

No. 662,319.

Patented Nov. 20, 1900.

J. SMITH.

APPARATUS FOR BURNING LIQUID FUEL.

(Application filed May 22, 1899.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 3.

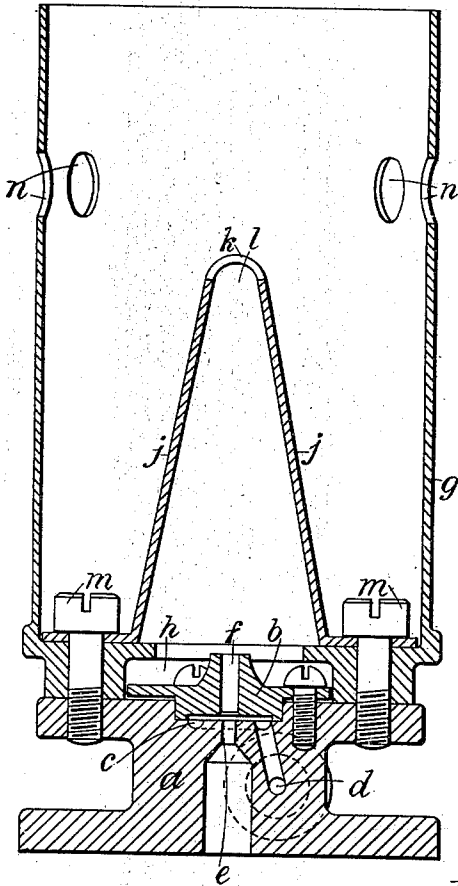


Fig. 1

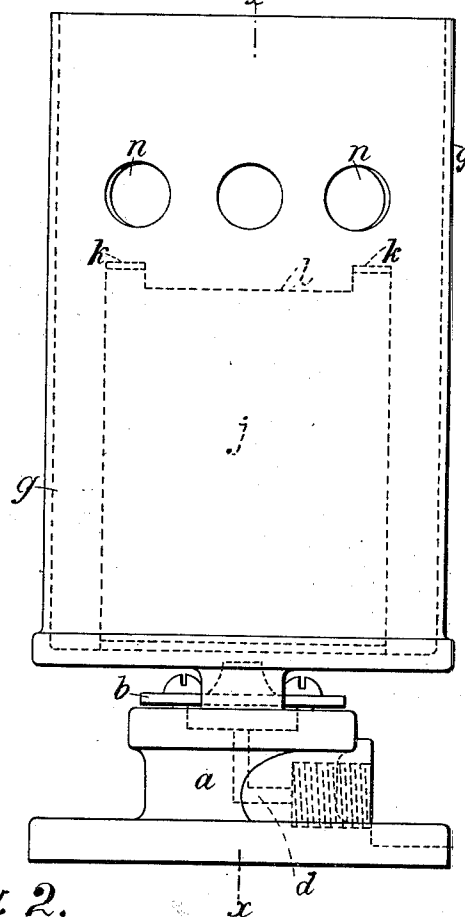
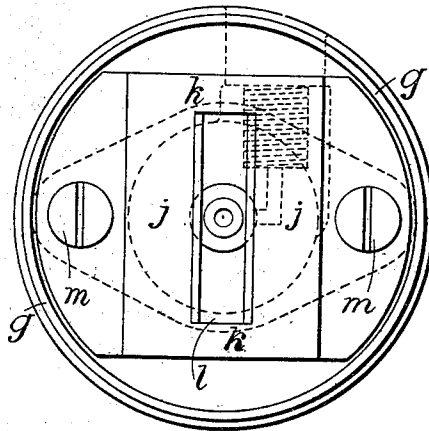


Fig. 2.



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3 Sheets—Sheet 2.

