L. F. MASSEY & W. H. SNOW.

ELASTIC FLUID HAMMER.

APPLICATION FILED JUNE 10, 1910.

1,087,799.

Patented Feb. 17, 1914.

2 SHEETS—SHEET 1.

FIG. 1

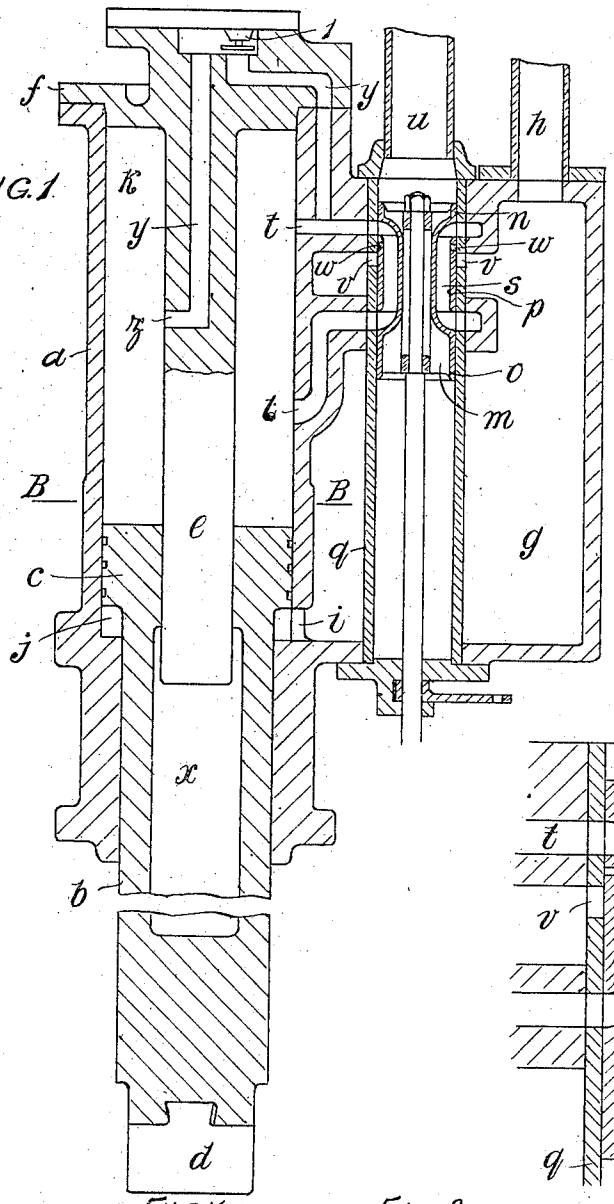


FIG. 2

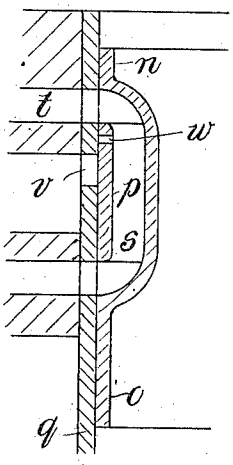


FIG. 6.

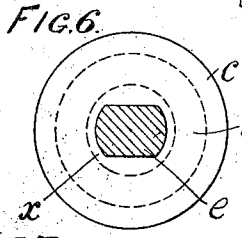


FIG. 7.

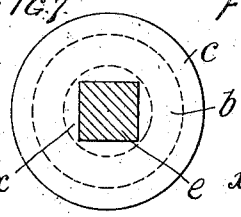


FIG. 8.

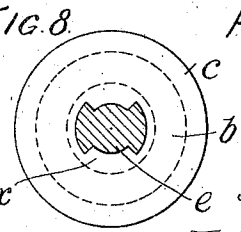
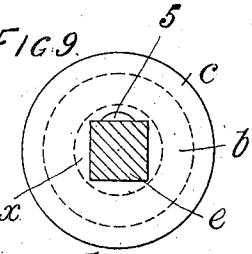


FIG. 9.



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2 SHEETS—SHEET 2.

