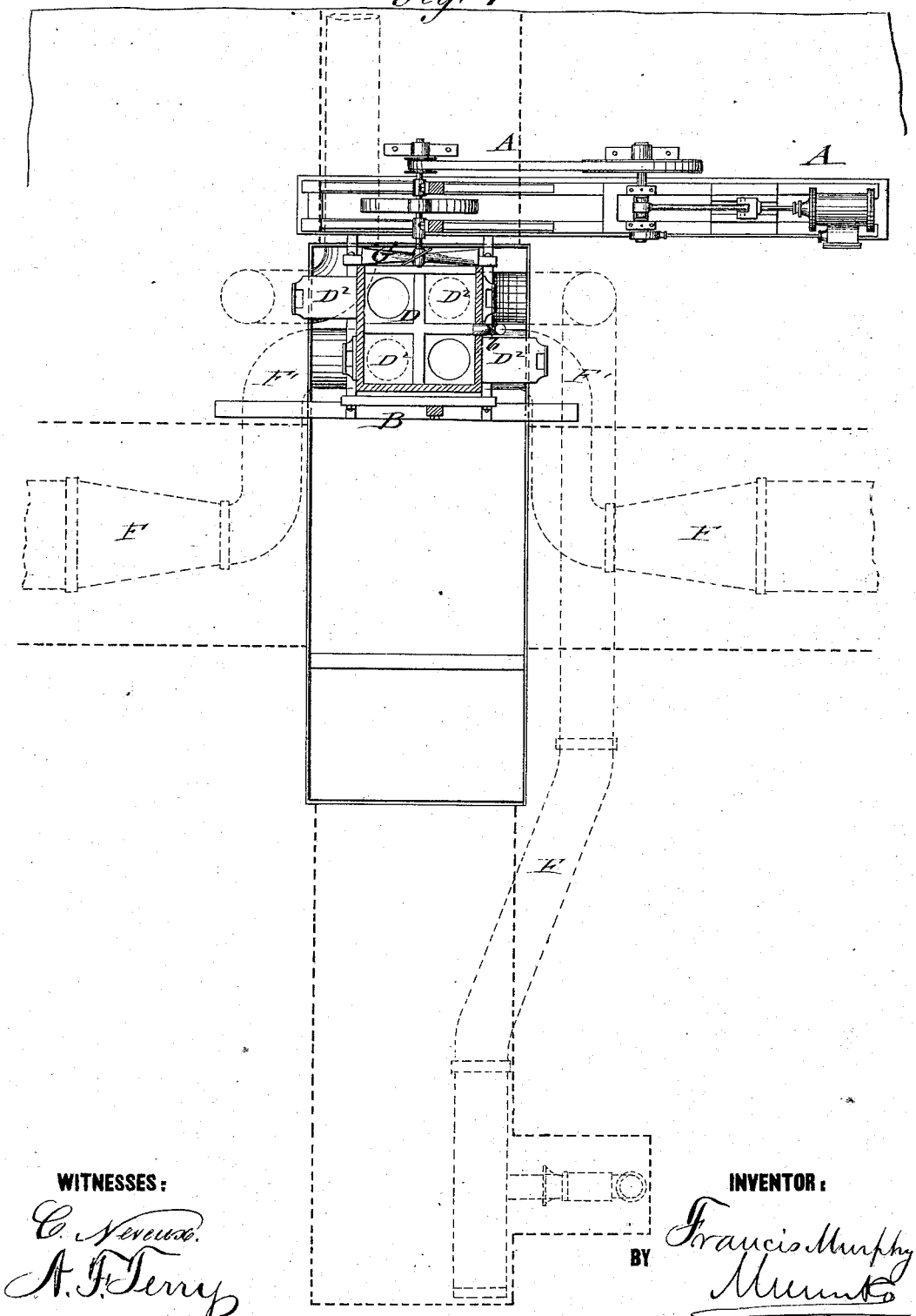
3 Sheets--Sheet 1.

F. MURPHY.

Ventilating-Apparatus for Coal-Mines.

No. 163,098. Patented May 11, 1875.

Fig. 1



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Ventilating-Apparatus for Coal-Mines.

