J. WATT.

Steam-Hammers.

No. 227,460. Patented May 11, 1880.

Fig. 4.

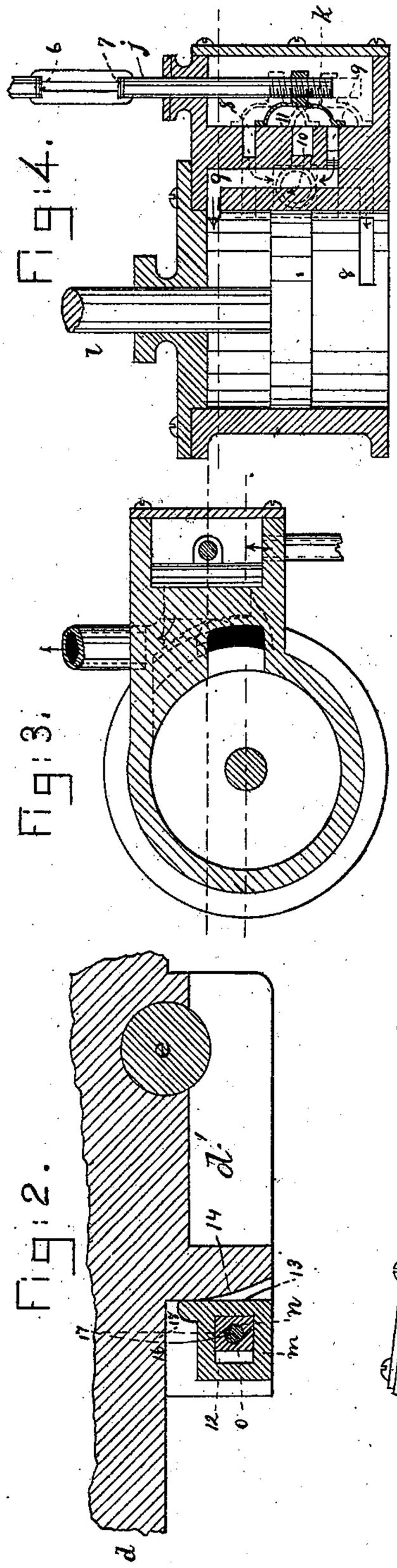


Fig. 3.

Fig. 2.

Fig. 1.

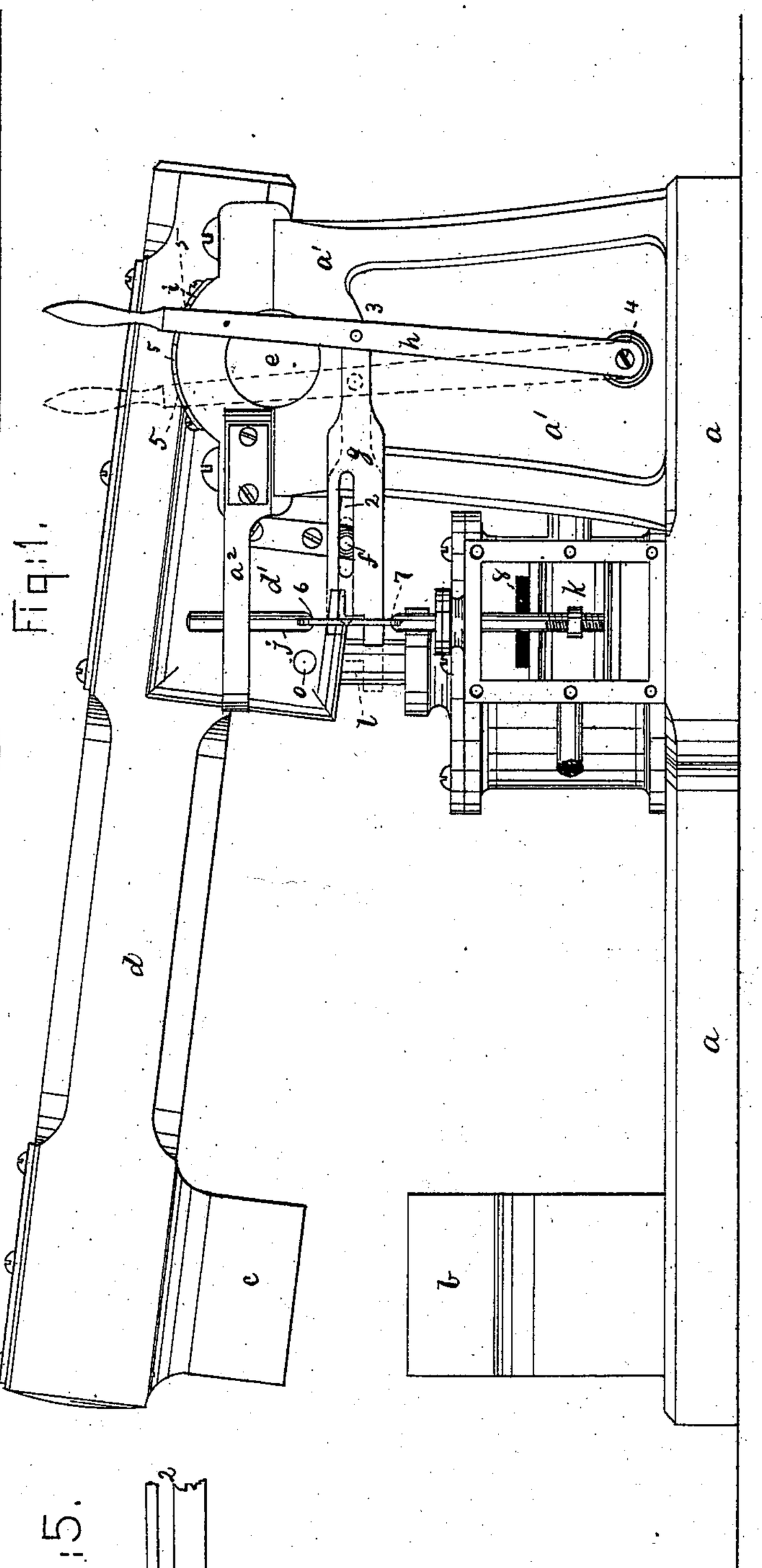
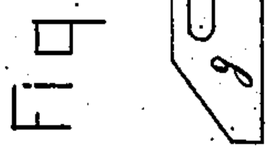