FIG 3

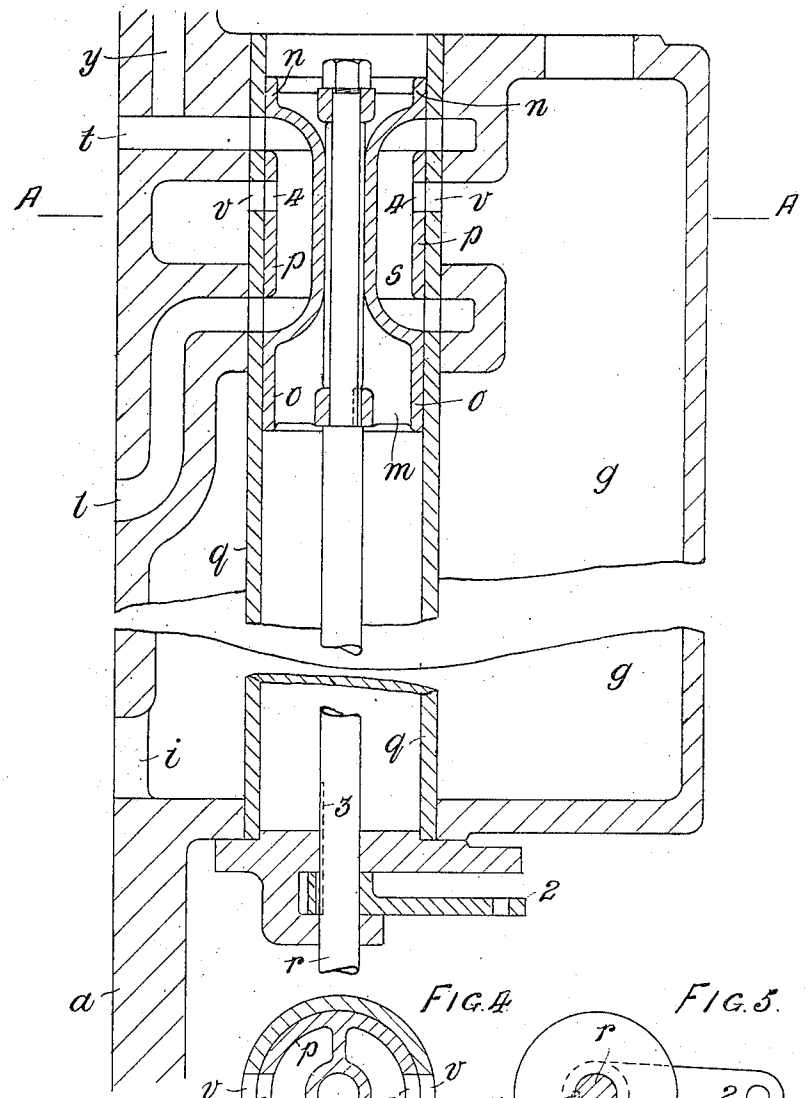
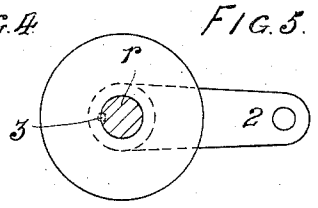


FIG. 4

FIG. 5.



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UNITED STATES PATENT OFFICE.

LEONARD FLETCHER MASSEY AND WILLIAM HENRY SNOW, OF MANCHESTER, ENGLAND.

ELASTIC-FLUID HAMMER.

1,087,799. Specification of Letters Patent. Patented Feb. 17, 1914.

Application filed June 10, 1910. Serial No. 566,194.

To all whom it may concern:

Be it known that we, LEONARD FLETCHER MASSEY, engineer, a subject of the King of the United Kingdom of Great Britain and Ireland, and resident of 4 Egerton road, Fallowfield, Manchester, in the county of Lancaster, England, and WILLIAM HENRY SNOW, draftsman with B. & S. Massey, of The Steam Hammer Works, William street, Openshaw, Manchester aforesaid, a subject of the King of the United Kingdom of Great Britain and Ireland, and resident of 29 Scarsdale road, Victoria Park, Manchester, in the county of Lancaster, England, have invented new and useful Improvements in Elastic-Fluid Hammers, of which the following is a specification.

This invention relates to hammers worked by elastic fluids as for example compressed air and steam and has for its objects to improve the construction and control of such hammers and to cause the motive fluid to be used expansively in a simple way and with certainty without at all complicating the mechanism of the hammers and further to facilitate the striking of light blows and especially of light and rapid blows and in cases where this is requisite to enable specially heavy blows to be struck by using the working fluid non-expansively.