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Fig. 2

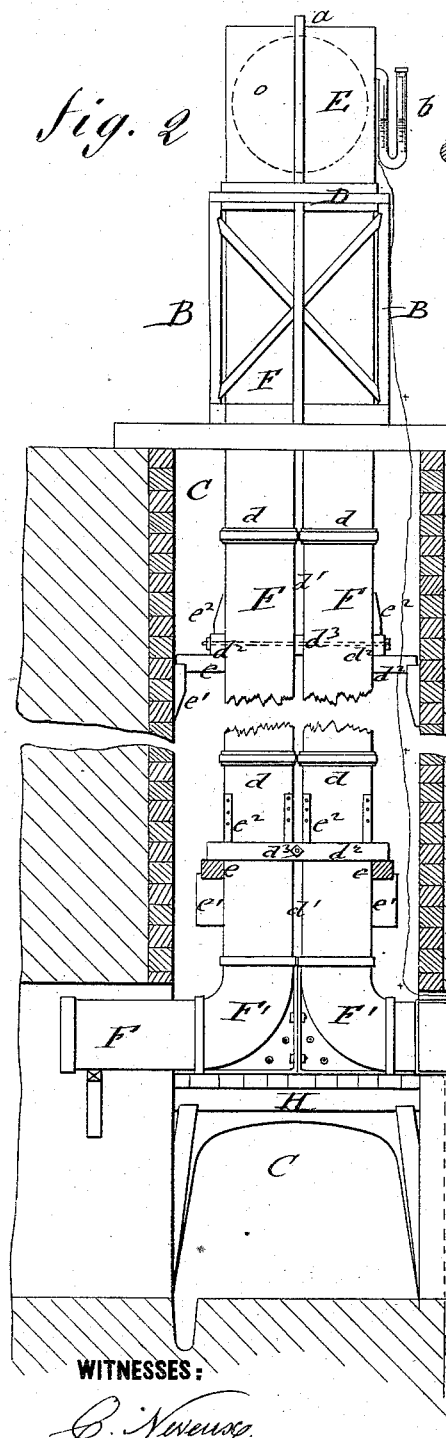


Fig. 4

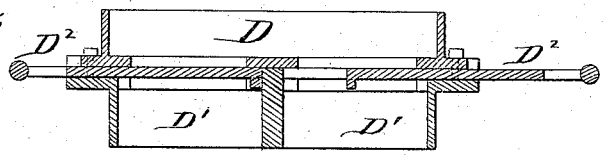
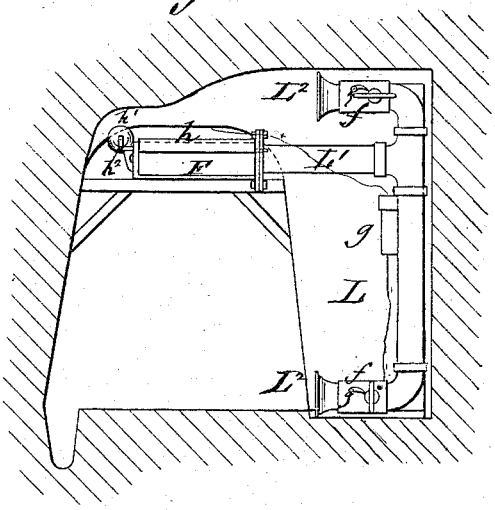
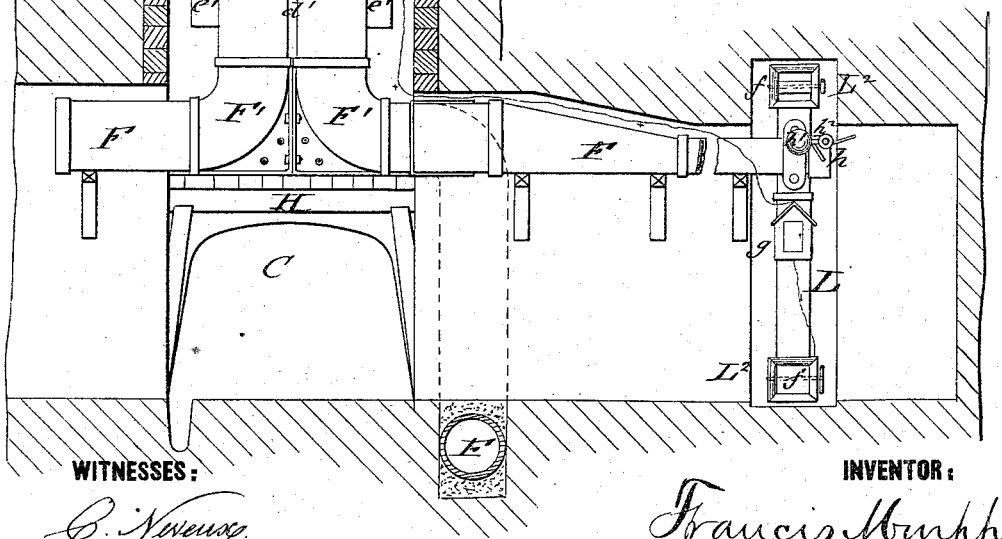