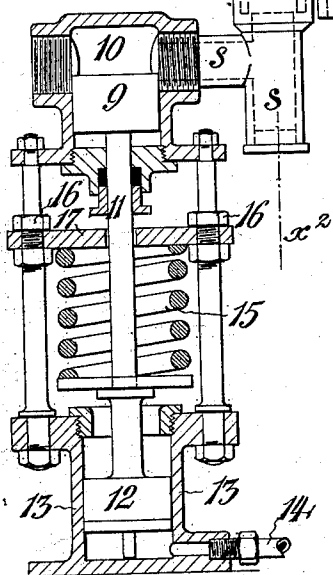
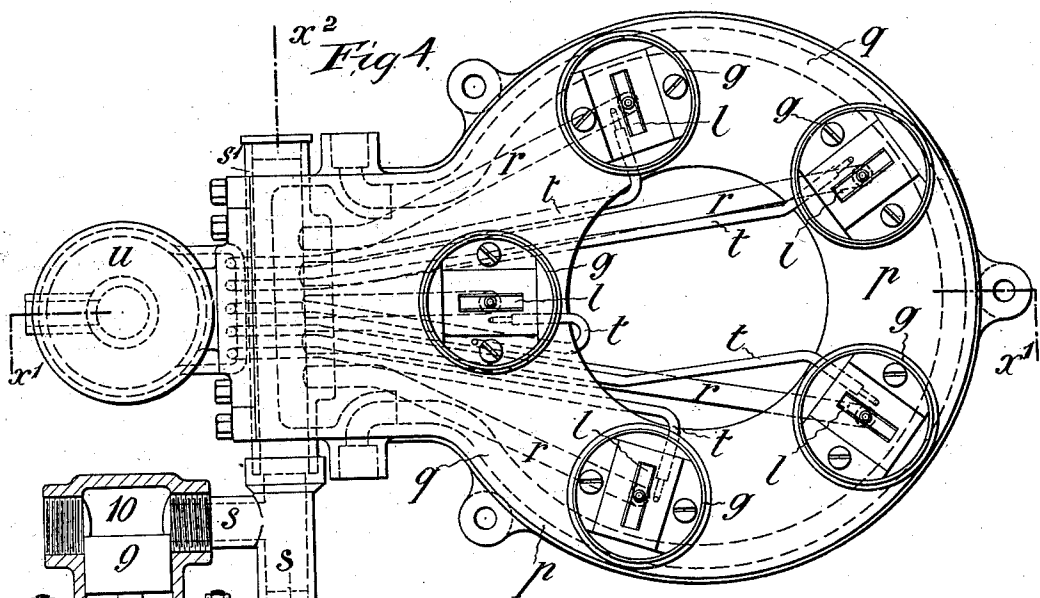
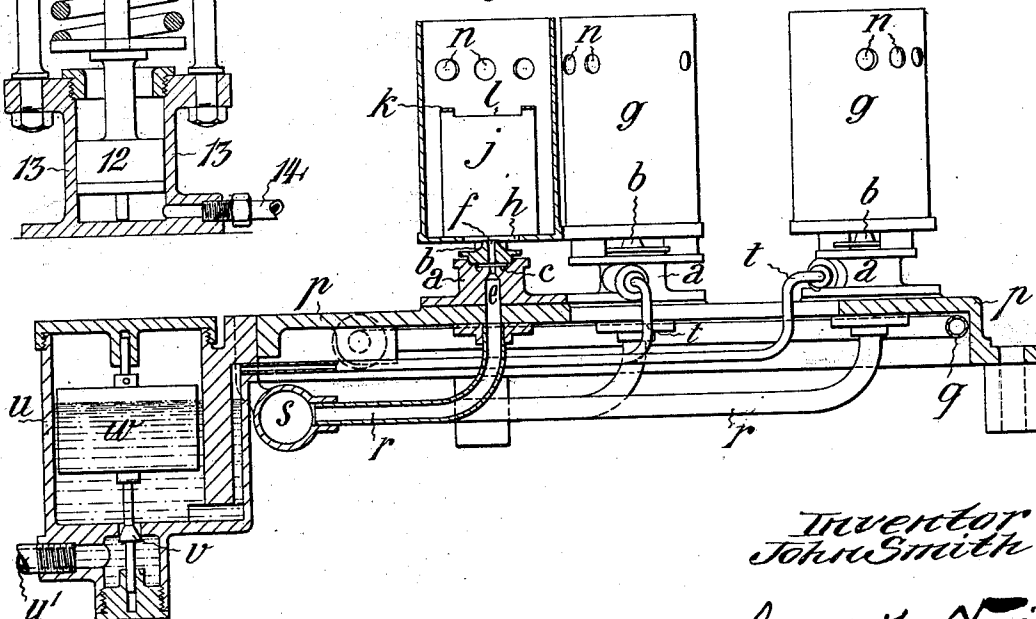


Fig. 5.



