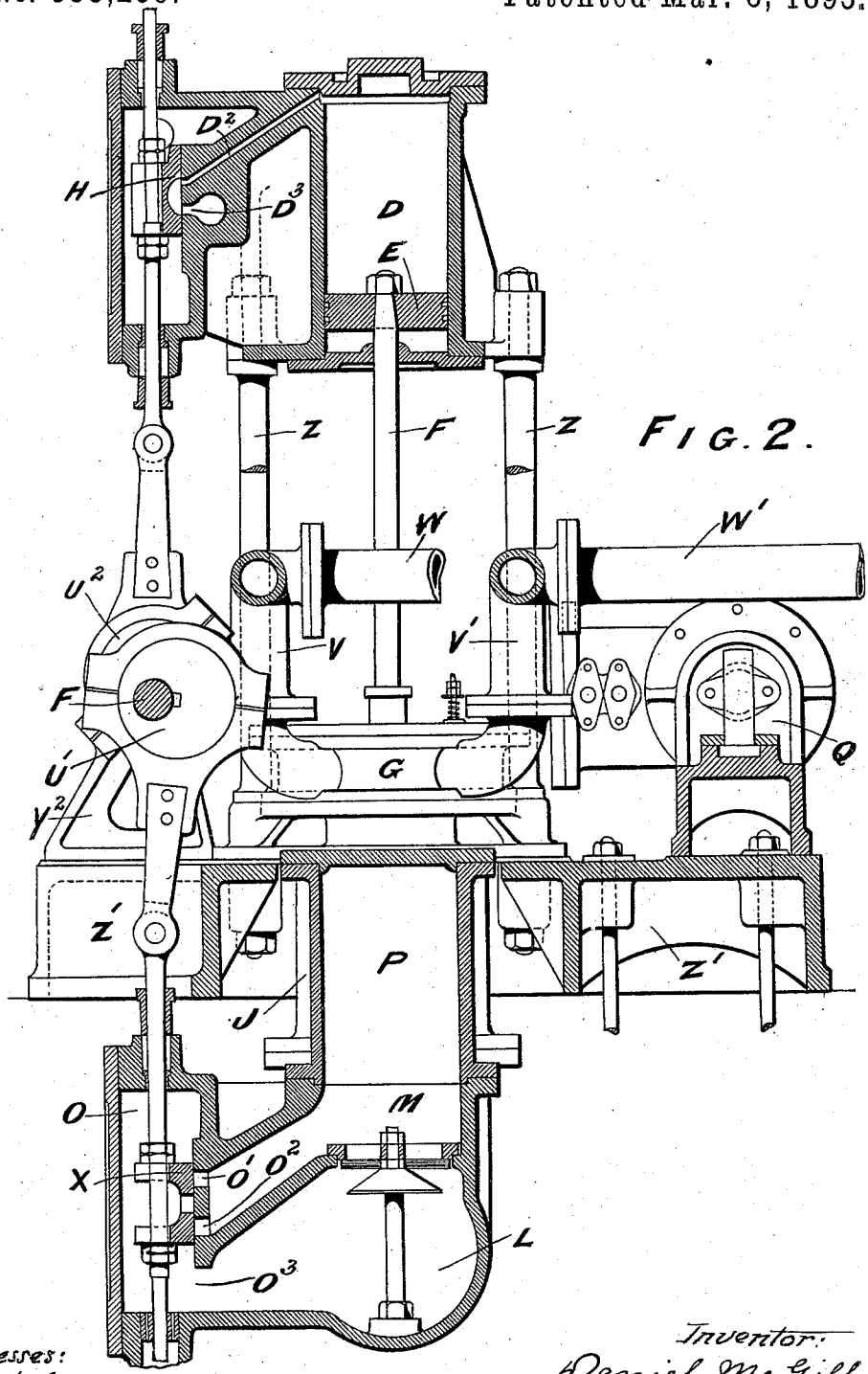

FIG. 2.

