A. M. LOW.

CHARGE FORMING ARRANGEMENT FOR USE IN INTERNAL COMBUSTION ENGINES AND TURBINES.

APPLICATION FILED JAN. 9, 1909.

974,087. Patented Oct. 25, 1910.

3 SHEETS—SHEET 1.

FIG. 1.

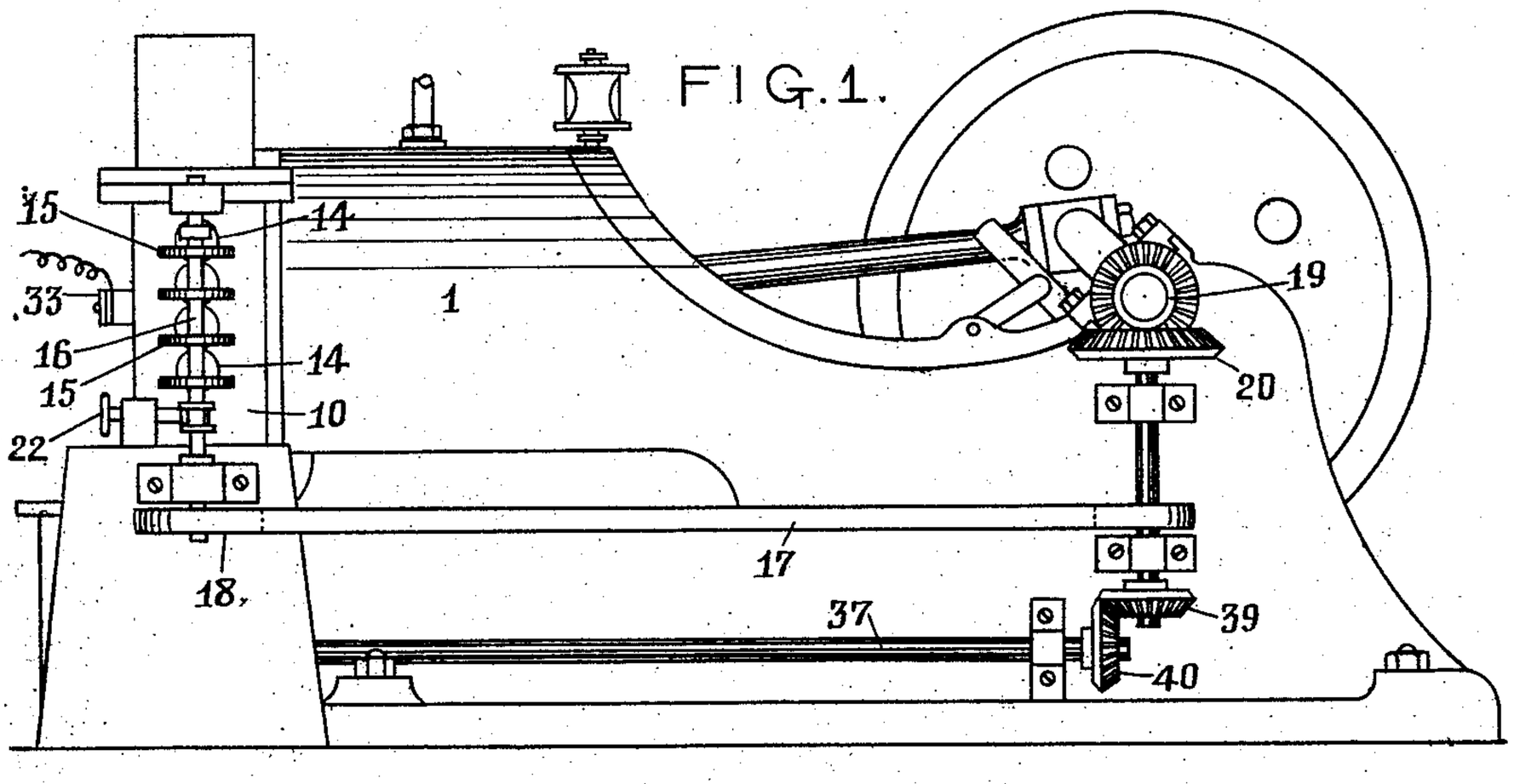


FIG. 2.

