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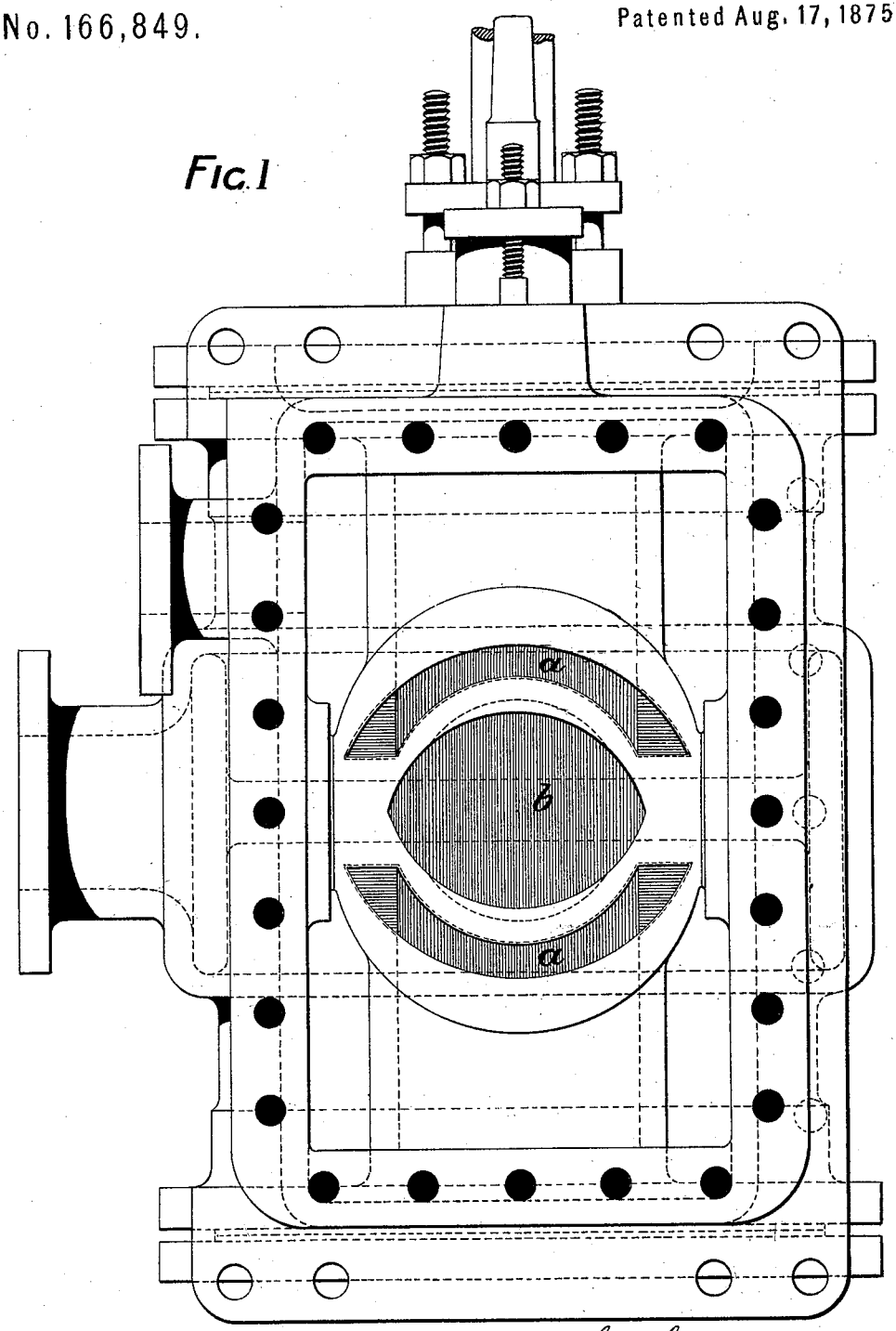
Ports for Steam-Engine Cylinders.

No. 166,849. Patented Aug. 17, 1875.

FIG. 1



Witnesses. Harry Smith.
Thomas M. Hunn

W. C. Church,
by his Attorneys
Howson and Son

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W. C. CHURCH.