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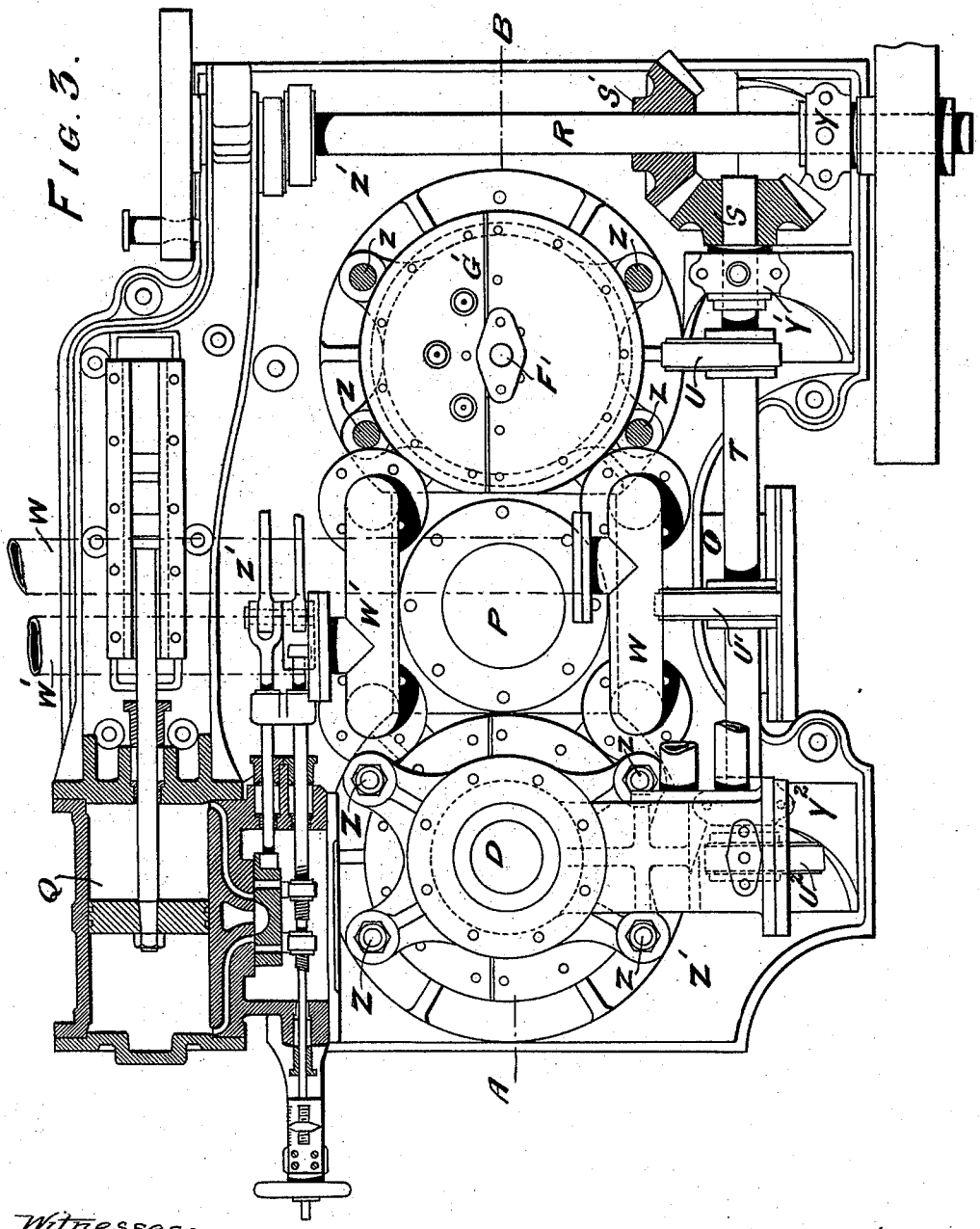
FIG. 3.



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(No Model.) 4 Sheets—Sheet 4.

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MEANS FOR COMPRESSION OF AIR.

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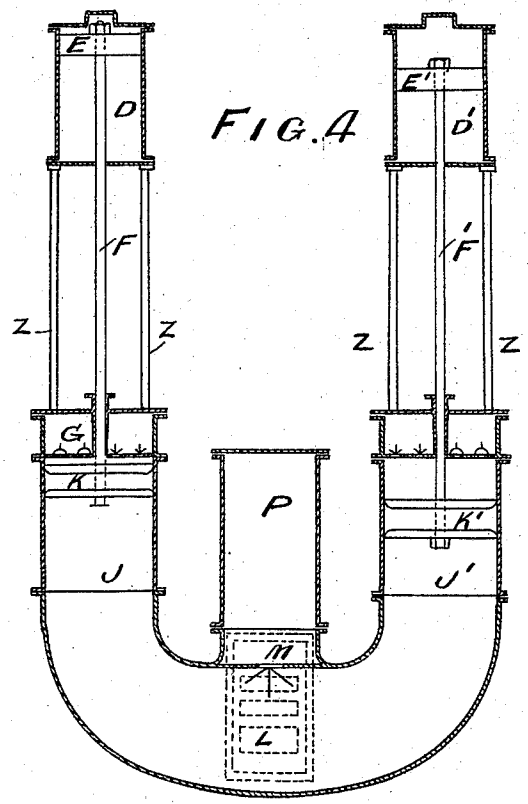
FIG. 4



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UNITED STATES PATENT OFFICE.