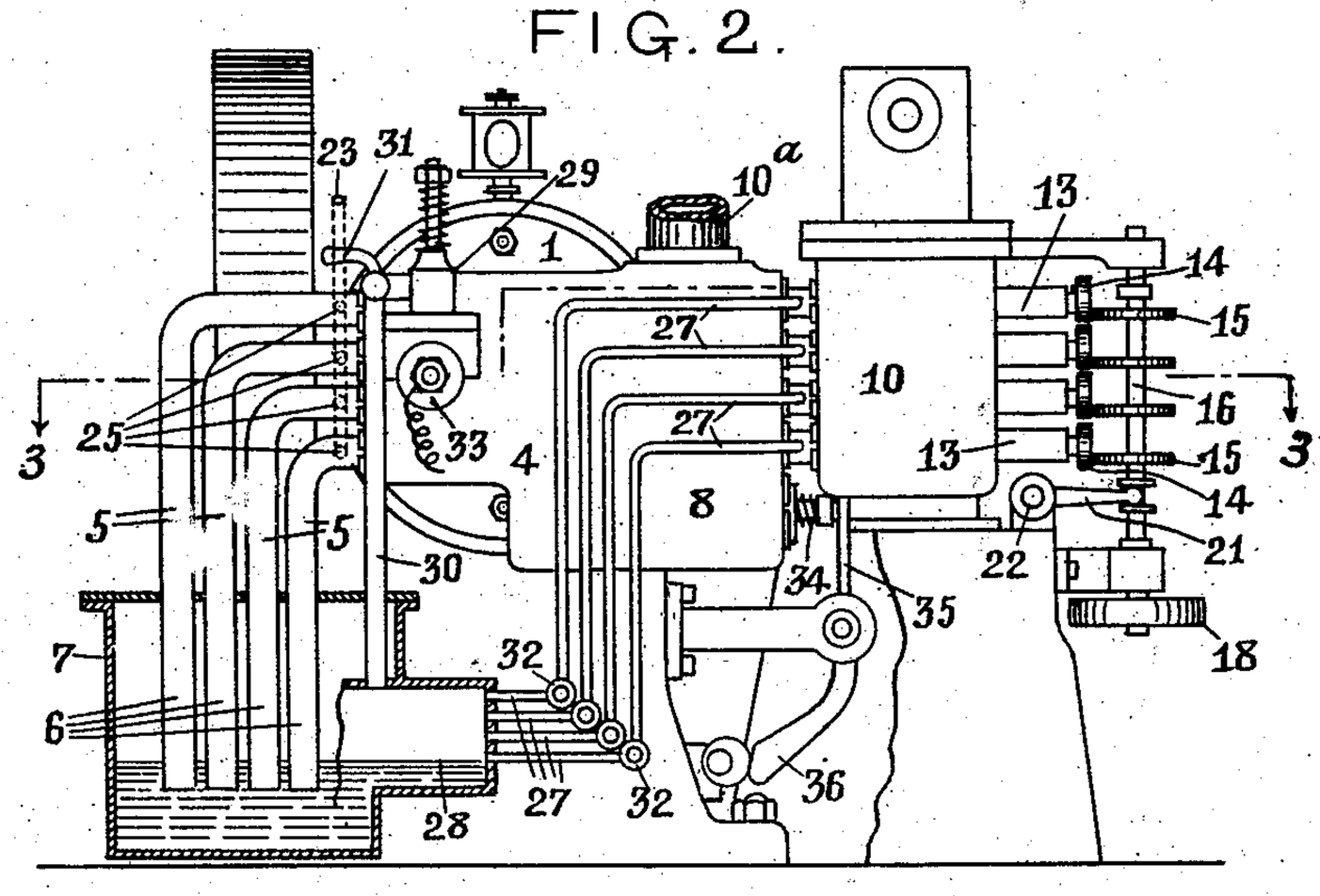
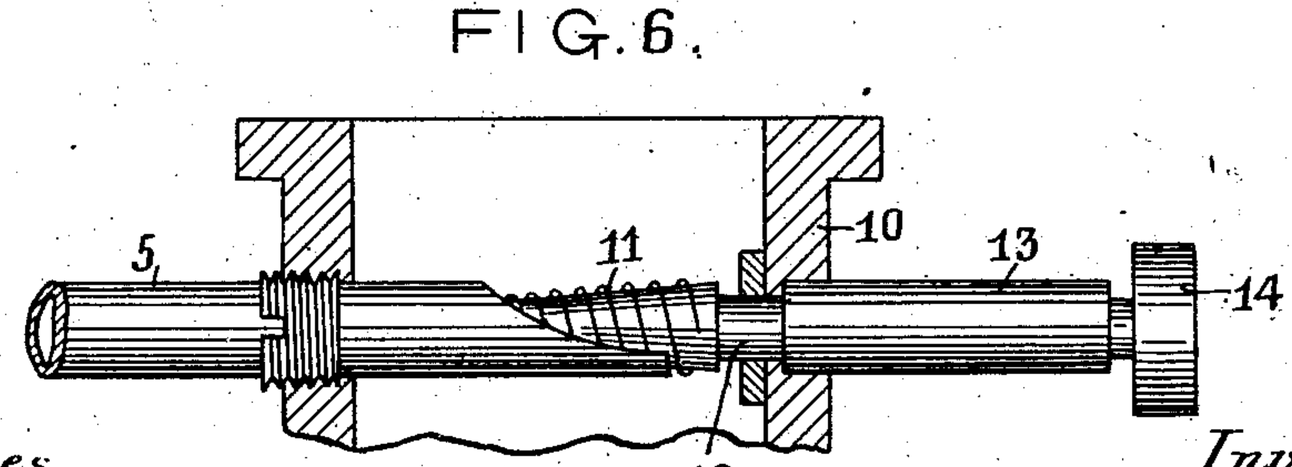


FIG. 6.



Witnesses.

R. J. Haddan

A. T. Morrill

Inventor

Archibald Montgomery Low-

by R. J. Haddan

Attorney

A. M. LOW.

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FIG. 7.