The invention is applicable to vertical, horizontal or inclined hammers worked by any elastic fluid, steam and compressed air being examples, and both to hammers having pistons moved to and fro along cylinders and to hammers with pistons made to turn to and fro as vanes in cylinders and therefore, since for convenience this invention will be described in reference to a vertical hammer worked by compressed air, the references in the claims in this specification to upper and lower sides of pistons and upper and lower spaces, places and parts above and below the piston are to be interpreted in the case both of pistons made to move to and fro along cylinders and pistons made to turn like vanes backward and forward in cylinders in the sense that "lifted" means moved away from the anvils and like parts and that the sides of pistons, spaces places or parts are "upper" and "above" if directed away from and farther than others from the anvils and like parts and in the direction of movement causing the rams to move from anvils and like parts and "lower" and "below" if directed toward and nearer to the anvils and like parts and in the direction of movement causing the rams to move toward the anvils and like parts.

As described in reference to a vertical hammer worked by compressed air the invention refers to the type of hammer in which the area under the piston is considerably smaller than the area above the piston and in which the supply of compressed air is in constant communication with the lower end of the cylinder and therefore acts continuously on the piston tending to lift the hammer and in which the hammer is controlled by a distributing valve governing the admission to and the exhaust from the top of the cylinder.

The accompanying drawings illustrate one form of hammer made according to this invention and a variation in detail thereof and will serve also to enable other modifications of this invention readily to be understood and carried into effect in hammers of the said form and in other forms of hammers.

Figure 1 is a vertical section taken through the cylinder, valve-chest and air-reservoir of one hammer and parts therein showing the hammer sufficiently for the illustration of this invention, some parts being shown in side elevation for clearness and convenience. Fig. 2 is a vertical section corresponding to part of Fig. 1 but drawn upon a larger scale. Fig. 3 is a vertical section similar in many respects to a portion of Fig. 1 but drawn upon a larger scale and illustrating a second hammer. Fig. 4 is a horizontal section taken on the plane indicated by the line A A through the valve-chamber shown in Fig. 3 and Fig. 5 is a plan of part of the face of the cover at the lower end of the valve-chamber shown in Fig. 3 and a lever provided for turning the spindle of the valve in such valve-chamber and held by such cover against partaking in the lengthwise movement of such spindle. Figs. 6, 7, 8 and 9 are horizontal sections taken on planes indicated by the line B B showing the piston and some forms of the guide which may be used therewith.

The same letters of reference are employed to indicate corresponding parts in all the figures of the drawings.

In Fig. 1, *a* is the hammer cylinder in which the ram *b* works. The upper part of the ram *b* forms a piston *c* and the lower

part projects through the lower end of the cylinder *a* and has the hammer-face provided upon it in the case shown by a pallet *d* being secured to it. The ram *b* is hollow and a guide *e* fixed rigidly to and, in the case illustrated, solid with the cylinder cover *f* projects into it. The guide *e* and the surface or faces of the ram *b* in contact with it may be so formed as to prevent the ram *b* from twisting while allowing it to move freely up and down. For example the guide *e* may be made square, rectangular, cruciform or with radial or other surfaces to work against corresponding surfaces on the ram. Fig. 6 shows a guide *e* of circular transverse section with two flats. Fig. 7 shows a guide *e* of square section. Fig. 8 shows a guide with four circular parts of two different radii so as to be formed with four radial surfaces.

Compressed air supplied to the air-reservoir *g* through the pipe *h* enters freely through the port *i* into the bottom *j* of the cylinder *a* and acts continuously on the under side of the piston *c* tending to raise it. When the piston *c* is in the upper part *k* of the cylinder *a* the air passes from the bottom *j* of the cylinder *a* through the port *l* to the distributing valve *m* which is shown as a tubular piston-valve having upper and lower collars *n o* and a central ring *p* to fit within the cylindrical valve-chamber tube *q*. The valve-spindle *r* connected to the distributing valve *n* by means of collars and fins formed thereon serves as means for moving it. If the valve *m* is raised the air passes on through the passage *s* within the central ring *p* and through the port *t* to the top *k* of the cylinder *a*. Here it acts on the top of the piston *c*. It is thus acting on the upper and lower surfaces of the piston *c* but as the area of the upper surface is greater than that of the lower the ram *b* is forced down. As it descends the piston *c* passes or overruns the port *l* and thus cuts off the supply of air to the distributing valve *m*. The air already admitted to the top *k* of the cylinder *a* therefore acts expansively for the rest of the stroke. If the valve *m* be now lowered the top *k* of the cylinder *a* will be opened to the atmosphere through the port *t* and the pipe *u*. The hammer will then rise again under the influence of the constant pressure below the piston *c*. In this manner a very sharp cut-off-action is obtained which is very certain and must operate on all strokes.