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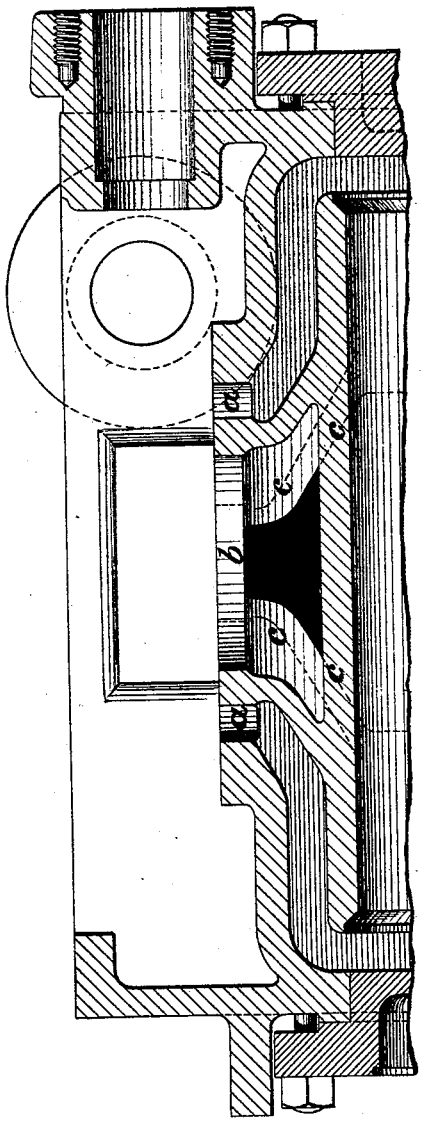

Fig 2

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W. C. CHURCH.

Ports for Steam-Engine Cylinders.

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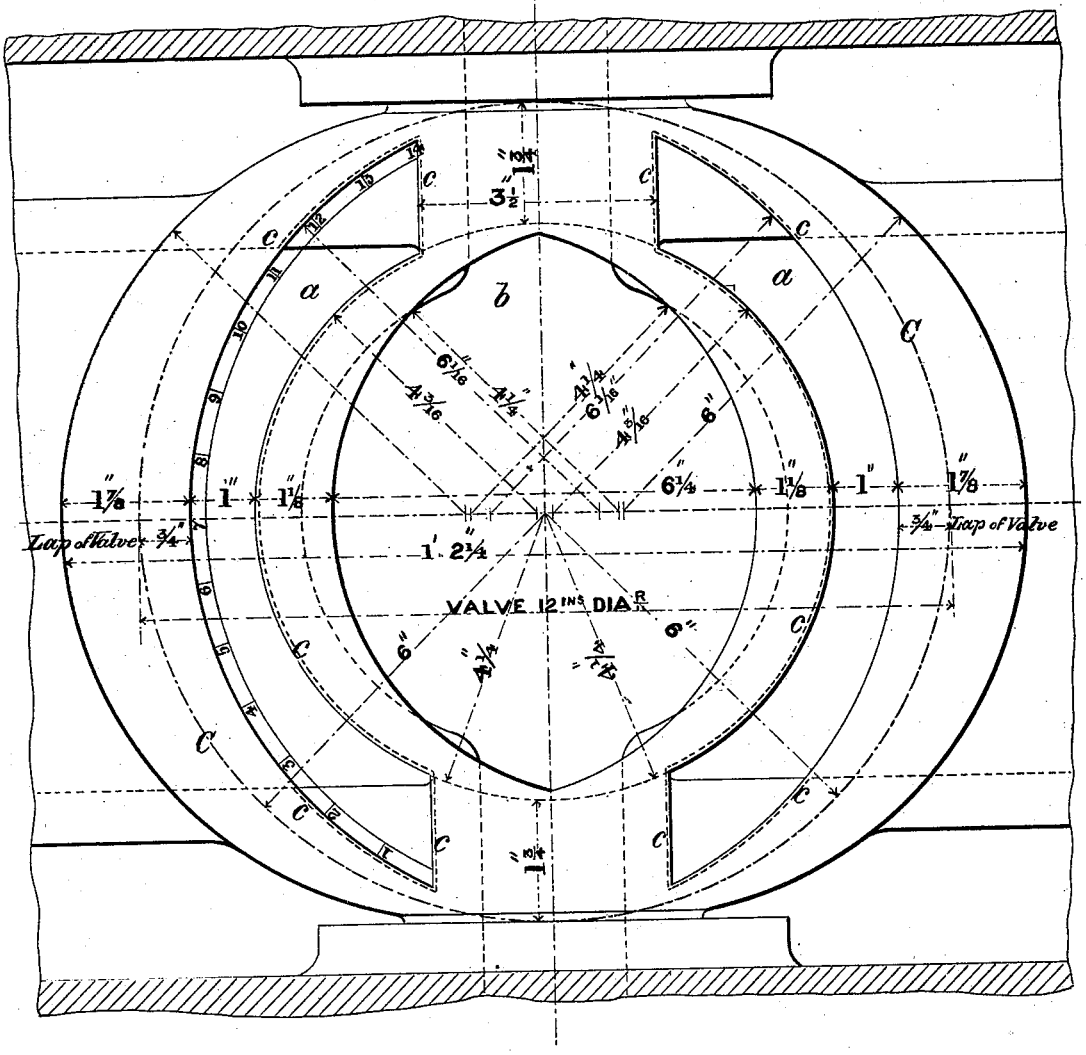
FIG. 3.



