106899

Sheet 1

George Westinghouse Jr: Impvt in Steam Engine & Pump

PATENTED AUG 30 1870

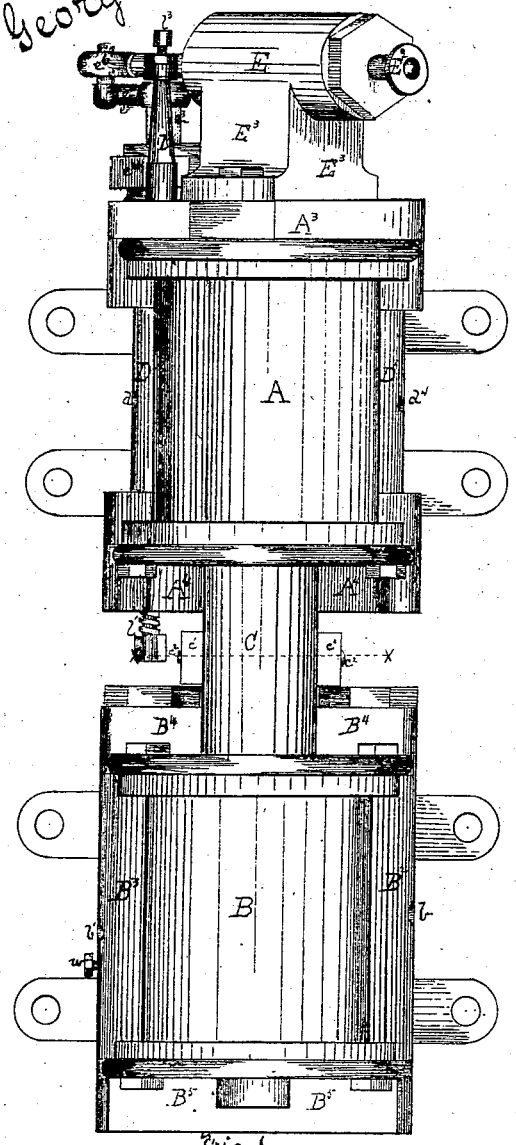

Fig. 1.

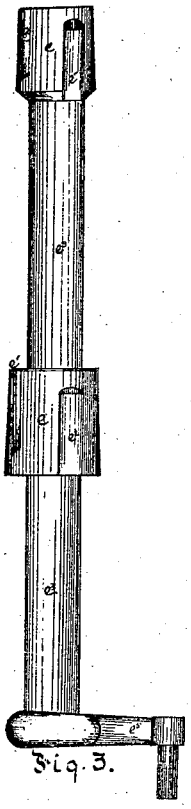

Fig. 3.

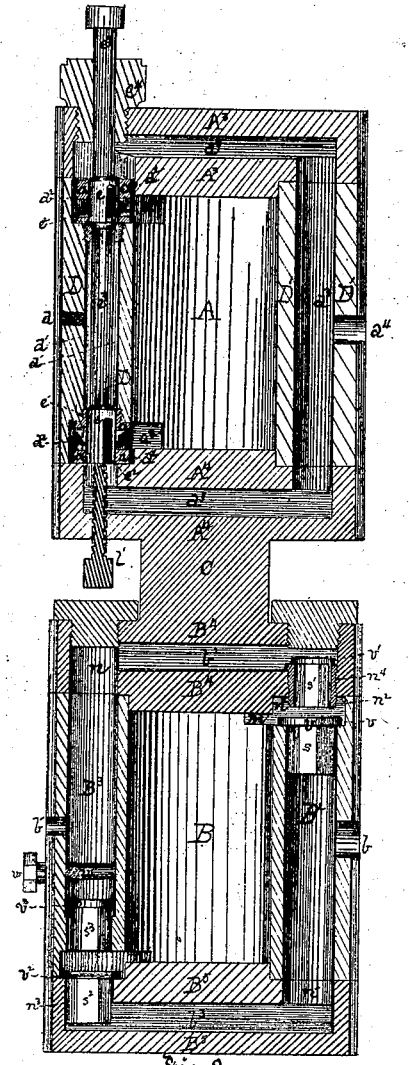

Fig. 2.

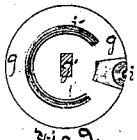

Fig. 9.