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3 Sheets—Sheet 3.

Fig. 6.

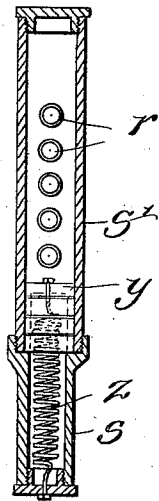
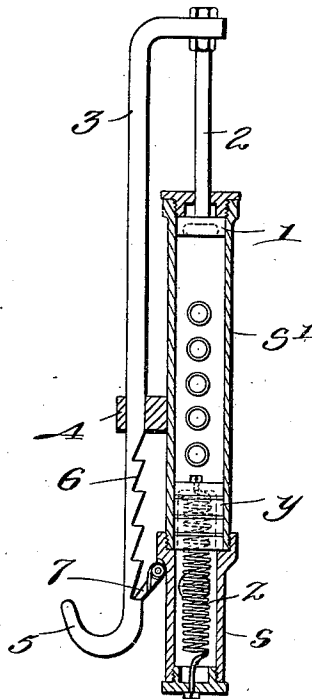


Fig. 7.



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UNITED STATES PATENT OFFICE.

JOHN SMITH, OF LONDON, ENGLAND.

APPARATUS FOR BURNING LIQUID FUEL.

SPECIFICATION forming part of Letters Patent No. 662,319, dated November 20, 1900.

Application filed May 22, 1899. Serial No. 717,751. (No model.)

To all whom it may concern:

Be it known that I, JOHN SMITH, engineer, a subject of the Queen of Great Britain, residing at Penge, London, England, have invented certain new and useful Improvements in Apparatus for Burning Liquid Fuel, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a side elevation, Fig. 2, a plan, and Fig. 3 a vertical central section, on the line $x x$, Fig. 1, illustrating one form of my improved burner. Fig. 4 is a plan view, having means applied thereto for automatically regulating the supply of air by means of the variation of pressure in the steam-generator; Fig. 5, a vertical central section on the line $x x'$, Fig. 4, showing a compound burner constructed according to my said invention. Fig. 6 is a sectional view of one form of the automatic controller on line $x^2 x^2$, Fig. 4. Fig. 7 is a sectional view of another form of automatic controller for use in connection with the apparatus shown in Fig. 5. Figs. 8 and 9 are vertical central sections illustrating other forms or modifications of my improved burner.

My invention is designed to provide improved apparatus for burning liquid fuel for heating purposes, which apparatus shall be very economical and advantageous for applying heat to steam-generators and other apparatus and can be readily adjusted to regulate or control the amount of heat produced by it.

My said invention partly consists in a burner in which the liquid fuel is drawn up from a tank or other vessel by means of a jet of compressed air, whereby it is sprayed or atomized and projected into a combined vaporizer and deflector or spreader arranged within a flame or ignition chamber, the said jet of air also causing one or more induced currents of air to enter the said vaporizer and mix with the hydrocarbon vapor therein.

My said invention also partly consists in a burner the lower part whereof is so constructed as to form a combined aspirator and sprayer, while the upper part is constructed in such a manner as to form a combined vaporizer and deflector and a flame or ignition chamber or casing, one or more air-admission openings being arranged between the said

two parts of the burner, and the said casing surrounding the vaporizer and being also provided with air-admission openings suitably arranged relatively to the said vaporizer.

My said invention also partly consists in the combination of an aspirator and sprayer comprising an air-jet, a shallow annular chamber surrounding the outlet thereof and having an inlet for the liquid fuel, and a jet or nozzle extending from said annular chamber in line with the air-jet, and a vaporizer and spreader, whereby the spray of liquid fuel is vaporized and at the same time deflected or spread out, so as to facilitate and insure its complete vaporization and produce an extended flame of great heating power.

My said invention also partly consists in the combination of an air-jet, a shallow annular chamber surrounding the outlet thereof and having an inlet for the liquid fuel, and a spray jet or nozzle extending upward or forward from said chamber in line with said air-jet, so that as the liquid fuel admitted to the said annular chamber flows in a thin film toward the central opening or jet a spray thereof will be projected by the compressed air through said spray jet or nozzle into said vaporizer and spreader.