Witnesses Harry Smith
Thomas H. McIlvain

W. C. Church,
by his Attorneys
Howson and Son.

UNITED STATES PATENT OFFICE.

WALTER C. CHURCH, OF WESTMINSTER, ENGLAND.

IMPROVEMENT IN PORTS FOR STEAM-ENGINE CYLINDERS.

Specification forming part of Letters Patent No. **166,849**, dated August 17, 1875; application filed July 12, 1875.

To all whom it may concern:

Be it known that I, WALTER CHARLES CHURCH, of 8 Victoria Chambers, Victoria Street, in the city of Westminster, England, have invented Improvements in the Cylinders of Steam, Air, Gas, or Hydraulic Motive-Power Engines or Steam-Hammers, of which the following is a specification:

My invention (for which a British patent, No. 563, was issued April 19, 1872,) relates more particularly to the construction of the port-faces of steam, air, gas, or hydraulic motive-power cylinders, fitted with the peculiar circular slide-valve in respect of which I made application for a patent March 2, 1874, but is also applicable with circular slide-valves of other constructions, and it has for its object enabling the length and width of the steam-passages to be reduced, while increasing the length of the port for the lead.

In order to effect these objects I make the valve-ports in the cylinder of a peculiarly-curved form, as hereinafter described, and illustrated on the accompanying drawings.

Figure 1 represents a plan, drawn to a reduced scale, of a cylinder constructed with my improved steam and exhaust ports. Fig. 2 is a corresponding longitudinal section of a portion of the cylinder with the steam and exhaust ports. Fig. 3 represents a plan of my improved ports adapted to a twelve-inch circular slide-valve.

Similar letters indicate corresponding parts in all the figures.

The valve-ports, in lieu of being rectangular, are of the peculiar curvilinear form shown in Figs. 1 and 3 of my drawings. The ports are also angled or inclined below the port-face to suit their curvilinear form, as shown by the dotted lines *c* in Fig. 2, which angle or inclination extends round the exhaust side, across the ends of the steam-ports, and round to the passages to the cylinder, as shown at *c* in Fig. 3. These last-mentioned dotted lines also show the clearance requisite below the port-face for the tool to clear in slotting them out, as each arc can be slotted under a radial slotting-machine in small-sized cylinders.

This form of steam-port *a* enables the steam-passages to the cylinders to be shortened and reduced in width, as shown in plan in Figs. 1 and 3, while at the same time a larger area and uniform lead for admission onto the piston are obtained throughout the entire length of the port.

In the plan, Fig. 3, I have also shown the method of setting out the various curves requisite for a valve twelve inches diameter, which is as follows, reference being had to the figured dimensions on the said plan: First, describe the circle of the valve C of the diameter fixed upon, which, as shown in the drawing, Fig. 3, is twelve inches diameter, or six inches radius. Within this circle, mark off on each side, from the circumferential line on the center line, the outside lap and the width of the steam-port *a*, which are, respectively, three-fourths of an inch and one inch, as shown in the plan, Fig. 3. This gives the width of valve-face, namely, one and three-fourths inch. This dimension will vary according to the outside lap of the valve and the width of the steam-port *a*, also of the inside lap, if adopted. The diameter of the exhaust-opening in the valve is found by subtracting the width of the valve-face on each side from the diameter of the valve C, namely, twelve inches minus three and a half inches, which leaves eight and a half inches for the diameter of the exhaust-opening in the valve C. This dimension will also vary according to the inside lap of the valve adopted.