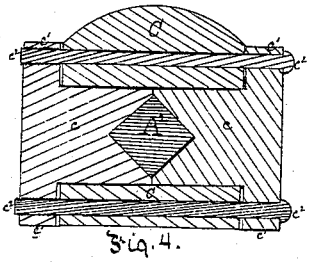

Fig. 4.

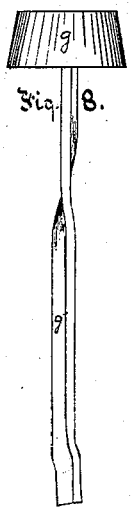

Fig. 8.

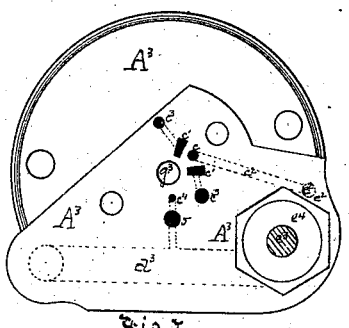

Fig. 7.

Witnesses:

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106899 George Westinghouse Jr: Imp'v't in Steam Engine & Pump.

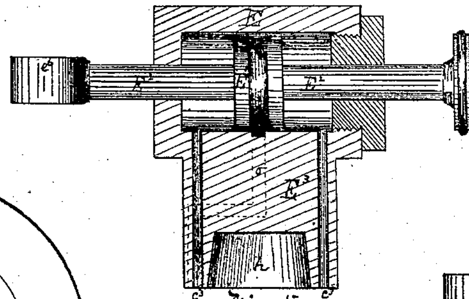

Fig. 5

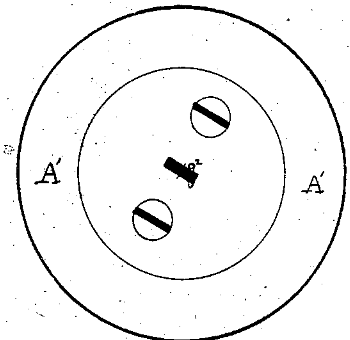

Fig. 10.

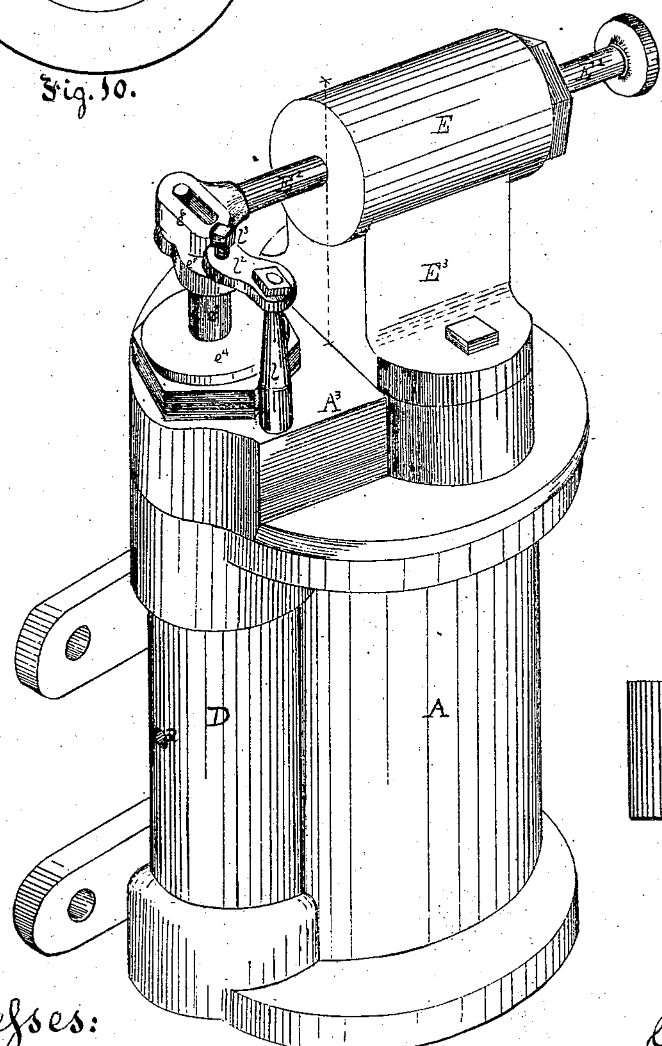

Fig. 6.

