(No Model.) 2 Sheets—Sheet 1.

C. COCKSON.

VENTILATING FAN.

No. 284,279. Patented Sept. 4, 1883.

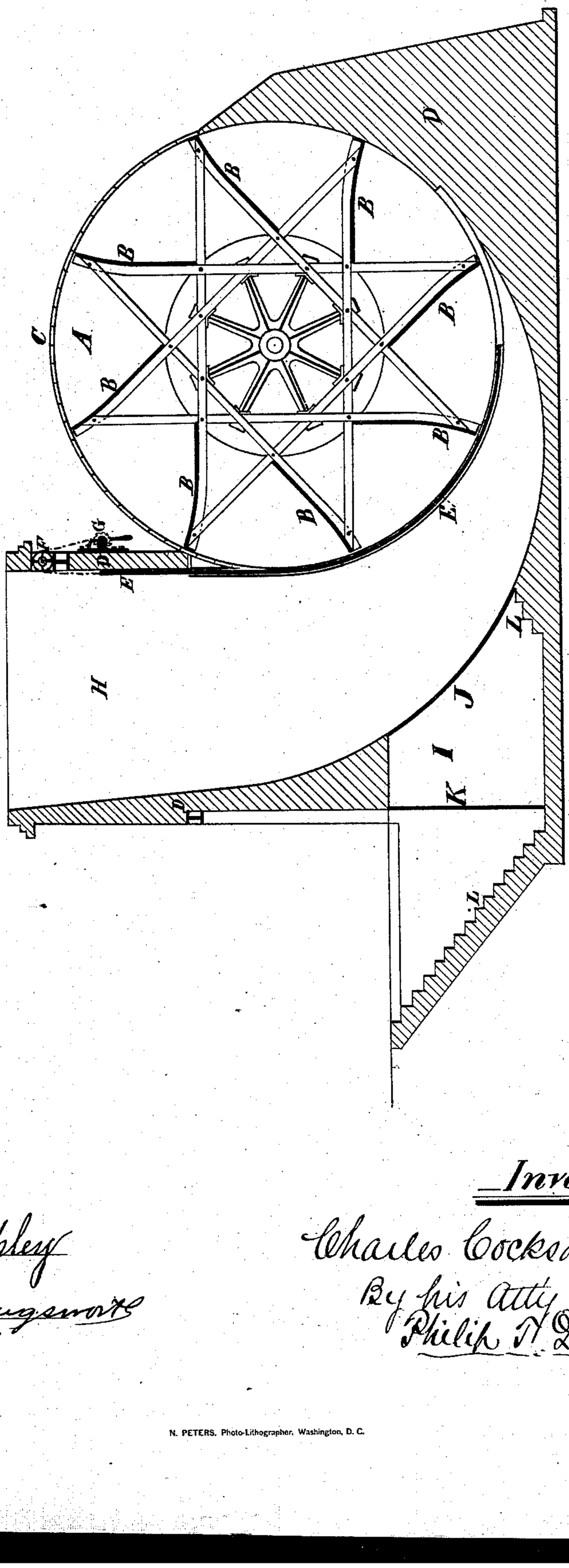

Fig 1.

Witnesses.

Harry Shipley

Sidney P. Hollingsworth

Inventor.

Charles Cockson.

By his Atty

Philip T. Dodge.

(No Model.)