DANIEL McGILL, OF WELLINGTON, NEW ZEALAND.

MEANS FOR COMPRESSION OF AIR.

SPECIFICATION forming part of Letters Patent No. 535,259, dated March 5, 1895.

Application filed July 21, 1894. Serial No. 518,412. (No model.)

To all whom it may concern:

Be it known that I, DANIEL McGILL, of Wellington, New Zealand, but temporarily residing at London, England, have invented Improved Means for the Compression of Air or other Gases, of which the following is a specification.

My invention relates to means for the compression of air or other gases and is effected by means of steam acting as a motive power upon water or other liquid interposed between wood or metallic pistons so as to make use of the initial pressure and expansive force of the steam through the medium of the water or other liquid upon the air or other gas, a cushioning device being employed in order to transfer the action backward and forward between two duplicate steam pistons. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a front elevation of my apparatus; the left hand half is in section through the steam cylinder and air pump; the other half is a general outside view. Fig. 2 is an end elevation of the same, sectional through one steam cylinder, and the chamber P and valve chest thereto. Fig. 3 is a plan of the same. Fig. 4 is an outline diagrammatic sectional elevation.

Similar letters refer to similar parts throughout.

D and D′ are ordinary cylinders commonly used in connection with steam engines into which steam is alternately admitted and exhausted by slide valves such as H, Fig. 2.

D^2 and D^3 are ports or passages.

E and E′ are ordinary metallic pistons.

F and F′ are piston rods secured to the pistons E and E′.

G and G′ are ordinary air-valve chests commonly used in connection with air compressors.

H is a slide valve commonly used in connection with steam cyliders.

J and J′ are cylinders commonly used in connection with air compressors.

K and K′ are pistons secured to the piston rods F and F′ commonly used in air or water cylinders.

L is a port or pipe connecting the cylinders J and J′ and either cast in connection with or otherwise secured to the said cylinders J and J′.

M is a branch on the pipe or port L.

O is a valve chest cast in connection with or otherwise secured to the pipe or port L.

O′, O^2 and O^3 are ports in pipe L and branch M.

P is a cylinder cast in connection with or otherwise secured to the branch M of the pipe or port L.

Q is an engine of ordinary construction operated by the compressed air and driving the valve motions.

R is the crank-shaft of engine Q.

S and S′ are miter or bevel wheels.

T is a counter shaft.

U, U′ and U^2 are eccentrics operating valve gear.

V and V′ are air delivery and suction branches cast on or otherwise secured to the air-valve chests G and G′.

W and W′ are air delivery and suction pipes.

X is a slide valve controlling communication between L and M.

Y, Y′ and Y^2 are bearings carrying shaft T.

Z are pillars carrying the cylinders D and D′.

Z′ is the bed plate of the apparatus.

It will be seen from this description of the several parts and by reference to the drawings that my apparatus compresses air or other gas by means of steam acting as a motive power on the upper sides of the pistons E and E′ in the steam cylinders D and D′; the piston E of the steam cylinder D being coupled or connected by the piston-rod F with the piston K in the cylinder J and the piston E′ being coupled or connected by the piston rod F′ with the piston K′ in the cylinder J′.

The pipe or port L, valve chest O, lower part of P, and all the space up to the bottom of the pistons K, and K′ of the cylinders J and J′, the branch M and port spaces O, O′, O^2 and O^3 are filled with water or other liquid, the space above the liquid level of the cylinder P containing air or other gas.

The space in the cylinders J and J′ above the pistons K and K′ or between the pistons K and K′ and the air-valve chests G and G′, except what space is occupied by the piston-rods, F and F′ is space allowed for the suction and discharge of air by the pistons K and

K′, such air being admitted and discharged through ordinary air-inlet and air-outlet valves in the air valve chests G and G′ and is drawn and delivered through the respective air suction and delivery branches V, V′, and air suction and delivery pipes W, and W′.

The cylinder P may be fitted with a wood or metallic piston loaded either by a spring or otherwise, if the air cushion is not effective without such loaded piston.