My said invention also partly consists in a combined vaporizer and spreader inclosed in a perforated casing and having converging sides joined at the top by bridge-pieces, one at each end, so as to form a narrow elongated opening, said vaporizer and spreader being so arranged and proportioned relatively to said casing as to leave a space between each of its open ends and said casing.

My said invention, moreover, comprises improved means for regulating the supply of compressed air and liquid fuel to the said burner; and my said invention further comprises other combinations and devices hereinafter described, and pointed out in the claims.

The base of the burner shown is made in two parts $a b$, which are firmly united, and in the top of the lower part a there is formed an annular chamber or channel c , which can be connected through a passage d with a tank or other vessel containing liquid fuel. A central hole or jet e is also formed through the lower part a of the base for connection with

any suitable source of supply of compressed air, and in the upper part *b* of the base there is formed a hole or jet *f* slightly larger in diameter than the air jet or nozzle *e* and suitably proportioned relatively thereto. The upper and lower parts *a b* of the base are so made as to leave between the air jet or nozzle *e* and the annular channel or chamber *c* a space through which the liquid fuel can flow in a thin annular film from the said channel *c* toward the air-jet *e*, so that as it is drawn from the said space by the jet of compressed air it will be projected thereby in the form of spray through the hole or jet *f*. The base thus constructed therefore forms a combined aspirator and sprayer, whereby the liquid fuel is drawn from a tank situated at a suitable level and is projected in the form of spray into the vaporizer.

The formation of a partial vacuum in the hole or jet *f* plays a very important part in the lifting and measuring (or proportioning) of the liquid fuel. To this end the hole or jet *f* is made larger in diameter than the air jet or nozzle *e*, as above mentioned; but the difference between these diameters in most cases is preferably small. This is well illustrated in Fig. 3. It has also been found that the length of the hole or jet *f* is an important factor to be taken into account in determining the relative sizes of these parts, which are best found by experiment, so that when a supply of air is admitted to the burner the partial vacuum produced will be sufficient to draw the most efficient proportion of oil in a thin film through the annular space between the upper and lower parts *a* and *b* of the base to give a flame of the required character. By this construction when the supply of air to the burner is increased or decreased the effect of the partial vacuum will become greater or less, respectively, and consequently the flow of oil to the burner will be increased or decreased also and proportionately. If, however, the hole or jet *f* is of too great a diameter relatively to the diameter of the nozzle *e*, the effect of the partial vacuum produced in the jet *f* when a current of air is supplied to the burner will be increased, and consequently an excessive amount of the liquid fuel will be drawn into the burner. By employing a space between the upper and lower parts *a* and *b* of the burner sufficiently small to permit the passage of only a thin film the liquid fuel is spread or distributed equally around the air-jet, so that when the burner is in operation liquid fuel will surround and flow onto the jet of air in the form of a thin annular film, which is more readily converted into spray than a solid circular jet, conveying an equal quantity of the liquid fuel in equal time.

In the burner shown in Figs. 1 to 3 the casing *g* forms a flame or ignition chamber and is partially closed at its lower end by the base *a b*, one or more suitable openings *h* being left, through which induced currents of air

can enter around the spray-jet. In this casing is arranged my combined vaporizer and spreader, which is composed of sheet metal or other suitable material, and the two sides *jj* whereof are inclined so as to converge toward their upper ends and are connected at the top by bridge-pieces *k k*, one at each end, so as to leave a narrow elongated opening *l* between the said bridge-pieces for the egress of the mixture of vapor and air from the vaporizer. The lower ends of the said sides *jj* are attached to the bottom of the casing *g*, so that they are symmetrically disposed relatively to the spray-jet *f*, the connection being made in the arrangement shown by means of screws *m*, which also serve to secure the said casing to the base *a*. This combined vaporizer and deflector instead of being made from a single metal plate, as shown in Figs. 1, 2, and 3, may consist of separate plates united by suitable bridge-pieces at the top. Air-admission holes *n* are provided in the casing *g* on opposite sides thereof and about on the same level as the upper end of the said vaporizer and deflector, and the said vaporizer and deflector are made of such size in proportion to the casing *g* as to leave a suitable space between the latter and each of the open ends of the vaporizer to admit a sufficient supply of air into the said vaporizer from the said casing. The above-described construction and relative arrangement of the said combined vaporizer and spreader and the casing play an important part in determining the vaporization of the sprayed liquid fuel, its admixture with air, and the spreading of the inflammable vapor thus produced, with the result that perfect combustion of the liquid fuel is insured.