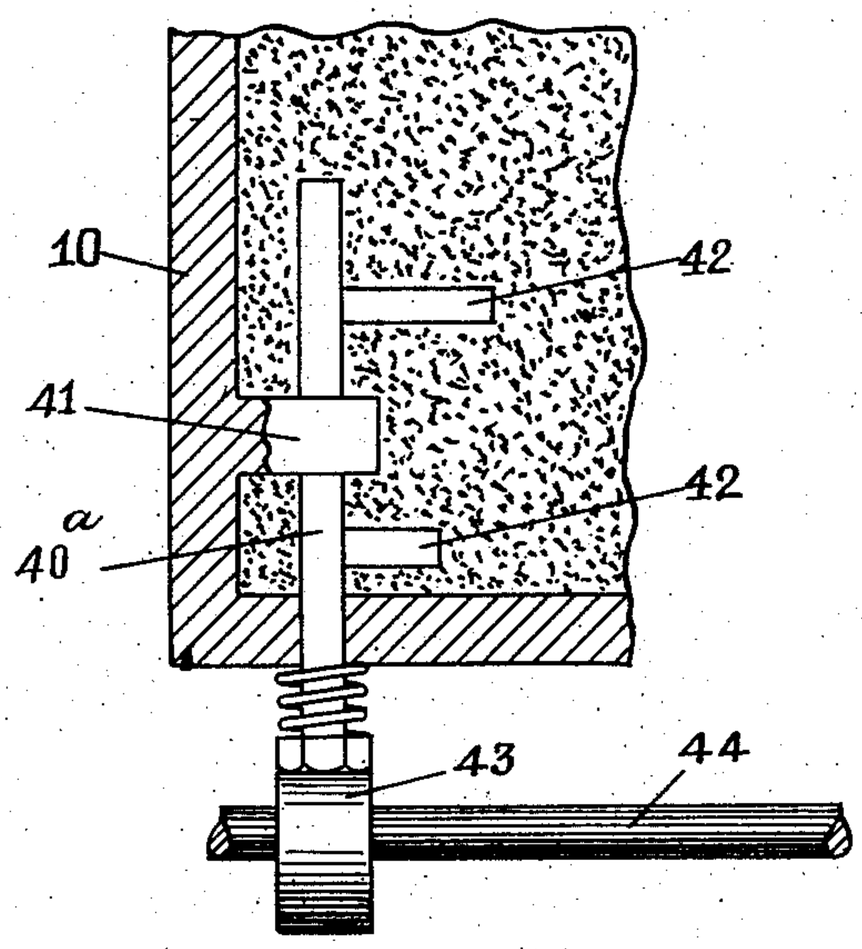
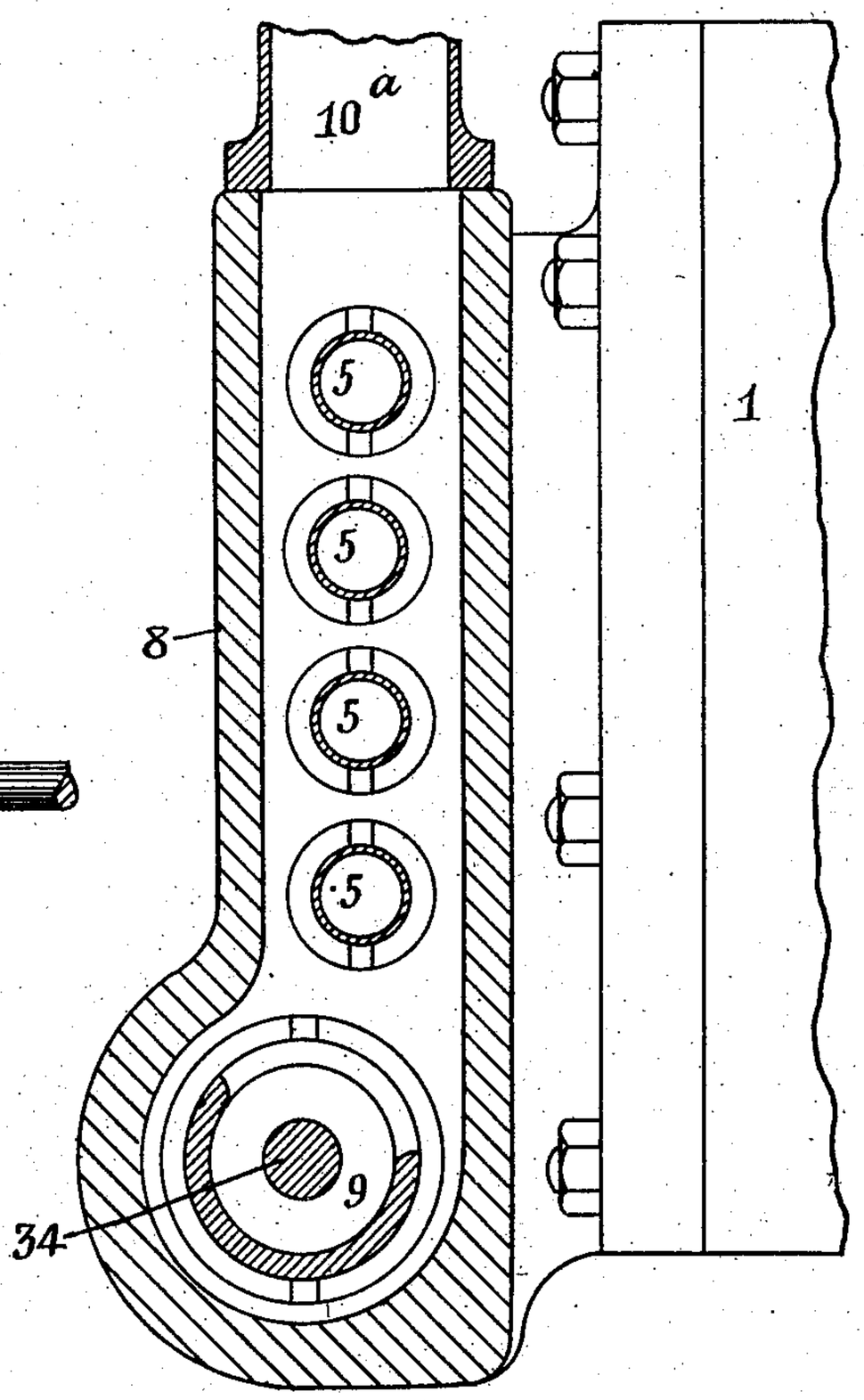