Fig. 5.



Witnesses

L. F. Connor.

Jos. P. Livermore

Inventor.

James Watt.

by Crosby & Gregory, Attys.

UNITED STATES PATENT OFFICE.

JAMES WATT, OF WATERTOWN, MASSACHUSETTS.

STEAM-HAMMER.

SPECIFICATION forming part of Letters Patent No. 227,460, dated May 11, 1880.

Application filed February 27, 1880.

To all whom it may concern:

Be it known that I, JAMES WATT, of Watertown, county of Middlesex, State of Massachusetts, have invented an Improvement in Steam-Hammers, of which the following description, in connection with the accompanying drawings, is a specification.

My invention relates to steam-hammers; and it consists, first, in a novel device for operating the valve, whereby the length of the stroke of the hammer may be regulated by the operator while the hammer is in motion; also, in the arrangement and relative position of the ports in the valve-seat, by which the hammer is caused to operate on pieces of material of different thickness without necessitating any adjustment of valve movement or position of the anvil; also, in a guide for the piston-rod head and a novel arrangement of the point of attachment of the piston-rod head relative to the pivotal point of the arm of a tilt-hammer.

The valve-stem is provided with two fixed points, herein shown as the ends of a slot in the said valve-stem, and a tappet-arm, caused to have a reciprocatory or oscillating movement in the said slot, alternately strikes the ends thereof and moves the valve-stem and valve.

The end of the tappet-arm which passes through the slot in the valve-stem is made of varying width, and its other end is pivoted to a handled shifting-lever, itself pivoted and adapted to be engaged and held in position by a notched segment attached to the framework. By moving this shifting-lever the operator is enabled to bring a narrower or wider portion of the tappet-arm in position to strike the end of the slot in the valve-stem, and consequently to allow a greater or less movement of the said tappet-arm before it operates the said valve, thus varying the length of stroke of the hammer as desired.

The steam-ports leading from the steam-chest to the cylinder are crossed, so that an ordinary D slide-valve in its downward movement, opening the upper port, admits steam to the lower end of the cylinder, and vice versa.

The bridge between the upper induction-port and the exhaust-port is made wider than that between the lower induction and exhaust ports, such construction causing the upper port to be opened to admit steam beneath the piston when the hammer in its down-stroke is a considerable distance from the anvil, thus enabling it to be used upon material of considerable thickness. If, however, the hammer is working on thin material, the valve will travel farther down, thus exposing the wide bridge before mentioned, but not uncovering the exhaust-port, as would be the case if the bridge were of ordinary width.