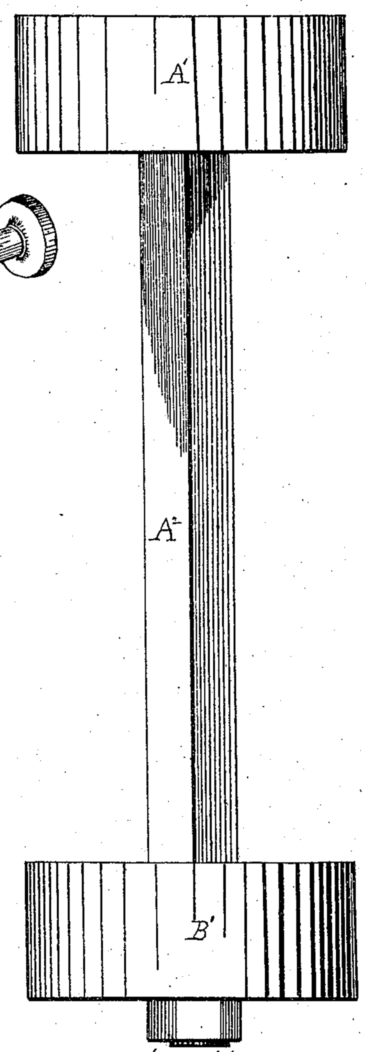

Fig. 11.

Witnesses:
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GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

Letters Patent No. 106,899, *dated August* 30, 1870.

IMPROVEMENT IN STEAM-ENGINE AND PUMP.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of the city of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Steam-Engine and Pump; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing, in two sheets, making a part of this specification, in which—

Figure 1 is a front elevation of my improved engine and air-pump;

Figure 2 is a sectional elevation, as formed by a vertical plane passing through the main steam and air-passages, a little back of the piston-stem;

Figure 3 is an enlarged (inverted) view of the main steam-valve, stem, and valves;

Figure 4 is a cross-section in the line *x x*, fig. 1;

Figure 5, sheet 2, shows a vertical section of the auxiliary cylinder, an outside view of which is contained in figs. 1 and 6, said section being taken in the line *x x*, fig. 6.

Figure 6, sheet 2, is an enlarged view in perspective of the main and auxiliary cylinders and their connections;

Figure 7, sheet 1, is an end view of the main cylinder-head A^3, just under the auxiliary engine, and showing the arrangement of ports for admitting steam to and from the auxiliary engine, by means of a valve and stem, of which latter—

Figure 8 is a side elevation, and

Figure 9 is a view of the lower face.

Figure 10, sheet 2, is an end view of the steam-piston-head, showing the slot through which the piston-stem of fig. 8 operates; and

Figure 11 is an elevation of the main steam and air-pistons, and of the stem which connects them.

Like letters of reference indicate like parts in each.

My present improvement relates more particularly to steam-engines and air-pumps for operating atmospheric power car-brakes, such as are described in Letters Patent granted to me April 13, 1869; but the devices presently to be described are, many or all of them, applicable to other uses, as will be obvious to those skilled in the art.

The nature of my invention consists in the construction of improved devices for operating steam-engines and air-pumps.

To enable others skilled in the art to make and use my improvement, I will proceed to describe its construction and mode of operation, with more particular reference to its use in connection with atmospheric steam-power car-brakes.

The main steam-cylinder A and air-pump barrel B are bored out each with the usual cylindrical cavity.

In the former I arrange a steam piston-head, A^1, fig. 11, and in the latter a pumping-piston or plunger, B^1, both suitably packed.

The head A^1 and plunger B^1 are connected by a stem, A^2, in such a way that at any part of the stroke they shall occupy corresponding positions in their respective cylinders.

The stem A^2 is square in cross-section, or of other than circular shape, so that, by passing through a stuffing-nut of like shape, it, as well as the head A^1 and plunger B^1, with which it is rigidly connected, will be prevented from turning around.