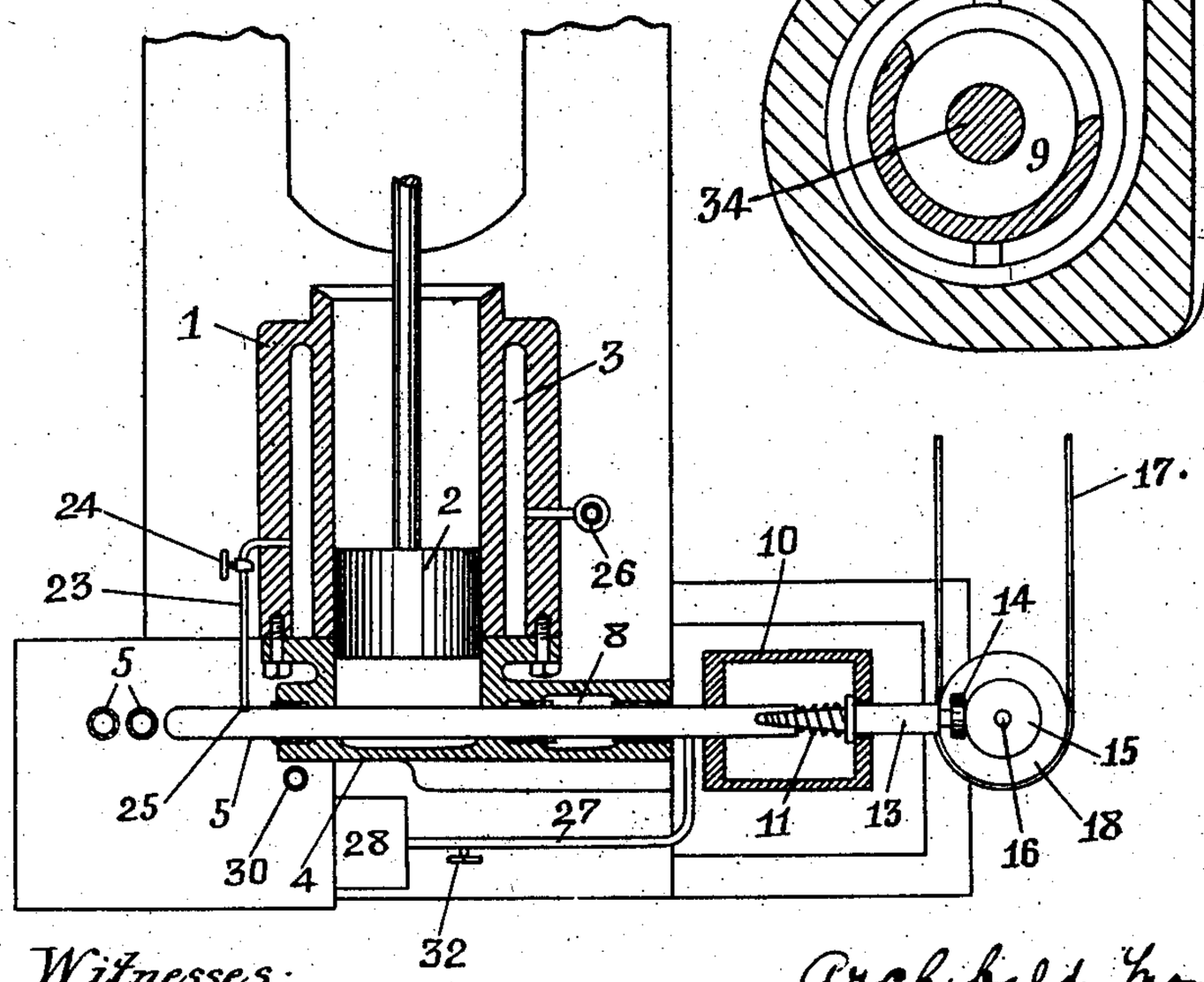