2 Sheets—Sheet 2.

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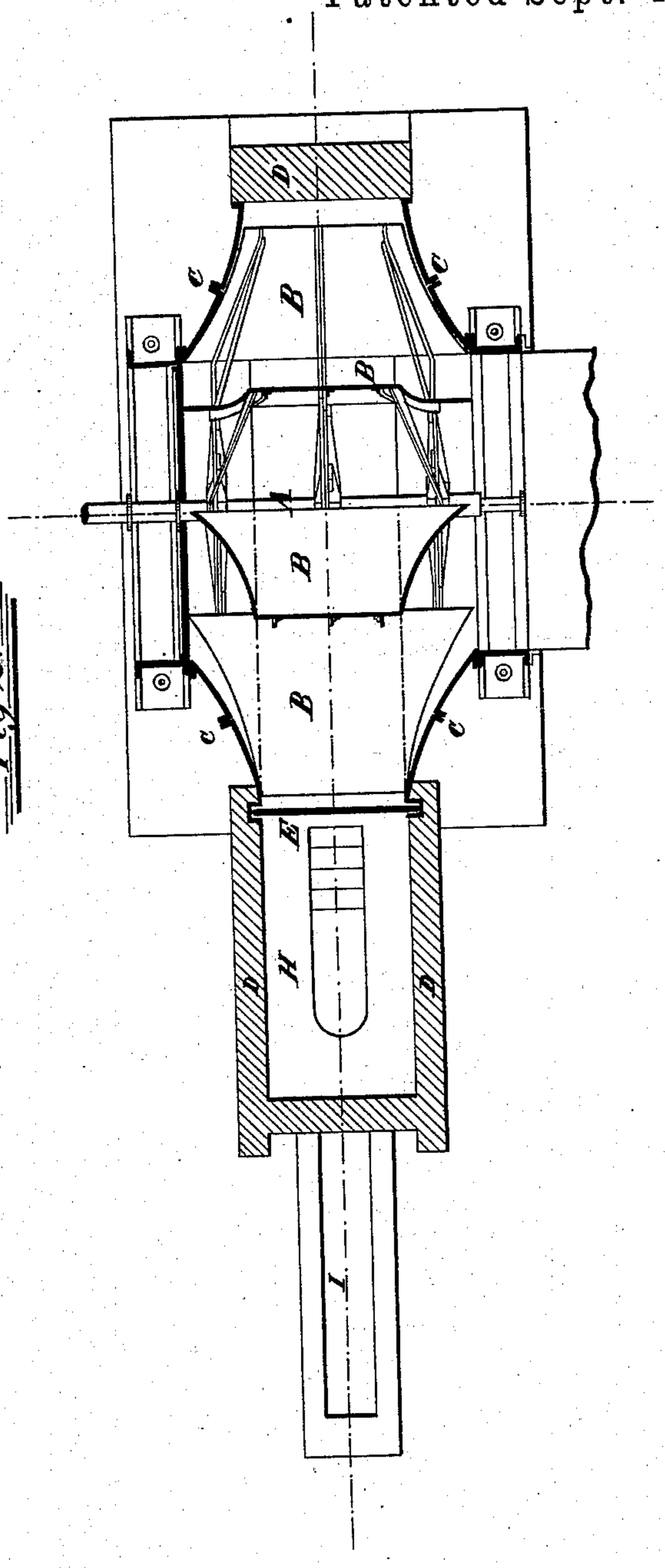

Fig 2.

Witnesses.

Harry Shipley

Sidney P. Hollingsworth

Inventor.

Charles Cockson.

By his Attorney.

Philip T. Dodge.

UNITED STATES PATENT OFFICE.

CHARLES COCKSON, OF WIGAN, COUNTY OF LANCASTER, ENGLAND.

VENTILATING-FAN.

SPECIFICATION forming part of Letters Patent No. 284,279, dated September 4, 1883.

Application filed May 17, 1882. (No model.) Patented in England February 28, 1882, No. 974.

To all whom it may concern:

Be it known that I, CHARLES COCKSON, of Wigan, in the county of Lancaster, in the Kingdom of Great Britain, have invented certain new and useful Improvements in Ventilating-Fans, (for which I have received provisional protection in Great Britain, dated February 28, 1882, No. 974,) of which the following is a specification.

In most ventilating-fans as at present made there is great loss of power from the following causes: first, being open at the extremity over a large part of their circumference, or at least surrounded by a casing placed at a considerable distance from the fan, there is a great loss of power from unnecessary work; second, if the diameter of the fan be divided into equal parts and these form imaginary annular divisions, it will be at once seen that the cubical contents of the outer annuli are far greater than those of the annuli nearer the center, providing the vanes are rectangular. When the fan is at work the pressure of air, owing to the centrifugal force put into it, increases very much as it travels toward the periphery of the fan, so that if the fan-vanes are of equal width throughout there will be a much greater total pressure exerted on the surface of the vanes at the parts near to the periphery than there is at those nearer to the center of the fan. This pressure increases in accordance with the formula $P=mv^2$, where P= pressure exerted by the fan-vane per square foot of area, *m* the mass moved, and *v* the velocity of the air, so that if I double the velocity of the air in its passage through the fan I double the pressure of the air at the periphery, and consequently ought only to take half the width of fan-vane there, by which means the total pressure in each of our previously-mentioned equal annular divisions, as found by multiplying the pressure of air in pounds per square foot by the area of surface of each fan-vane in annular division will be the same for all our imaginary divisions, and consequently we shall put a stop to the excessive vibration at present found in all fans having rectangular vanes, which vibration entails useless work, and is deleterious to the structure of the fan. Now, the Guibal fan successfully gets over the first difficulty, and other fans in a more or less perfect manner avoid the second; but I know of no other fan than mine that is not objectionable on one or other of these grounds. Now, in order to lessen vibration in the fan, (which is produced by the greatly varying strains on the structure caused by the increasing velocity of the air during its passage from the inlet-end of fan-vanes to the periphery of the same,) I so proportion the area of the vanes that the total pressure exerted on the surface of the vanes is the same throughout the fan. Having so proportioned the width of the fan-vanes we shall have an equal area of air-passage through the fan from the inlet to the discharge end of the vanes. This curving of the outline of the vanes is a very easy matter of calculation, and the fan may be constructed so as to have one side of the vanes straight, the balancing of the pressure being obtained by curving the other side of fan-vanes; or the same result can be obtained by curving both sides of fan-vanes, as in the drawings. The way of doing it is not material, so long as the area of air-passage through the fan is kept the same from the inlet to outlet end of vanes. The fan will be properly proportioned as to the air-pressure, and will be a near approach to a "noiseless" fan, and without "vibration."