Fig. 3





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F. MURPHY.

Ventilating-Apparatus for Coal-Mines.

No. 163,098. Patented May 11, 1875.

Fig. 1

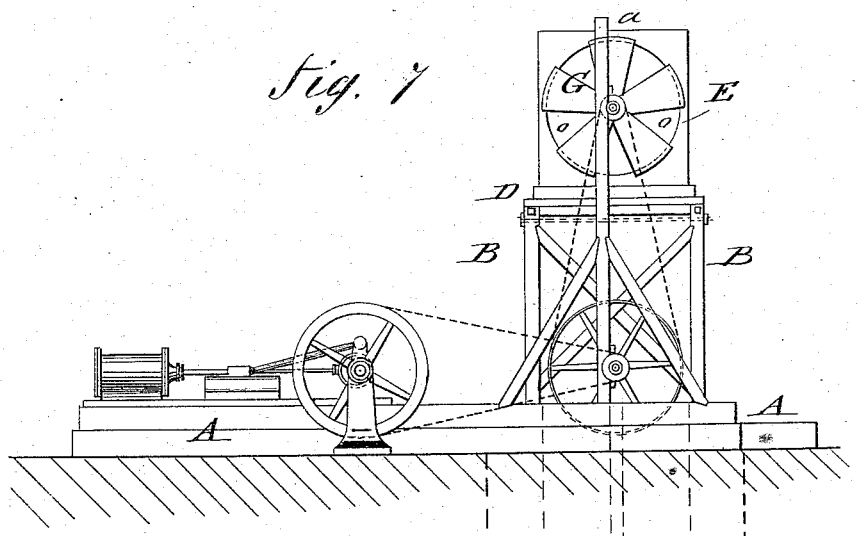

Fig. 5

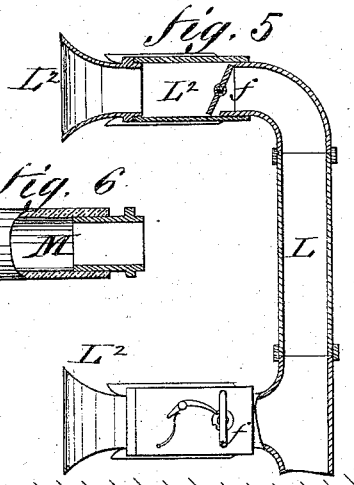

Fig. 6

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UNITED STATES PATENT OFFICE.

FRANCIS MURPHY, OF STREATOR, ILLINOIS.

IMPROVEMENT IN VENTILATING APPARATUS FOR COAL-MINES.

Specification forming part of Letters Patent No. **163,098**, dated May 11, 1875; application filed August 15, 1874.

To all whom it may concern:

Be it known that I, FRANCIS MURPHY, of Streator, in the county of La Salle and State of Illinois, have invented a new and Improved Ventilating Apparatus for Coal-Mines, &c., of which the following is a specification:

My invention relates to an improved apparatus for ventilating coal-mines, tunnels, and other places subject to the generation and the accumulation of noxious gases or vitiated air.

In all underground excavations, but more particularly in coal-mines, the air becomes impure from various causes, and requires to be frequently removed. There have been many different contrivances for ventilating mines, the most successful of the same consisting in the rarefying of the air at some point at the bottom of the mine by means of a furnace or steam-jet, which creates a draft or current of air through the works. This mode necessitates, however, a system of double and cross entries, provided with doors, curtains, &c., for causing the current to traverse the longest possible course through the works before reaching the furnace or steam-jet. If the works are extensive, this mode becomes very complicated, cumbersome, and expensive. The main objection to this system is that it will not remove "fire-damp" (carbureted-hydrogen gases) or "black-damp," (carbonic-acid gas,) both of which prove so fatal to human life, and produce casualties of frequent occurrence. One of these gases, being lighter than atmospheric air, collects in the highest, the other, being heavier, in the lowest, places of the mines.