FIG. 3.

FIG. 5.





Witnesses:
A. J. Riddell
A. Morrill

Inventor
Archibald Montgomery Low.
by R. H. Riddell
Attorney

A. M. LOW.

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FIG. 7.

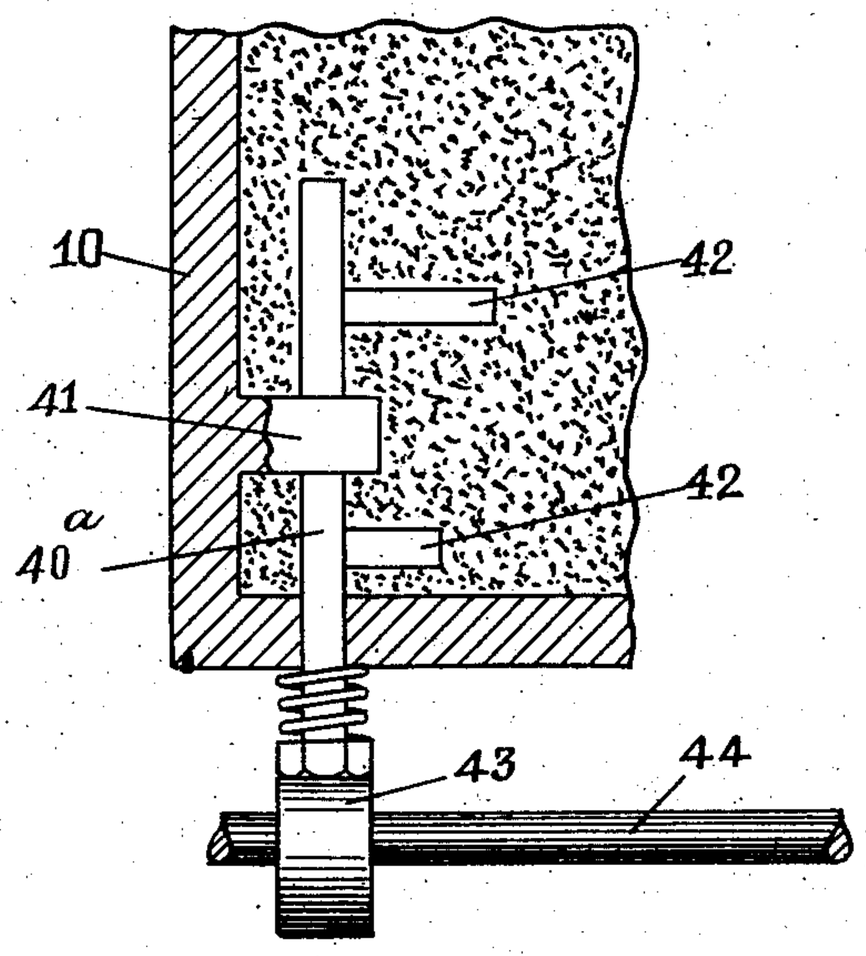
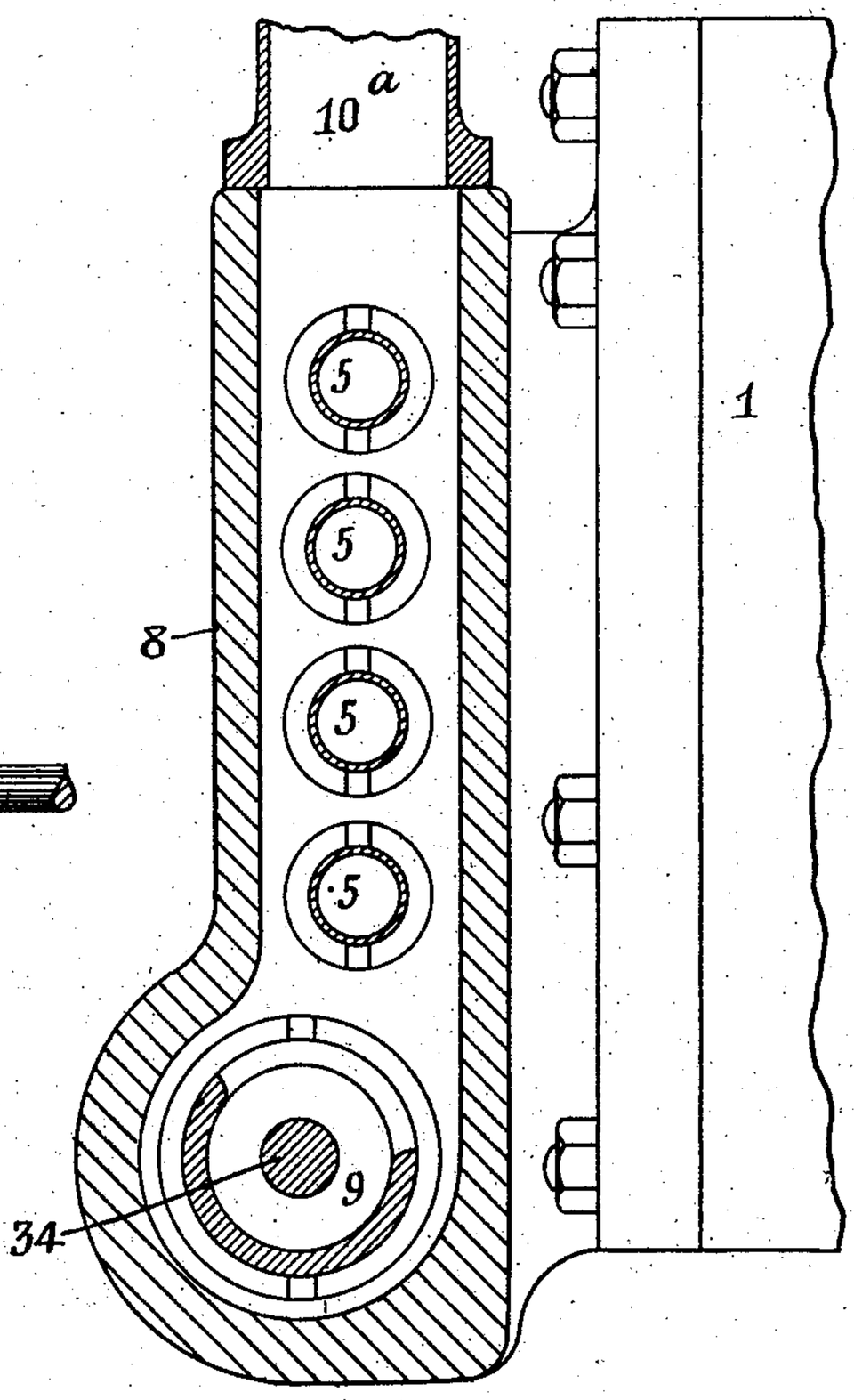
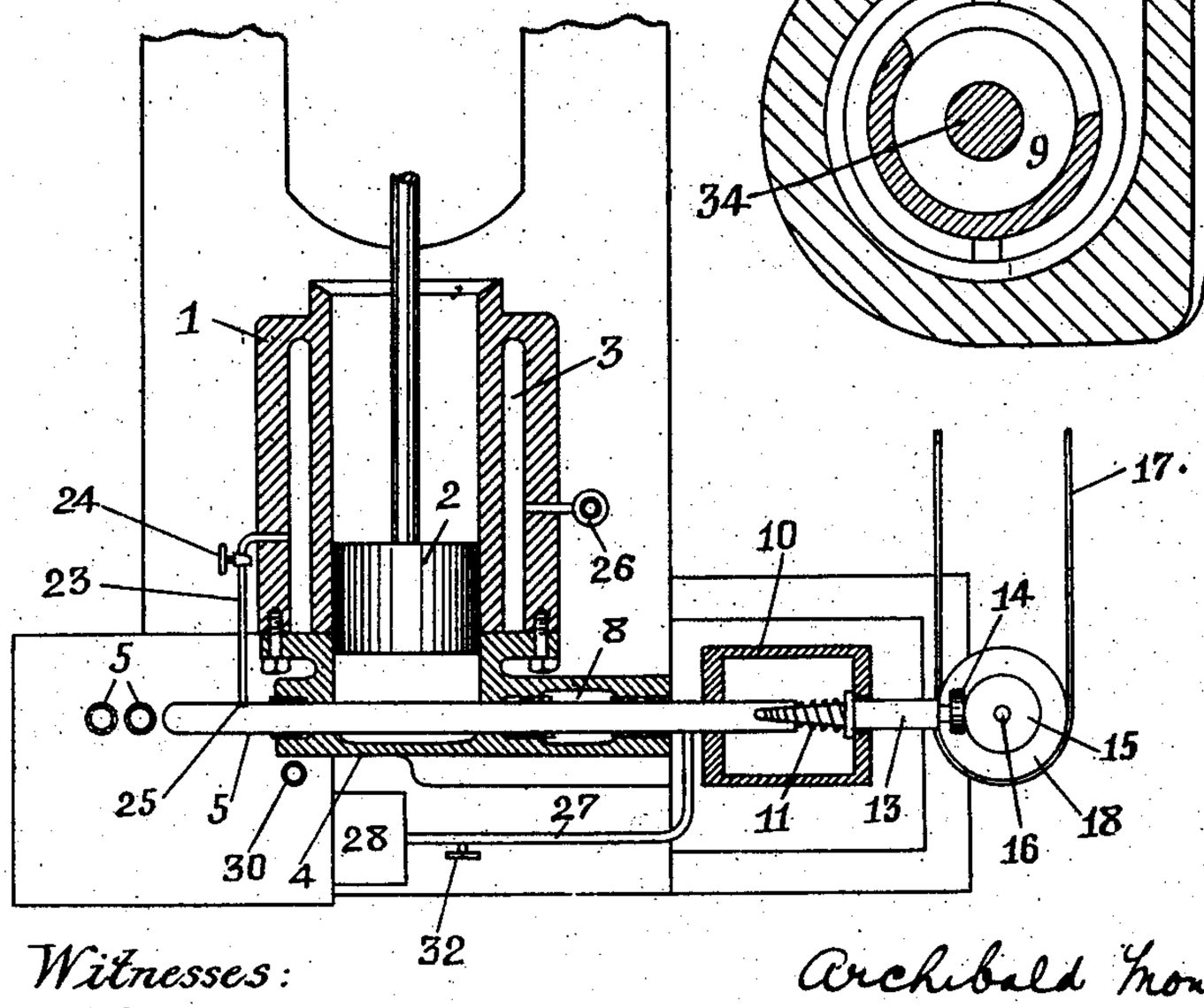