The radius for the outer edges of the port-face is the same as that of the valve, namely, six inches, and the width from the outside of the port-face to the outer arc of the steam-port *a* is one and seven-eighths of an inch. This dimension can be varied according to the travel and outside lap of the valve or the length of the port-face decided upon. The radius for the outer arc or curve of the steam-port *a* is about one-sixteenth of an inch greater than that of the valve-face C, and is therefore about six and one-sixteenth inches, as shown in the drawing, Fig. 3, giving a uniform opening of one-eighth of an inch for the entire length of the arc of the steam-port *a*, which is fourteen inches long, and allowing the port to commence opening at the two extremities of the arc or curve in lieu of on the center line. The same result occurs on the exhausting side of the steam-port. This dimension

also varies according to the lead or opening decided upon. When a greater amount of uniform lead or opening is required the radius of the outer arc of the steam-port *a* will increase in a greater proportion to the radius of the valve-face C, as, the valve-face being circular, its motion causes the steam-port *a* to open more quickly on the center line while traveling over the port-face, thereby requiring the outer arc of the steam-port *a* to be struck with a greater radius than that of the valve C, thus giving a greater opening with a uniform lead on the entire length of the arc of the steam-port *a*, and thereby accomplishing, by increasing the radius of the outer arc, any amount of uniform lead or port-opening required.

The width of the steam-port *a* on the center line is one inch, and the radius of the arc of the inside of the steam-port *a* is about one-sixteenth of an inch less than the radius of the exhaust-opening in the valve C, namely, about four and three-sixteenths inches, which produces a uniform opening throughout the entire length of the arc on the exhaust side of the steam-port *a*, and as the valve *c* travels over the steam-port *a*, and opens the exhaust side thereof at the same time, the length of the exhaust-arc of the valve C increases in such a rapid manner over the inner arc of the steam-port *a* as to allow the steam to escape freely from the cylinder. The exhaust-opening in the valve C being of a circular form, it opens more quickly on the center line, and therefore the arc on the exhaust side of the steam-port *a* is struck with a less radius than that of the valve C, which is four and one-half inches, as shown in Fig. 3. This dimension will also vary by reducing the radius of the inner arc of the exhausting side of the steam-port according to the inside lap of the valve and the amount of uniform opening required.

The width of the bar between the steam and exhaust ports on the center line is one and one-eighth inch, and the radius of the arc of the exhaust-port *b* is the same as that of the exhaust-opening in the valve C, namely, four and one-fourth inches. This dimension will also vary according to the inside lap of the valve adopted; and when the valve C works expansively, only opening the steam-port *a* on the center line three-eighths of an inch, the inside of the circular exhaust-opening in the valve C will be flush with the arc or curve of the exhaust-port *b*, (see plan, Fig. 3,) thereby producing a uniformity of wear on the surfaces, whether working in full throw or expansively. This can also be varied, so that when the valve just opens on the lead the same result can be obtained.

The practical rule adopted for giving additional outside lap on ordinary rectangular slide-valves over the steam-ports increases the width of the valve-face, thereby giving an increased area on the back of the valve exposed to the pressure of steam in the steam-chest, tending to press it to the port-face; but in a circular slide-valve of my improved construction, as described in the specification of my application of March 2, 1874, the outside lap of the valve may be increased without increasing the area on the back of the valve acted upon by the pressure of steam in the steam-chest by bringing the outer curves or arcs of the steam-ports *a a* closer together on the center line, leaving, nevertheless, a sufficient area between the two curves or arcs of the exhaust-port *b* for the steam to escape freely from the cylinder, also leaving a uniform opening throughout the entire length of the curve or arc of the steam-port *a*, (which is fourteen inches long, as hereinbefore described, and illustrated by Figs. 1 and 3;) hence the superiority of my method for setting out the ports on the port-face for circular valves will be obvious.

Although I have given a twelve-inch valve as an example, it is obvious that the diameter may be varied, as a greater or less area of port-opening or lead is required for admission onto the piston, and therefore the advantages to be gained by the adoption of this form of port-face in cylinders of large diameter is the dispensing with the double or gridiron port-face, as by my improved mode of port-face I can give all the area of port-opening necessary for the admission of steam onto the piston, as well as a sufficient area to the exhaust, thereby saving a large amount of steam in charging the passages for each stroke of the engine.

In the case of single-acting cylinders—that is to say, cylinders in which the motive fluid acts upon one side only of the piston or ram—one steam-port and one exhaust-port only will be required, which will be constructed upon the principles hereinbefore described. When, however, the invention is applied to cylinders requiring two port-faces, in order to shorten the steam-passages into the cylinder, the ports are arranged in a manner similar to those for single-acting cylinders, but two sets are employed, viz., a steam-port and exhaust-port for each side of the piston.

I claim—

1. A cylinder provided with a port or ports, *a a*, curved and expanding in width from the center to the ends, all as and for the purpose set forth.

2. The combination of the curved port or ports *a* with the exhaust-port *b*, widest on its transverse diameter, as set forth.

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

W. C. CHURCH.

Witnesses:

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FREDK. C. DYER,
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