In starting my apparatus the engine Q is actuated by steam, the air supplied from the air cylinders J and J′ being shut off by a valve until sufficient air pressure is generated in the receiver. The steam and steam exhaust valves in connection with the engine Q are then shut and the engine Q actuated by air discharged from the air cylinders J and J′. The cylinder of the engine Q may be of sufficient size to pass and expand the whole of the compressed air to refrigerate the same; or if refrigeration of the air is not required, the cylinder of Q may be only of such size as will drive the valve motion and may be geared in any desired way to the eccentric shaft T. The stroke is commenced with the initial pressure of steam acting upon one of the pistons E when it is at the top of its respective cylinder D, see Fig. 4, the air piston K, coupled to the piston E by the piston rod F, simultaneously commencing its stroke in the act of air suction, the pistons in the other steam and air cylinders D′ and J′ respectively being already at about five-eighths of their return stroke by the support of the liquid in the pipe L and chamber P between the pistons K and K′, the ports O′, O^2, O^3 between L and P being closed by the valve X. At this point about three-eighths of the stroke remains to be completed in the air cylinders J′ and D′ and the space L between the pistons K and K′ being entirely filled with liquid, and the ports O′, O^2, and O^3, communicating between L and P being closed, the piston D is forced down by the steam conjointly with the piston K, which acting directly upon the liquid between it and the piston K′ in the other air cylinder J′ finishes the remaining three-eighths of the upward stroke in the cylinders J′ and D′ compressing the air contained in the space above the piston K′ in the cylinder J′, which will be discharged through the valve box G′ and the branch W in proportion to whatever initial pressure is applied in connection with the steam cylinder D. The valve H appertaining to cylinder D′, permits the contents of that cylinder above the piston E′ to be discharged to the exhaust during the upward stroke of the piston E′. The piston E has now made three-eighths downward stroke, with initial steam pressure from the boiler and at this point steam is cut off from the cylinder D by the valve H appertaining to that cylinder but is not allowed to exhaust. The remainder of the stroke of the piston E is now effected under the expanding action of the steam, aad the valve X, being now timed to open the communication between the pipe L and chamber P, the liquid or water in L is forced into the chamber P compressing the cushion of air therein, until the piston E has completed its stroke, the piston E′ remaining stationary during this period at the top of its stroke. The steam in cylinder D is now allowed to exhaust by the valve H appertaining to that cylinder, and the reaction of the cushion of air in P, operating through the liquid in L, the valve X still allowing the ports O′, O^2, O^3, to be in communication with one another, carries back the piston E throughout five-eighths of its upward stroke. The ports O′, O^2, O^3, are now closed by the valve X and the piston E′ is at the top of its stroke ready to repeat the aforesaid operation when steam pressure is admitted on top of it, while the piston E is now in the position of the piston E′ in the foregoing description.

Should there be any leakage or waste reducing the necessary volume of liquid between the pistons K and K′, I provide a pump which may be conveniently operated by hand attached to any convenient part of the pipe or port L by means of which such leakage or waste of liquid may be at once replaced.

The slide valves H H and X before mentioned derive their motion from the eccentrics U, U′ and U^2, which are secured on the shaft T which derives its motion by means of the miter or bevel wheels S, and S′, S being secured to the shaft T derives its motion from S′, which is secured to the crank shaft R of the engine Q, which is actuated by the compressed air delivered from the cylinders J and J′ in the manner before described.

The proportions I have adopted in the explanation of the action of the apparatus of five-eighths and three-eighths of the stroke would vary in accordance with the initial pressure of steam used which governs the balancing point of the expansive effect of the steam in its action in compressing the air in the upper portion of the cylinder P, but would be in all cases in corresponding proportion to those given, and in accordance with the terminal pressure due to the initial pressure acting in the steam cylinders D and D′.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In an air or gas compressing engine the combination with the two single acting steam cylinders and duplicate single acting air cylinders of a pipe or port connecting the open ends of said air cylinders, and filled with a liquid between said air pistons, and of an air cushion or chamber communicating with the said connecting pipe or port, by orifices controlled by an externally operated valve.

2. In an air or gas compressing engine, the combination of two single acting steam cylinders and pistons controlled by ordinary slide valves, with two single acting air or gas com-

pressing pistons and cylinders with usual inlet and outlet air valves, and connected at ends opposite to air valves by a pipe or port filled with liquid, and an air cushion vessel thereon, controlled by shut off valve.

3. In an air or gas compressing engine the combination of duplicate single direct acting steam cylinders and air compressing cylinders with steam and air pistons on single rod in each pair, with an auxiliary engine with crank, fly wheel, and counter shaft, operating, by compressed air or gas charge from compressors, the valve gear of said compressing direct acting engines.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

DANIEL McGILL.

Witnesses:
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CHARLES H. CARTER.