In a tilt-hammer all the points in the arm of the hammer, and consequently the point at which a connecting-rod may be pivoted, move in arcs around the pivotal point of the hammer-arm, while it is necessary that the end or head of the piston-rod should reciprocate in a straight line. It is consequently not possible to connect the end of the piston-rod directly to the hammer-arm.

The movement in an arc of the point of the hammer-arm at which the force is applied may be considered as a compound motion, one element or component of which is in the line of motion of the piston-rod and the other at right angles to the said line. As herein shown, a block is used free to move in a transverse guide in the piston-rod head in a direction at right angles with the movement of the said piston-rod, and this block is connected with the hammer-arm by a suitable pin, so that the movement of the piston-rod in a straight line and that of the block at right angles thereto give the desired curvilinear movement to the pin and hammer-arm. By placing this pin a distance of about one-half its average stroke below the pivotal point of the hammer-arm the transverse movement of the said block is reduced to a minimum.

The end or head of the piston-rod rests against a shoulder in the hammer-arm, the said shoulder being shaped as a portion of a cylinder having the same axis as the hammer-arm, so that the piston-rod head, always resting against it and guided by it, will move in a straight line tangent to the said cylinder.

Figure 1 is a side view of a steam-hammer provided with my improvements, the cover of the steam-chest being removed; Fig. 2, a sectional view of a portion of the hammer-arm

and piston-rod head, showing the devices for guiding the latter and attaching it to the hammer; Fig. 3, a horizontal section of the steam chest and cylinder; Fig. 4, a longitudinal section thereof, and Fig. 5 a modification of the tappet-arm, to be referred to.

The frame *a a'*, anvil *b*, hammer-head *c*, and arm *d*, pivoted at *e* in bearings on the frame *a'*, are and may be of any usual construction.

Attached to the hammer-arm *d*, or a portion of framing *d'* connected therewith, is a pin, *f*, which reciprocates with the said hammer-arm and enters a slot, 2, in a tappet-arm, *g*, pivoted at 3 to a shifting-lever, *h*, pivoted at 4 to the frame *a'*, and provided with a suitable handle. The upper part of the shifting-bar *h* is engaged and held in the desired position by one of the notches, 5, in a suitable holding-arc, *i*.

The tappet-arm *g* receives a reciprocating or oscillating movement from the hammer-arm through the pin *f*, and its end plays between and alternately strikes two fixed points on the valve-stem *j*, the said points being shown as ends 6 7 of a slot in the said valve-stem; but it is obvious that pins or other equivalent devices might be used on a solid valve-stem.

The end of the tappet-arm which strikes the fixed points 6 and 7 of the valve-stem to move the valve is of varying width, so that as it is moved longitudinally in the said slot by varying the position of the shifting-lever *h* a narrower or wider portion will be in position to engage the points 6 7 on the valve-stem. In Fig. 1 the end is shown as of three different widths, corresponding to the three notches 5 in the arc *i*.

In the position shown in full lines the narrowest part of the tappet-arm is in the slot, giving the longest stroke to the hammer, while the position shown in dotted lines gives the shortest stroke.

If the tappet-arm is constructed as shown in Fig. 5, the length of stroke can be graduated as desired; but in practice three different lengths, as attained by the form shown in Fig. 1, are usually sufficient.

It is obvious that a single point or pin might be used on the valve-stem, to be used in connection with a tappet-arm forked to embrace the said pin, the width or opening of the fork being varied to give different lengths of stroke.

The valve-stem *j*, passing through and guided by a projecting portion, a^2, of the frame-work, carries the valve *k*, shown as a D-valve of usual construction, controlling the entrance and exhaust of the steam through the crossed induction-ports 8 9 and exhaust-port 10. The upper induction-port, 8, leading to the lower part of the cylinder, is placed a considerable distance above the exhaust-port, or, in other words, the bridge 11 is made much wider than usual.

The port 8 is placed at such a height that it will be completely opened when the hammer in its downstroke has reached the point, as shown in Fig. 1, to strike a piece of material of the greatest thickness ever used in practice, so that the steam will enter below and raise the hammer for the next stroke; but if the hammer is working on thin material the said port will be opened while both hammer and valve are moving with great rapidity and the former with great momentum, so that the steam entering below the piston will not reduce the force of the blow materially, but will to a certain extent cushion the piston, and the valve, in its further downward movement, does not uncover the exhaust-port.