When air under pressure is supplied to the burner through the jet *e*, the liquid fuel is, as above stated, thereby drawn up into the annular channel *c* and flowing in a thin annular film toward the orifice of the jet *e* is projected in the form of spray into the vaporizer *jj*, and at the same time currents of air are induced through the openings *h* between the casing *g* and the base of the burner. The spray being dashed against the heated surfaces of the vaporizer *jj*, is converted into vapor, which is mixed with air. On ignition of the inflammable vapor thus produced flame issues from the top of the vaporizer, the vapor being spread out into a flattened jet by the inclined surfaces of the said vaporizer.

When the burner is constructed as above described, the entering air will usually suffice to prevent undue heating of the base of the burner. If desired, however, I provide the said base with a water-circulating passage.

In Figs. 4 and 5 I have shown a number of burners, such as I have hereinabove described, mounted on a common base plate or casting *p*, so as to form a compound burner which is very advantageous for generating steam or for other purposes. The said base plate or casting *p* is provided with a water-

circulating pipe *q* for keeping it cool. The several burners are connected by pipes *r* with a common air-supply pipe *s* and by pipes *t* with a common reservoir or tank *u* for containing liquid fuel. This tank *u* is of comparatively small capacity and is provided with a valve *v*, actuated by a float *w* for regulating or controlling the admission of the liquid fuel through the passage *u'* into the said tank *u* from a reservoir or tank of larger capacity situated at a higher level, so that the liquid will be maintained at an approximately constant level in the smaller tank *u*.

In Fig. 6 I have shown a device whereby the heat produced by a compound or multiple burner, such as is shown in Figs. 4 and 5, will be automatically regulated or controlled according to the pressure of the compressed air. The device shown comprises a piston-valve *y*, arranged to be moved to and fro within a cylindrical part *s'* of the pipe *s*, which is provided with a number of apertures or ports connected, respectively, with the air-pipes *r* of the several burners, so as to put one or more of the said ports in communication with the air-supply or shut them off, according to the pressure of air in the said pipe *s* behind the said piston-valve. The said piston-valve *y* is held in the position shown by a spring *z*. When air under pressure from any suitable source is admitted to the said pipe *s* behind the piston-valve *y*, the spring *z* will be extended and the piston-valve moved along past a larger or smaller number of the ports leading to the pipes *r*, so as to put a larger or smaller number of the burners into communication with the air-supply. When the air-admission to the pipe *s* is cut off or reduced, the spring *z* will draw back the piston-valve *y*, and thus shut off a larger or smaller number of the said ports. Therefore by simply regulating the admission of air to the pipe *s* any desired number of the said burners can be set in operation or shut off, according to the heat required.

I sometimes provide an adjustable device whereby the travel of the piston-valve *y* can be regulated or limited, so as to permit the supply of air to one or more of a predetermined number of the burners. For this purpose I arrange in the pipe *s* a disk or piston 1, Fig. 7, connected by means of a rod 2 to a bar 3, which slides in a guide 4 and is provided with a handle 5 and with a rack 6, with which a pawl 7 is adapted to engage in order to hold the disk 1 in any position to which it may be adjusted. By these means the number of burners which can be put in operation can be limited as may be desired.

I sometimes provide for the automatic regulation or control of the supply of compressed air to the said pipe *s* by means of a controlling device actuated by variations of the pressure in a steam-generator heated by means of the said burners or by variations of the heat applied to such steam-generator. For example, I connect a suitable valve for

regulating the supply of compressed air to the said pipe *s* with a controlling device adapted to be operated by variations of the pressure in the said steam-generator or in a regulating-tube which is heated simultaneously therewith by means of the said burners and which contains liquid. By these means variations of pressure in the said generator or in its regulating-tube will increase or diminish the supply of compressed air to the pipe *s*, and consequently the pressure of the air acting upon the piston-valve *y*, and the latter will therefore be moved in one or the other direction, so as to increase or diminish the number of burners in operation.