The fan-casing will of course have to be built according to the curve of sides of fan-vanes, and the fan-chimney I propose to build of ample dimensions, *évasée* in form, as set forth in the drawings.

The advantages which I claim for my improved Guibal fan are as follows:

(*a*) That having minimized vibrations, we may in practice run the improved fan at greatly-increased speed, providing the fan be made strong enough to resist the centrifugal force, which tends to tear away the arms of fan from the shaft, and the bearings be proportioned to the speed desired. This ability to run the fan at high speed gives us the power of at any time doubling or increasing in any reasonable proportion the amount of air circulating in a mine or tunnel. This has not been heretofore practicable with Guibal fans, (unless runing at a very low speed,) on account of the dangerous vibration of the fan with increasing speed.

(*b*) By using the improved type of fan a

great saving in the first cost of a ventilating-plant will be effected, as a much smaller size of fan, and consequently smaller casing and foundations, will be required.

(*c*) This great saving in first cost has no corresponding disadvantages, such as decrease of efficiency or increase of fuel, used to keep the fan at work.

(*d*) In many cases the fact of being able to economize space by putting up a comparatively small fan which will do the work of a large one will be a matter of great importance, as well as a great saving in first cost.

In the drawings, Figure 1 is a longitudinal section; Fig. 2, a horizontal section with the fan itself in plan. In these A is the fan, with curved vanes B. In this case both sides are curved, but one only could be curved to twice the extent, the curving being so arranged that the breadth of fan-blade at any point multiplied by the distance of that point from the center line of the fan-shaft shall be equal. The theoretically best curve will be found on calculation to be approximately that set forth in the drawings, varing with the dimensions of the fan. C is the casing, formed of wooden lagging; D, brick-work; E, sliding shutter to regulate escape. These three should be constructed so as to leave as little space as possible between them and the revolving vanes. F, pulley; G, winch or windlass for raising the sliding shutter; H, *évasée* chimney; I, passage to enter chimney and fan-race, closed by doors J and K; L, stairs to same. In the Guibal fan the sliding shutter is suspended from a beam placed across the chimney. This is an impediment to the air. I have therefore designed the arrangement set forth, in which the pulley supporting the sliding shutter is built into the wall of the chimney and does not interfere with the draft.

I am aware that a fan having blades of rectangular form has been combined with a flexible gate arranged to move about the periphery of the fan, in a line substantially concentric therewith, for the purpose of diminishing the area of the discharge-opening between the fan-case and the discharge-flue; but owing to the peculiar action of my improved blades the gate represented in the accompanying drawings has a peculiar action not secured by its combination with fans of ordinary form. Consequently there exists a peculiar relationship between the gate arranged as described and the fans constructed on my plan.

I am aware that a fan has been described and illustrated, separate and apart from a casing, with blades of diminishing width toward the periphery, and with annular side plates secured to the edges of said blades, the intention being to facilitate the ingress of air, which, being admitted at the center, passed outward between the blades and between the annular side plates. To such construction I make no claim.

I claim as my invention—

1. A ventilating-fan in which the fan-blades revolve in a close-fitting casing and are diminished in breadth as they approach the periphery, so as to equalize the strain or total pressure throughout the fan.

2. The combination of a device, E, for regulating the area of escape, with a ventilating-fan in which the fan-blades diminish in breadth as they approach the periphery, so that the cubical contents of any annular division described by the revolution of an equal breadth of fan-blade, measured diametrically, shall be equal.

3. In combination with a device, E, (forming a continuation of the casing,) for regulating the area of discharge, a casing of a ventilating-fan both of the sides of which gradually approach each other toward the periphery, so that their distance apart at any given point multiplied by the distance of that point from the center line of the shaft shall be approximately equal.

4. In a fan, the combination of the sliding shutter E with the pulley F, placed in the wall, so as to avoid injuring the draft, and the winch device G, placed over the fan.

5. The combination, with a close-fitting casing and *évasée* or expanding chimney, of a ventilating-fan having the vanes diminishing toward their extremities, in the manner and for the purposes described.

CHARLES COCKSON.

Witnesses:
WM. P. THOMPSON,
JOSEPH JAMES ROYDEN.