Light blows and particularly light and rapid blows may be given by the valve *m* being moved so as to allow only a slight admission of air to the upper part *k* of the cylinder *a* through the port *t* from the lower part *j* of the cylinder *a* and then quickly moved so as to close the passage through the port *t* or to open the port *t* to "exhaust." It will be seen that when the piston *c* is in the lower half of the stroke no air can pass through the port *l* to the distributing valve *m* from the lower part *j* of the cylinder *a* and therefore some other provision must be made if it is desired to strike a blow after raising the ram *b* through only a few inches or other distance insufficient to allow communication of the port *l* and the upper part *k* of the cylinder *a* with the lower part *j* of the cylinder *a*. To enable this to be done the valve-chamber *q* is formed with a port *v* giving direct communication between the air-reservoir *g* and the valve *m* and the valve *m* is formed with a port *w* by which communication may be opened between the air-reservoir *g* and the passage *s*.

In the case illustrated the ports *v w* are each formed as two openings at opposite sides of the valve-chamber tube *q* and valve *m* respectively. This port *w* is principally required for light blows and so it is made of very small capacity and is so placed that it is only opened when the valve *m* is moved slightly as is the case for light blows. If the valve *m* is moved farther to strike a full blow the port *w* is closed again. In this way the striking of light blows is enabled to be accomplished very easily and conveniently. The port *w* if kept open after the descent of the ram *b* may be used to keep the ram *b* pressed down so as to grip "work" upon the anvil. The space *x* within the ram *b* below the guide *e* may be in free communication with the top *k* of the cylinder *a* as is indicated in Fig. 9 which shows a passage 5 formed in the piston *c* and ram *b* to allow fluid to flow between the space *x* and the top *k* of the cylinder, but it is found preferable to make it a separate chamber by making the guide *e* an air-tight fit or nearly an air-tight fit in the ram *b*, so that it forms or serves as a plunger. It is represented as so made in all the figures of the drawings excepting Fig. 9. In addition a passage *y* communicating with the port *t* is made to communicate with a port *z* formed about midway in the length of the guide *e* and a valve 1 to allow air to pass only in the direction from the port *t* to the port *z* is provided in the passage *y*. At the commencement of the downward stroke of the piston *c* air is free to pass through the one-way valve 1 into the space *x* but as the piston *c* descends the port *z* through which air enters the space *x* is closed by the piston *c*. After this the air in the chamber *x* expands and is compressed again as the ram *b* rises. It thus acts as a spring or cushion the strength of which is least when the hammer is at the bottom of its stroke and gradually increases as the hammer rises. The variable pressure within the space *x* acting in conjunction with the constant pressure below the piston *c* has the effect of giving a graduated upward force. This causing the lifting force to be greater

at the commencement of the upstroke than when the hammer *b* is nearer the top enables the ram *b* to rise quickly from the "work" and yet to move more slowly toward the top of the stroke and thus obviates the danger of the ram *b* hitting the cylinder-cover *f*.

The distributing valve *m* is sometimes modified so as to enable specially heavy blows to be struck by using the air non-expansively. This can be accomplished by making the valve *m* as shown in Figs. 3, 4 and 5. In these figures the valve *m* is shown as adapted to be turned by means of the lever 2 through which the valve-spindle *r* is made to slide while being engaged therewith by means of a key 3. In one extreme position of the lever 2, ports 4 formed in the valve *m* correspond with the ports *v* in the valve-tube *q* so that air may pass through them from the air-reservoir *g* and in the other extreme position of the lever 2 the ports 4 are closed. When the valve *m* is turned so as to leave the ports 4 open, air is admitted to the passage *s* of the distributing valve *m* during the whole of the stroke and thus enable air at the supply pressure to be admitted to the cylinder *a* during the whole stroke for the purpose of striking heavy blows or holding down the hammer to grip the "work" upon the anvil. It will be clear that in this case the air will not be used so efficiently as when it is used expansively but it will be convenient in certain cases to be able to strike extra heavy blows even at the extra cost.