Between the cylinders A B is a stuffing-box, C, figs. 1 and 4, through which plays the stem A^2. This box is mortised through transversely at or near its middle part, and a pair of stuffing-nuts, *c c*, with suitable packing, inclose the stem A^2, the packing faces of the nuts being shaped to fit the stem. The nuts *c c* fit neatly into the mortise of the box C.

The outer ends of the nuts are T-shaped, so that the projecting ends c^1 of the T-heads shall project up and down beyond or outside of the mortise.

A pair of screw-bolts, c^2 c^2, are then passed through the ends c^1 of the T-heads, so as to give the nuts *c* a sufficiently secure hold on the stem A^2. At the same time I so proportion the several parts that the nuts *c*, when screwed up, shall have a little lateral play, that is, the distance between the opposite ends c^1 shall be a little in excess of the thickness of the box C, as shown. I thus prevent any excess of pressure and loss by friction thereby on either side of the stem A^2. The stuffing-nut *c c* adapts itself to the pressure, and constitutes a self-adjusting packing.

The steam-chest D has a port, *d*, for the admission of steam from the boiler. This chest has a cavity, d^1, which connects the valve-seats and ports at its opposite ends. These valve-seats *a*, at the ends, are bored out with a slight taper, as shown.

Around each valve-seat is bored out an annular cavity, d^2. Through the opposite sides of each valve-seats *a* are two steam-ports, a^1 a^1, which lead from the cavity of the steam-chest *d* into the annular cavity d^2, and thence steam passes into the cylinder through ports a^2.

The valves *e* are of conical form, and operate by a rotary motion closely in their valve-seats *a*. They are rotated by a stem, e^3, which, at one end, projects through a stuffing-nut, e^4, and packing, and on its end is a crank, e^5, through which the rotary motion is imparted, as presently to be explained.

In the faces of each of these valves *e* is a series of recesses, e^1, which alternate with another series, e^2, one series, e^1, opening at one end of the valve, and the other series, e^2, at the other. One of these series, e^1, is for the supply of steam from the chest d^1, through the ports a^1 a^2 to the cylinder A, and the other, e^2, for

the exhausting steam from the cylinder A through the same ports into steam-passages d^3, which lead through the cylinder-heads A^3 A^4 to the exhaust D^1 on the opposite side of the cylinder A, whence the steam passes off through an exhaust-port, d^4.

The valves *e* are carefully and accurately adjusted in their seats *a* by means of set-screws l^1 l^2, the one, l^1, passing directly through the cylinder-head A^4, figs. 1 and 2, and the other, l^2, being supported by an arm, l^2, and post *l*, figs. 1 and 6. The inner ends of the set-screws l^1 l^2 bear against the ends of the valve-stem e^3, so that by loosening one and tightening the other, the valves *e* can be adjusted in their seats readily and with accuracy.

In order to impart the desired rotary motion to the valves *e*, I use an auxiliary steam-cylinder, E, which is fitted with a piston, E^1, and stem E^2. To furnish this cylinder E with steam, I run a steam-port, c^2, fig. 7, from the steam-chest D, through the body of the cylinder A, through its outer head A^3, and terminate it in the port *c*, on the outer face of the head A^3.

On the opposite side of the ports *c* are two ports c^1, each of which communicates by a steam-passage, c^3, leading through the head A^3, thence upward through the cylinder base E^3, fig. 5, into the cylinder E, one at or near each end, so as to admit steam on opposite sides of the piston E^1.

To open and close the ports *c* c^1, I use a rotating disk-valve, *g*, figs. 8 and 9, which has a stem, g^1, flat, or of other than circular shape in cross-section, and twisted, as in fig. 8. This valve *g* operates in a chamber, *h*, fig. 5, in the lower face of the cylinder base E^3.

The stem g^1 extends through an opening, g^2, in the cylinder-head A^3, fig. 7, which opening is merely large enough to permit of its rotating, and thence through a slit, g^2, in the end of the piston A^1, fig. 10, in which slit it operates closely, so that as the piston moves up and down, the twists of the stem g^1 following the slit shall give a slight rotary motion to the valve *g*. These twists should be at only two points, and at such points as will be acted on at or near the end of each stroke of the piston A. Below the slit g^2 the piston-head A^1 and stem A^2 should be hollow or chambered out to a depth at least equal to the length of the stem.