An arrangement of this kind is shown combined with the compound burner in Fig. 4 of the drawings, in which a piston-valve 9, working in a cylinder 10, is adapted to control the supply of compressed air to the pipe *s*. This piston-valve is connected by a rod 11 with a piston 12, working in a cylinder 13, to which steam is admitted beneath the piston through a pipe 14 from a steam-generator or from a regulating-tube arranged in the combustion-chamber thereof. The piston 12 is held down by a spring 15, the compression of which can be regulated by adjusting the nuts 16, bearing against the cross-head 17.

It is obvious that in the working of my improved burner I may, if desired, employ steam instead of compressed air.

What I claim is—

1. In an apparatus for burning liquid fuel, the combination of a central tube or passage for compressed air, a shallow annular chamber surrounding the outlet thereof and having an inlet for the liquid fuel, another tube or passage extending from said annular chamber, in line with said air-passage, and a vaporizer and spreader open at its ends and having converging sides joined at the top by bridge-pieces, and a narrow elongated opening between said bridge-pieces, substantially as, and for the purposes, described.

2. In an apparatus for burning liquid fuel, the combination of a perforated casing, a combined vaporizer and spreader therein, having converging sides joined at the top by bridge-pieces one at each end of a narrow elongated opening, said vaporizer and spreader being so arranged and proportioned relatively to said casing as to leave a space between each of its open ends and said casing, and means to introduce a spray of liquid fuel into said vaporizer and spreader, substantially as, and for the purposes, described.

3. In an apparatus for burning liquid fuel, the combination of a base made in two parts, one of which is formed with an air-jet and with an annular channel around the same having an inlet for the liquid fuel, and the other with a spray jet or nozzle of larger diameter than said air-jet and forming an extension thereof, a capillary space being left between the two parts of said base to permit the flow of a film of the liquid fuel from said

annular channel to said air-jet, and a vaporizer and spreader open at its ends and having converging sides joined at the top by bridge-pieces, and a narrow elongated opening between said bridge-pieces, substantially as, and for the purposes, described.

4. In an apparatus for burning liquid fuel, the combination of a compressed-air jet, an annular chamber around the same having an inlet for the liquid fuel, a spray jet or nozzle forming an extension of said air-jet, and a combined vaporizer and spreader having sides converging as they recede from said nozzle and connected at the top by bridge-pieces so as to leave a narrow elongated opening for the passage of the inflammable vapor, and a flame chamber or casing surrounding said vaporizer and spreader and provided with air-inlets, substantially as, and for the purposes, described.

5. In an apparatus for burning liquid fuel, the combination with a plurality of burners having compressed-air inlets of a common air-supply pipe having ports communicating with said inlets respectively and a regulator actuated by the compressed air whereby a greater or less number of said ports are opened or uncovered according to the pressure of the supplied air, substantially as, and for the purposes, hereinbefore described.

6. In an apparatus for burning liquid fuel, the combination, with a plurality of burners having compressed-air inlets of a common air-supply pipe having ports communicating with said inlets respectively, a regulator actuated by the compressed air whereby a greater or less number of said ports are opened

or uncovered according to the pressure of the supplied air, and a controlling device actuated by variations of steam-pressure whereby the admission of air to said regulator is controlled, substantially as, and for the purposes, hereinbefore described.

7. In an apparatus for burning liquid fuel, the combination, with a plurality of burners having compressed-air inlets, of pipes connected with said air-inlets, a common air-supply pipe having ports connected respectively with the pipes from the several burners, and a regulator for controlling the number of said burners supplied with compressed air from the said common supply-pipe, which regulator comprises a spring-controlled piston-valve in said pipe movable over said ports by the air-pressure, substantially as, and for the purposes, hereinbefore described.

8. In an apparatus for burning liquid fuel, the combination, with a plurality of burners having compressed-air inlets, of a common air-supply pipe having ports communicating with said inlets respectively a regulator in said pipe comprising a spring-controlled piston-valve movable over said ports by the compressed air, and an adjustable stop for limiting the travel of said piston, substantially as, and for the purposes, hereinbefore described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN SMITH.

Witnesses:

DAVID YOUNG,
ALEXANDER W. ALLEN.