The formation of the ram *b* hollow and of large diameter and the provision of the guide *e* within the ram *b* enable the large bearing surfaces found advantageous in practice to be provided and also when requisite enable the hammer to be guided very accurately against twisting without involving any inconvenient friction and in particular the provision of the passage *y* in the central guide *e* obviates the employment of an inconveniently thick piston but if it be desirable in any case to dispense with the central guide *e* this may be done or other modes of construction may be adopted without departure from the principles of this invention.

The application of this invention to a hammer different from that described by way of example in the position of the cylinder and piston or the like or in the use of a piston made as a vane to turn backward and forward in the cylinder only involves corresponding changes in the positions of the orifices and ports and passages and valves employed.

What we claim as our invention is:—

1. In a hammer worked by elastic fluid, the combination of a cylinder, a differential piston therein, the smaller side of which is subjected continuously to the pressure of the motive fluid, a valve chamber in communication with the end of the cylinder in which the larger end surface of the piston is exposed, a port leading to the said valve chamber and opening into the cylinder at a part overrun by the piston and a valve in said valve chamber which is uncontrolled by the motive fluid or hammer piston and is moved wholly by and under the direct control and movement of the operator for each stroke to allow more or less or to prevent the passage of the motive fluid from the said valve chamber to the end of the cylinder where the larger end of the piston is exposed whereby the operator is enabled to effect separate control of the time, force and speed of each blow of the hammer.

2. A hammer worked by elastic fluid having a cylinder with a port for continuously admitting motive fluid to one part of such cylinder, a differential piston in said cylinder arranged to be continuously subject on its smaller side to the pressure of motive fluid and a ram connected to such piston, a valve-chamber, a second port which is made to communicate with the valve chamber and with the cylinder to lead motive fluid intermittently from the part of the cylinder receiving motive fluid continuously, said port being so placed that it is overrun by the piston to cut off the supply of motive fluid to the valve chamber, a third port for leading motive fluid to and from the cylinder from the valve chamber and to exhaust and a distributing valve in said valve chamber which is uncontrolled by the motive fluid or hammer piston and is moved wholly by and under the direct control and movement of the operator for each stroke to allow more or less or to close communication from the second port to the third and from the third port to exhaust, whereby the operator is enabled to effect separate control of the time, force and speed of each blow of the hammer.

3. A hammer worked by elastic fluid having a cylinder with means whereby it may receive motive fluid at one part continuously, a piston in said cylinder arranged to be continuously subject on one side to the pressure of the motive fluid and a ram connected to such piston, a valve chamber, a port which is in communication with the valve chamber and with the cylinder for the supply of motive fluid intermittently to such valve chamber from the part of the cylinder receiving motive fluid continuously and is so placed that it is overrun by the piston to cut off the supply of motive fluid to the valve chamber, a distributing valve which is movable in said valve chamber and under the direct manual control of the operator to open and close communication from the one to the other side of the said piston and from such other side to exhaust for regulating hammer blows, said valve being adapted to control only the admission and exhaust of motive

fluid at the other side of the piston and means for allowing motive fluid to flow to the distributing valve when desired without first flowing through the cylinder.

4. A hammer worked by elastic fluid having a cylinder with means whereby it may receive motive fluid at one part continuously, a connection for the supply of motive fluid, a piston in said cylinder arranged to be continuously subject on one side to the pressure of the motive fluid and a ram connected to such piston, a valve chamber, a port which is in communication with the valve chamber and with the cylinder for the supply of motive fluid intermittently to such valve chamber from the part of the cylinder receiving motive fluid continuously and is so placed that it is overrun by the piston to cut off the supply of motive fluid to the valve chamber, a port in the valve chamber having constant communication with the connection for the supply of motive fluid, a distributing valve movable lengthwise in said valve chamber and under the direct manual control of the operator to open and close communication from the one to the other side of the said piston and from such other side to exhaust and also adapted to be turned in said valve chamber by the operator, a port in the distributing valve arranged to be turned into and out of communication with the port in the valve chamber having constant communication with the connection for the supply of motive fluid, whereby the distributing valve being moved lengthwise in the valve chamber by the operator to open communication from the one side of the piston to the other side thereof brings about a hammer-stroke and the piston overrunning the said port placed to be overrun thereby cuts off the supply of motive fluid to the distributing valve and causes the fluid already admitted to the cylinder to work expansively and by the distributing valve being turned in the said valve chamber by the operator, motive fluid may be allowed to flow when desired to the distributing valve from the connection for the supply of such fluid without first flowing through the cylinder.