In the edge of the lower face of the valve *g*, right over the ports *c* c^1 is a notch, *i*, of sufficient extent to uncover two of the ports *c* c^1 at once, that is, the middle port *c*, and alternately one of the side ports c^1. Then, as the piston A^1 moves up and down, it rotates the valve *g*, uncovers the ports c^1 alternately, so that steam passes from the steam-chest D, through the ports c^2 *c* c^3 alternately into the cylinder E, on opposides of the piston E^1.

The stem E^2 of this piston is attached by an eye, e^6, to the crank e^5 on the end of the valve-stem e^3, so that as the former moves back and forth, the latter will receive a short rotary motion, to open and close alternately the ports a^1, which lead by recesses e^1 e^2, in the valves *e* *e* from the steam-chest D to the cylinder A, as already explained.

The eye e^6 is made oblong, as shown in fig. 6, so that it may shift the crank e^5, when the latter passes outside the line of motion of the stem E^2. To exhaust the steam from the cylinder E, I use the ports c^1 c^1 alternately as exhaust-ports. When either is cut off by the valve *g* from communication with the supply-port *c*, it opens into a groove, i^1, in the lower face of the disk *g*, which groove is always in communication with a port, c^4, fig. 7, which leads through the head A^3 to the main exhaust d^3. This exhaust c^4 is made comparatively small, so that the steam shall escape slowly, and thereby cushion the piston E^1.

It will be observed that the stroke required in the piston-head E^1 is exceedingly short, in fact, barely low enough to turn the stem e^3 and valves *e* sufficiently to cover and uncover the ports a^1. I make the head E^1 light, so that it may have but small momentum, and I also secure for it a short stroke, by running an additional exhaust-port, *o*, figs. 5 and 7, from near the middle of the cylinder E to the main exhaust d^3. Then as soon as the piston-head E^1 has passed such port either way, the steam behind it is exhausted so freely that the head E^1 has nothing to carry it further, except its momentum, and even this, little as it is, is taken up by the cushioning steam in front.

It will now be observed that the steam passes from the steam-chest D, along the recesses e^1 of one of the valves through the ports a^1, along the annular passage d^2, to the front of the main piston A^1, giving a throw or starting it on a stroke. At the same time the exhaust-recesses e^2 of the other valve coincide with the ports a^1 of that valve-seat, so that the steam in front of the piston passes out into the exhaust.

The stroke of the piston A^1 gives a throw to the valve *g*, opens the ports for the passage of steam to the cylinder E, and it, by its piston E^1 and stem E^2, rotates the main valve-stem e^3, so as to shift the recesses e^1 e^2 of the main valve *e*, whereby steam is admitted onto the other side of the main piston A^1, and exhausted where before it was supplied; and so on alternately and continuously.

In this way I communicate motion to the plunger B^1 of the pump-barrel B. This pump I use as an air-pump to compress the air, so as to make it operative by its elasticity in the application of car-brakes, or for other uses. The pump is designed for use in an upright position, as shown in fig. 1.

Along one side of it is an air-chamber, B^2, into which air is supplied through any suitable port *b*.

On the opposite side is a like air-chamber, B^3, through which, and out at a port, b^1, the air is forced through pipes to the reservoir, or direct to the brake-cylinder. These side air-chambers B^2 B^3 are extended at each end into the cylinder-heads B^4 and B^5 by chambers *u* u^1 u^2 u^3 bored therein, and air-passages b^2 b^3 extend across through the heads B^4 B^5, and connect such chambers. The air-chambers B^2 B^3 open into the cylinder by ports *m* m^1 at opposite ends. The upper end of the chamber B^2 is bored out, so as to give a valve-seat, on which rests a poppet-valve, *u*, the stems of such valve being such as to guide the valve to its seat, onto which it falls by its own weight.

Directly above this, in the chamber u^2, or in a valve-box, u^4, adjusted in such chamber, is a like valve, v^1, with stem s^1 operating in a similar manner.

The port *m* comes between these two valves.

In the lower end of the chamber B^3, or rather in the chamber u^3, is a similar poppet-valve, v^2, with stem s^2, falling by its own gravity onto a seat, and directly above it, resting on a seat in the lower end of the chamber B^2, is a like valve, v^3 and stem s^3.