The different positions of the valve are shown in Fig. 4. The upper end or head, *m*, of the piston-rod *l* is shown as provided with a transverse guide, 12, in which a block, *n*, is free to slide, the said block being connected by a pin, *o*, with the hammer-arm *d* or socket *d'* thereof.

The face 13 of the piston-rod head toward the pivotal axis *e* of the hammer-arm is plane and parallel with the axis or line of motion of the piston-rod *l*, and rests against the curved guiding-shoulder 14 in the socket *d'* of the hammer-arm, the said face 13 being tangent to the surface of the guiding-shoulder 14, which is shaped as a portion of a cylinder having its axis coincident with the axis *e* of the hammer-arm *d*.

It will be understood that, the piston-rod head being raised by the piston and its rod, the face 13 will always rest against and be guided by the curved guiding-shoulder 14, and will move in a straight line, the face 13 being kept at a uniform horizontal distance equal to the radius of the curved surface 14 from the axis *e* of the hammer-arm.

The piston-rod will impart motion to the hammer-arm through the block *n* and pin *o*, and the curved motion of the latter (shown by the dotted line 16 17) will be accomplished by the rectilinear motion of the piston-rod in a direction shown by the line 18 17, and the transverse motion of the block *n* therein, the amplitude of which is equal to the greatest distance between the said lines.

By placing the pin *o* below the axis of the hammer, so that its stroke will be from a point below to one above the said axis *e*, instead of wholly below or above it, the amplitude of transverse movement of the block *n* in the guide 12 is reduced to a minimum, its movement being backward and forward in each stroke, instead of being wholly in one direction in one stroke and in the opposite direction in the opposite stroke, and the force is applied from the piston to the pin *o* more nearly in the line of movement of the said pin than would be the case if the said pin were so placed that its movement would be wholly below or wholly above the axis of the hammer-arm.

I claim—

1. In a steam-hammer, a valve-stem adapted

to be struck and moved by a tappet-arm, and a tappet-arm and mechanism between it and the piston to give the said tappet-arm a reciprocatory motion, the said tappet-arm being provided with varying surfaces to engage the valve-stem at an earlier or later period of the stroke of the piston, and a shifting-handle, under control of the operator, to enable the tappet-arm to be moved to bring the proper portion of its surface in position to engage the valve-stem to give the desired length of stroke, substantially as and for the purpose described.

2. In a steam-hammer, the valve and valve-seat provided with exhaust and induction ports when the bridge between the exhaust-port and induction-port leading to the lower part of the cylinder is made wider than the bridge between the exhaust-port and induction-port leading to the upper part of the cylinder, to cause the said induction-port leading to the lower part of the cylinder to be opened when the hammer in its downstroke meets a piece of material of maximum thickness, and to prevent the exhaust-port from being uncovered when the hammer is working on material of minimum thickness, to thereby enable the hammer to be used on material of different thickness without adjustment, substantially as described.

3. In a steam tilt-hammer, the hammer-arm socket provided with a curved guiding-shoulder for the piston-rod head, and a pin secured to the hammer-arm socket, combined with the piston-rod head, provided with a plane surface to rest against and be guided by the said guiding-shoulder, and adapted to engage the said pin and move it and the hammer-arm, and at the same time allow free transverse movement of the pin in the said piston-rod head, substantially as and for the purposes specified.

4. In a steam tilt-hammer, the hammer-arm and its connected curved guiding-surface, combined with the piston-rod head and the pin *o*, having free transverse movement therein, and connected with the hammer-arm at a distance of about one-half the average amplitude of vibration of the said pin below the axis of the hammer-arm, to thereby reduce the transverse movement of the pin in the piston-rod head to a minimum, substantially as and for the purpose set forth.

5. In a steam-hammer, the valve and valve-stem, slotted longitudinally, as described, and a tappet-arm and its shifting-lever, the end of the tappet-arm entering the slot in the valve-stem and being of different widths at different distances from its extremity, combined with a pin carried by the hammer-arm to enter a slot in the said tappet-arm and impart to it a reciprocatory motion, substantially as described.

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

JAMES WATT.

Witnesses:

JOS. P. LIVERMORE,

N. E. C. WHITNEY.