5. A hammer worked by elastic fluid having a cylinder with means whereby it may receive motive fluid at one part continuously, a connection for the supply of motive fluid, a piston in said cylinder, arranged to be continuously subject on one side to the pressure of the motive fluid and a ram connected to such piston, a valve chamber, a port which is in communication with the valve chamber and with the cylinder for the supply of motive fluid intermittently to such valve chamber from the part of the cylinder receiving motive fluid continuously and is so placed that it is overrun by the piston to cut off the supply of motive fluid to the valve chamber, a distributing valve which is movable in said valve chamber to open and close communication from the one to the other side of the said piston and from such other side to exhaust for causing blows to be struck and otherwise controlling the working of the hammer and is made to control only the admission and exhaust of motive fluid at the said other side of the piston and a small port so placed as to open when the valve is in position for striking a light blow and closed again by further movement of the valve when a heavier blow is to be struck and means for allowing motive fluid to flow to the distributing valve when desired without first flowing through the cylinder, whereby the distributing valve being moved in said valve chamber by the operator to open communication from the one side of the said piston to the other side thereof brings about a hammer-stroke and the piston overrunning said port which is in communication with the valve chamber and with the cylinder cuts off the supply of motive fluid to the distributing valve and causes the fluid already admitted by the distributing valve to the cylinder to work expansively and the distributing valve being moved in the valve chamber for causing a light blow opens the said small port but closes it again if moved farther for a heavier blow to be struck.

6. A hammer worked by elastic fluid having a cylinder with a port for continuously admitting motive fluid to one part of such cylinder, a differential piston in said cylinder, the smaller side of which is subjected continuously to the pressure of the motive fluid and a ram connected to such piston and having an interior cavity and an internal guide fixed in the cylinder to enter the interior cavity of the ram and fitted to the ram so that the pressure of fluid within the said cavity may be increased as the ram is moved in one direction, a valve chamber in communication with the end of the cylinder in which the larger end surface of the piston is exposed, a port leading to the said valve chamber and opening into the cylinder at a part overrun by the piston and a valve in said valve chamber which is uncontrolled by the motive fluid or hammer piston and is moved wholly by and under the direct control and movement of the operator for each stroke to allow more or less or to cut off the passage of the motive fluid from the said valve chamber to the end of the cylinder where the larger end of the piston is exposed, whereby the operator is enabled to effect separate control of the time, force and speed of each blow of the hammer and the ram is prevented from hitting the cylinder cover.

7. A hammer worked by elastic fluid having a cylinder with a port for continuously admitting motive fluid to one part of such

cylinder, a differential piston in said cylinder the smaller side of which is subjected continuously to the pressure of the motive fluid and a ram connected to such piston and having an interior cavity and an internal guide fixed in the cylinder to enter the interior cavity of the ram and fitted to the ram to prevent it from twisting and so that the pressure of the fluid within the said cavity may be increased as the ram is moved in one direction, a valve chamber in communication with the end of the cylinder in which the larger end surface of the piston is exposed, a port leading to the said valve chamber and opening into the cylinder at a part overrun by the piston and a valve in said valve chamber which is uncontrolled by the motive fluid or hammer piston and is moved wholly by and under the direct control and movement of the operator for each stroke to allow more or less or to cut off the passage of motive fluid from the said valve chamber to the end of the cylinder where the larger end of the piston is exposed, whereby the operator is enabled to effect separate control of the time, force and speed of each blow of the hammer and the ram is prevented from twisting and from hitting the cylinder cover.

In testimony, that we claim the foregoing as our invention, we have signed our names in presence of two witnesses, this first day of June 1910.

LEONARD FLETCHER MASSEY.
WILLIAM HENRY SNOW.

Witnesses:
HOWARD CHEATHAM,
RUTH M. WILSON.