My apparatus is mainly designed for the purpose of removing these gases, which can only be effected by means of strong currents of air applied directly in the particular localities where they accumulate. This I accomplish by exhausting the gases with an apparatus controlled entirely from the outside. The exhaustion is produced by the creation of a partial vacuum in a properly-constructed chamber above ground. A spiral exhausting-fan revolves in close proximity to this chamber, from which air-tight tubes extend down through the shaft and along the galleries or entries to branch pipes and receivers at the extreme portions of the works.

In the accompanying drawing, Figure 1, Sheet 1, represents a plan view of my improved ventilating apparatus, as applied to the air-shaft of a mine, the dotted lines indicating the main tube connections with the entries; Fig. 2, Sheet 2, a longitudinal sectional side elevation of the apparatus; Fig. 3, an end elevation of a main tube with connecting branch pipes; Fig. 4, a detail vertical transverse section of the valve-frame; Fig. 5, Sheet 3, a detail vertical section of the branch pipes; Fig. 6, a detail section of the connection of one of the branch pipes with the flexible removable tube; and Fig. 7, a side elevation of the apparatus above ground and the arrangement of flexible tube in a low-roofed entry in connection with a gallery from which the mineral has been extracted.

Similar letters of reference indicate corresponding parts.

A A represent a frame of wood, which supports the engine and machinery for driving the spiral exhausting-fan. The steam is obtained from the large boilers connected with the hoisting apparatus, so that no additional outlay for the boiler is required. B B is another frame, which is placed immediately over the air-shaft C, Figs. 1 and 7. Frame B carries the valve-frame D, which is of cast-iron, and forms the bottom of the chamber E, in which the air is rarefied. The under side of the frame D is divided into four separate compartments, D′, into which the upper ends of the four main tubes F terminate. The four sliding valves D^2 open and close the compartments D^1 and regulate the connection between the main air-tubes and the chamber E. The frames A and B are firmly connected and braced for supporting these parts. A horizontal top piece, *a*, serves to hold the chamber E firmly on valve-frame D, which is cast in two parts, as shown in Fig. 4, the upper part being embedded and bolted to the lower. The valves D^2 slide between them, and require to be nicely fitted, so as to move freely in and out by hand. The engine is connected by driving-belts in the usual manner with the fan-shaft, the fan G being revolved thereby just outside of the circular side opening *o* of the chamber E, the diameter of the fan being a little larger than that of the opening. A mercurial gage, *b*, of chamber E indicates the amount of exhaustion therein