FIG. 3.

FIG. 5.





Witnesses:
A. J. Maddan
A. Morrill

Inventor
Archibald Montgomery Low.
by R. H. Maddan
Attorney

UNITED STATES PATENT OFFICE.

ARCHIBALD MONTGOMERY LOW, OF LONDON, ENGLAND.

CHARGE-FORMING ARRANGEMENT FOR USE IN INTERNAL-COMBUSTION ENGINES AND TURBINES.

974,087. Specification of Letters Patent. **Patented Oct. 25, 1910.**

Application filed January 9, 1909. Serial No. 471,424.

To all whom it may concern:

Be it known that I, ARCHIBALD MONTGOMERY LOW, a subject of the King of England, residing at Brook Green, London, W., in England, have invented certain new and useful Improved Charge-Forming Arrangements for Use in Internal-Combustion Engines and Turbines, of which the following is a specification.

This invention comprises improved charge forming arrangements for use in internal combustion engines of that class which comprises a chamber or chambers traversing or contained within the combustion space of the cylinder or within a member in communication therewith or a part heated by the exhaust gases from the cylinder, in which chamber or chambers the fuel is gasified and from which it is passed to the cylinder.

The invention consists in the novel features and combinations of parts hereinafter described and specifically pointed out in the claims and includes means by which the gas generated may be mixed with steam or air or other gas or gases before or after passing to the cylinder to form explosive mixtures of various compositions according to requirements. Exhaust heat from the cylinder can be used alone without that of the combustion space by not inserting the chamber or chambers in the cylinder, or the heat of the combustion space alone without that of the exhaust may be used, and the admixtures of steam and air are not essential to the invention.

The invention is adapted for use with various kinds of engines including turbines and for either solid, liquid or gaseous fuels but is primarily intended for the former for example in the form of coal dust, alone or mixed with other solids, coke and the like. A construction of engine particularly adapted for use with coal dust as fuel is shown in the accompanying drawings in which—

Figure 1 is a side elevation of a horizontal engine embodying my improvements. Fig. 2 is an end elevation with parts in section; Fig. 3 is a sectional plan view on the line 3—3 of Fig. 2. Fig. 4 is a sectional detail view on an enlarged scale of the combustion head of the cylinder and the exhaust box containing the fuel gasifying elements. Fig. 5 is a section on the line 5—5 of Fig. 4. Fig. 6 is an enlarged sectional detail view of the fuel feeding device and Fig. 7 is a sectional view showing means for agitating the fuel in the container.

1 designates the engine cylinder, 2 the piston therein and 3 the water jacket. To the inner end of the cylinder is bolted a combustion head 4 through which passes a plurality of tubes 5 extending at their lower open ends 6 into a liquid such as water contained within a vessel 7. The combustion head may be replaced by a separate chamber either in direct or valved communication with the interior of the cylinder and the tubes may be formed as chambers of any convenient shape or number, either separated or connected together according to requirements. Mechanical or other forms of valves may also be used for closing the open ends of the tubes 5 or equivalent chambers or they may be left open if desired. The opposite ends of the tubes 5 traverse a box 8 into which passes the exhaust from the cylinder 1 through the exhaust valve 9, this box having a discharge or outlet as at 10^a. After traversing the box 8 the tubes extend into a recptacle 10 adapted to receive the fuel which is fed into the ends of said tubes by means such as worms 11. The spindles 12 of the said worms are contained within tubes 13 in such a manner as to make a tight joint with the wall of the fuel receptacle and carry at their ends friction disks 14 adapted to be driven at the desired speed by co-acting disks 15 mounted on a vertical shaft 16 driven as by belt and pulley gear 17, 18 from the fly wheel or crank shaft 19 by bevel gearing 20.

The speed of the worms may be varied by adjusting the position of the disks 15 to or from the centers of the disks 14 by axial movement of the shaft 16 as by means of the lever and hand wheel 21, 22 respectively. Any other convenient means may be used for feeding the fuel and for operating the feed mechanism, or the fuel may be fed by gravity alone if convenient. In the case of liquid or gaseous fuel the engine itself requires little or no modification but the worm feed gear would be dispensed with and appropriate devices for feeding such liquid or gaseous fuel to the tubes would be furnished in lieu thereof.

Means for the introduction of steam or air or both to the tubes 5 are provided at a convenient point. In the drawing these means comprise a pipe 23 leading from the cylinder jacket 3 and entering the tubes 5 at 25 and provided with a controlling cock 24 for the control of steam, and said pipe may be extended as shown in Fig. 2 and provided with an air cock or valve in any convenient manner. The steam may also be obtained from any other convenient source. The steam or air can be admitted to the tubes 5 either separately or together or may be completely shut off if desired, and controlled either automatically or by hand. If, as in the construction illustrated, the steam is supplied from the cylinder jacket a relief valve 26 is used to relieve any excess of pressure. The steam may also be supplied from a separate source or be produced by exhaust heat. Pipes 27 lead from the tubes 5 into an extension 28 of the vessel 7 for conveying the gas or mixture from said tubes to the inlet valve 29 through the pipe 30, any grit or other undesirable solid matter being at the same time deposited in the vessel 7. The gases may also be cleaned or cooled by separate means if found more suitable. A controlling cock 31 is provided in the pipe 30 and this cock may be adapted to admit air at this point if desired. Each of the pipes 27 is provided with a cock 32 by which certain thereof may be cut out of action when required if working with a light load or for any other purpose connected with the working of the engine. 33 designates the igniting device of the engine and 34 the exhaust valve-stem which may be operated by the arm 35 from the cam 36 mounted on shaft 37 through gearing 39, 40 from the crank shaft. Fig. 7 shows means which may be employed for agitating the fuel in the receptacle 10, comprising a spring pressed rod 40^a working in a guide 41 and carrying arms or beaters 42, the projecting end of said rod being operated by a cam 43 on a shaft 44 driven by any appropriate means.

In its operation the engine can work on practically almost any cycle. Taking as an example the Otto or four stroke cycle with the use of anthracite coal, the engine is started in the ordinary manner until the tubes 5 are sufficiently heated to gasify or otherwise change the fuel. The feed worms 11 are now operated and the fuel fed into the tubes 5 and passed along same till it reaches the box 8 heated by the exhaust from the cylinder. At this point or from this point for some further distance into the tubes the fuel will be decomposed or gasified, the gas being sucked by the piston or driven by its own pressure into the pipes 27 to the inlet valve through the vessel 7 and pipe 30 as previously mentioned. Carbon residues continue to be fed along the tubes 5 and come in contact while in a heated state with steam or air or both as the case may be, introduced at 25, thus forming water gas, producer gas, or both which also passes away through pipes 27.

The engine may thus be run on coal gas alone or a mixture of coal gas and water gas, or coal gas and producer gas, or coal gas, producer gas and water gas, and other gases can be introduced if desired.