A little above this valve v^3 is a stop, *w*, to keep the valve from being driven too far from its seat. The port m^1 comes between these two valves.

It will be observed that all the valves described are seated by their own weight, and remain seated, except when raised by the incoming or outflowing air.

The operation is, then, as follows:

With the downward stroke of the plunger B^1 the air is forced out at the port m^1. Its pressure, in escaping, raises the valve v^2, through which it passes, and thence along the chamber B^3, and out at the port b^1. At the same time, to supply what would otherwise be a vacuum above the plunger, the air enters at the supply-port *b*, rises and passes through the valve *v*, and into the cylinder through the port *m*. With the upward stroke of the cylinder, the air above the piston B^1 passes out at the port *m*, lifts and passes through the valve v^1, follows the chambers u^2 b^2 *u* B^3 to the port b^1, whence a pipe conducts it to the reservoir.

To furnish a new supply of air beneath the piston,

the air rushes in at the supply-port b, follows the chambers B^2 u^1 b^3 u^3, lifts the valve v^2, and enters at the port m^1, and so the operation goes on continuously.

In many of the features described I do not desire to limit myself to the exact construction set forth. The valves e may be made cylindrical, instead of conical, and the seats shaped accordingly. Also, the same result may be accomplished, though less advantageously, with a single pair of recesses, e^1 e^2, on each valve, and a single port, a^1, as with two or more pairs of such recesses and a corresponding number of ports; but by the use of a double set of recesses, e^1 e^2, the two ports a^1 in each valve e, and the annular chamber d^2, surrounding each valve-seat, I provide for a more perfect balancing of the valves; also, in the construction of a valve for opening and closing the ports c c^1 of the engine E, and in operating the same by means of a hollow piston-head and stem, I do not limit myself to the disk-valve g and twisted stem g^1, described. A sliding valve of short throw might be made to do the same work by means of the valve-stem entering the hollow of the piston-head and stem, the two being so constructed that at any desired part of the stroke of the piston-head A^1, it shall engage some fixed point in or part of the valve-stem; hence, in this connection, I claim, broadly, a piston-head and stem, made hollow, for the insertion of a valve-stem, which latter is to be actuated thereby.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A pair of rocking-valves, e e, on a common stem, each valve having two or more recesses, e^1 e^2, such recesses alternating with each other, and opening on opposite directions on the same valve, substantially as and for the purposes described.

2. A valve-seat, a, having ports a^1, which open into an annular steam-passage, d^2, in combination with the valve e of the previous claim.

3. A piston-head and stem, made hollow for the insertion therein of a valve-stem, which latter is to be actuated therein and thereby, substantially as described.

4. A steam-valve, g, having a stem, g^1, twisted at such points, that entering a slit in a hollow piston-head and stem, it shall, by the motion of such head and stem, be rotated or rocked, substantially as described.

5. A groove, i^1, in the lower face of the disk-valve g, in combination with the ports c, c^1, and c^3, arranged substantially as described.

6. A central auxiliary exhaust, o, arranged at or near the middle of that part of a steam-cylinder through which the piston-head operates, for the purpose of arresting the stroke of the piston-head, substantially as set forth.

7. A stuffing-nut, c c, formed in two or more parts, so constructed together and arranged with reference to the stuffing-box as automatically to bear with equal pressure on the opposite sides of the stem, substantially as described.

8. The subject-matter of the last claim in combination with a piston-stem, A^2, of other than cylindrical form.

9. The air-inlet flues B^2 b^3 and air-outlet flues b^2 B^3, in connection with the air-ports m m^1 and valves v v^1 v^2 v^3, arranged substantially as described.

10. In combination with the valve-stem e^3 and valves e, the adjusting set-screws l F, arranged substantially as described.

11. The arrangement of the auxiliary steam-cylinder E, with its axial line at right angles to the axial line of the main cylinder, substantially as set forth.

In testimony whereof, I, the said GEORGE WESTINGHOUSE, Jr., have hereunto set my hand.

GEORGE WESTINGHOUSE, Jr.

Witnesses:

A. S. NICHOLSON,

THOS. B. KERR.