By using coke in lieu of coal, by varying the speed of fuel feed and by introducing steam or air or both into the tubes or equivalents the gas supplied to the cylinder can be varied and its quantity readily controlled.

The engine based on the above principle is exceedingly safe, as the volume of explosive gas and hot fuel present is extremely small, so that danger from fire or explosions is avoided. The engine for marine and other purposes is very much safer than steam as no fire or pressure boiler exists.

The engine can be run on almost any gas depending on the fuel used, and with each fuel there is a large range in the type of gas to be used. The quality and quantity can also be regulated with extreme ease. With each fuel the point at which air, steam or both is admitted to the chamber can be varied to produce various combinations and compositions of gas. The temperature of the generating chamber can be varied so as to convert into volatile gas, all bye or waste products (if any), with the exception of a small quantity of ash thus avoiding cleaning troubles as the fuel is forced through the tubes or chambers. Each generating tube can be arranged so that it can be removed and cleaned while the engine is in motion: and for light loads, one tube or any number can be operated as desired. Preignition is avoided, since the gas in the combustion head can be cooled as desired by increasing the amount of cooling effected by each tube inserted in said head so as to absorb the heat by varying the feed within limits and by varying the quality of the gas by regulating the proportion of water gas or steam. The engine can thus be run at a high cylinder temperature and low gas temperature, which is the ideal condition for efficiency without risk of preignition, enabling a greater range of pressure to be attained in the cylinder. In this way a large amount of the heat usually wasted in the exhaust and jacket is used in the generating chamber. An overload can be met and sustained in the case of bituminous coal, for example by wholly or partially cutting off air and steam from the tubes and running the engine on coal gas and air.

In the claims which follow the term cylinder is held to include the casing of a turbine or the like or the equivalent of the cylinder in other types of engines.

I am aware that it has been previously proposed to impart heat to fuel by means of the exhaust heat from the cylinder for assistance in gasifying said fuel and no claim is broadly made to this feature but

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

1. In charge forming means for use in internal combustion engines and turbines the combination with a cylinder of a combustion chamber in communication therewith, a gas generating chamber, traversing said combustion chamber, means for feeding fuel to said generating chamber, a liquid seal into which one end of the generating chamber extends, and means for conveying the gas generated in said latter chamber to said cylinder.

2. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a chamber through which the exhaust gases from said cylinder pass, a gas generating chamber traversing said combustion space and exhaust chamber, means for feeding fuel to said generating chamber, a liquid seal into which one end of the generating chamber extends, and means for conveying the gas from said generating chamber to said cylinder.

3. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a plurality of tubular gas generating chambers traversing said combustion space, means for feeding fuel to said generating chambers, a vessel containing liquid into which one end of said generating vessels extend, and means for conveying the gas from said generating chambers through the liquid containing vessel to said cylinder.

4. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a gas generating chamber traversing said combustion space means for feeding fuel to said generating chamber, a liquid seal into which one end of the generating chamber extends, means for conveying the gas generated in the generating chamber to the cylinder and controllable means for the introduction of a gas of different composition to the generating chamber.

5. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder having a water jacket, of a combustion space in communication with said cylinder, a gas generating chamber traversing said combustion space, means for feeding fuel to said generating chamber, a liquid seal into which one end of said generating chamber extends, means for conveying the gas generated in the generating chamber to the cylinder, and controllable means for the introduction of steam from the cylinder jacket to said generating chamber.

6. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a plurality of tubular gas generating chambers traversing said combustion space, means for feeding fuel to said generating chambers, a vessel containing liquid into which one end of each of said generating chambers extends, means for conveying the gas generated in said latter chambers, through the liquid containing vessel, to the cylinder, and controllable means for the introduction of a gas of different composition to said generating chambers.

7. In charge forming means for use in internal combustion engines and turbines, the combination of a gas generating chamber, a fuel receptacle into which said generating chamber extends, devices adapted to feed the fuel from said receptacle into the generating chamber and variable speed mechanism for operating said feed devices.

8. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a gas generating chamber traversing said combustion space, devices for feeding solid fuel into said generating chamber, variable speed mechanism for operating said feed devices, and means for conveying gas from said generating chamber to the cylinder aforesaid.

9. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a plurality of tubular gas generating chambers traversing said combustion space, a fuel receptacle into which one end of each of said chambers extends, devices adapted to feed fuel from said receptacle into the generating chambers, variable speed mechanism for operating said feed devices, a vessel containing liquid into which the other end of each of said generating chambers extend, separate controllable gas conduits from each of said generating chambers to said liquid containing vessel, and a gas conduit between said vessel and the cylinder aforesaid.

10. In charge forming means for use in internal combustion engines and turbines, the combination with a cylinder of a combustion space in communication therewith, a plurality of tubular gas generating chambers traversing said combustion space, a fuel receptacle into which one end of each of said chambers extends, devices adapted to

feed fuel from said receptacle into the generating chambers, variable speed mechanism for operating said feed devices, a vessel containing liquid into which the other end of each of said generating chambers extend, separate controllable gas conduits from each of said generating chambers to said liquid containing vessel, a gas conduit between said vessel and the cylinder aforesaid and controllable means for introducing a gas of different composition into each of said gas generating chambers.

In witness whereof I have signed this specification in the presence of two witnesses.

ARCHIBALD MONTGOMERY LOW.

Witnesses:
A. J. HADDAN,
A. HARB.