from which the velocity of the air through the tubes can be computed. The main tubes F pass in vertical direction, from the valve-frame D, through the air-shaft, to the bottom of the same, being made of wood and in suitable lengths, the joints being secured by the boxes *d d*, Fig. 2, also of wood. These boxes are strengthened by iron bands or hoops, as shown, and fitted closely around the joints. The tubes F are kept sufficiently apart to admit those boxes, wooden pieces d' being interposed for this purpose between them. Stouter pieces d^2 are applied to the outside of the tubes, and connected by cross-bolts d^3 for binding the tubes firmly together, as shown in Fig. 2. At proper intervals, as the column is built up, the pieces d^2 and d^3 extend beyond the tubes, so as to rest on cross-pieces *e*, which are supported on brackets e^1 spiked firmly to the timber lining of the shaft. By means of the inverted brackets e^2, fastened to tubes and seated on pieces d^3, the tubes are relieved of the excessive pressure that might otherwise crush the wood at the joints. The cross-pieces *e* also act as lateral stays, and keep the column perfectly plumb. The lowermost parts of the main tubes F are firmly jointed to quadrantal elbows F^1, which are supported and rigidly secured on a strong bridge, H, Fig. 2, erected at the bottom of the air-shaft. The elbows F^1 are made of cast-iron, with horizontal and vertical flanges, which connect with the convex sides by webs. The four elbows are firmly bolted together through the webs and vertical flanges, and form a solid and substantial base for the tube column. From the outer ends of the elbows the main tubes take horizontal courses and extend through the main entries, as shown in Figs. 2, 3, and 7, the mineral being cut away for the tubes to pass around and back of the lining of the shaft. The main tubes are made either of circular shape and laid below the bottom of the entry, which is to be preferred for "low-roofed mines," or are placed overhead, being of wood and of square or oblong cross-section, according to the height of the entry, which is the preferable mode for "high-roofed mines." In the latter case the tubes are supported on suitable cross-pieces overhead, which are let into the side walls. The vertical branch pipes L are in both cases connected with the main tubes by intermediate tubes L^1, and are placed into recesses cut into the side walls of the entries, so as to be entirely out of the way. Each branch pipe L has two bell-shaped receivers, L^2, one at the upper end to take in the light gas, (fire-damp,) and the other at the lower end to take in the heavy gas (black-damp.) Each receiver L^2 is provided with an eccentric valve, *f*, which can be opened and closed by hand, as required. When these valves are closed the external pressure keeps them perfectly air-tight. To these branch pipes are also attached alarm-telegraph boxes *g g*, which are connected to the surface by properly-insulated wires, by means of which signals may be sent to the man at the engine when necessary. The circular air-tubes set into the floor may be of cast-iron, or ordinary drain-tiles may be used, but the part to which the branch pipe is attached should be of iron. The joints are inclosed in movable circular bands, and calked in the usual manner. These mains are laid on a porous bed of gravel or other suitable material for drawing off the collecting moisture to the pumps. The extreme ends of all the main tubes and of the sub-mains below ground are provided with stop-valves *h*, Figs. 2 and 3. These valves are so balanced by the weights h^1 attached to them by pivoted levers h^2 that they retain their position when closed with a moderate pressure. This pressure is augmented, however, by the external pressure of the air when that in the tubes is rarefied, but, by the reversal of the fan and the forcing of air into the tubes, especially when one at the time only is exposed to the draft, the interior pressure acts on the valves and overcomes the counterpoise of the weight h^1, which then falls into the position indicated in Fig. 2, and throws the valve completely open. When the valves are all open the motion of the fan is reversed, and the gases and foul air are drawn out in the usual manner.

It will be found in practice that the gage will indicate with tolerable accuracy when the stop-valves *h* are open, but, to make it absolutely certain, the falling weight may be made to close a galvanic circuit, the wires of which connect with a galvanometer on the surface. This gives an undoubtable assurance that a thorough ventilation through all the valves is produced.

A flexible tube, M, Fig. 7, made of any suitable material and size, is attached to the upper end of the branch pipe L, the receiver being removed and the tube inserted, to be attached firmly by suitable catch-springs, that hold it to its place. The tube M passes into the newly-excavated space through a channel cut in the roof, and rests on suitable cross-pieces spiked to the props that support the roof of the mine, the extreme end resting on a movable tripod. This flexible tube is mainly designed for the purpose of removing the powder-smoke quickly after blasting, as the sulphurous smoke, when confined within so small a place, renders the air both unwholesome and unpleasant. One tube is sufficient for about three rooms by placing it in the central one, and cutting occasionally through the partition walls into the adjoining rooms for letting the smoke pass out.

The fan may be used either for forcing air into the mine or for drawing out or exhausting the same. The latter gives, in reality, the best ventilation, from the fact that when the impure gases are drawn off by the powerful suction of the fan, the entire space below becomes filled with pure air from the surface, whereas air forced in by compression cannot drive out the heavy gases, and can only partially remove the light gases, which would still leave the mines in constant danger of explo-

sion. By this apparatus the whole system of double entries and special air-courses can be dispensed with, as the main tubes become the course for the return current. These main tubes require only the ordinary entries or passage-ways necessary to open up the works and carry off the mineral, they being so placed as not to interfere with the regular business of the mine.

In some mines the air-shaft and pumps are placed over one of the main entries, at some distance from the hoisting-way. In such cases the bridge, and that part of the apparatus above the same, are placed in the air-shaft, as before described, and three of the horizontal main tubes are brought forward together toward the intersection of the main entries, where they are distributed each to its own entry, keeping back of the timbers and out of the way, as in the former case. The remaining tube is extended in the direction opposite to the others, through the entry in which the shaft is sunk.

The machinery required by this method of ventilation is very simple, and all the portions likely to get out of repair are above ground, and constantly under supervision. The first outlay is very small in comparison to the value and importance of the object gained, being the perfectly safe and healthy condition of the mine without the slightest risk of endangering human life.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination of revolving fan G and valves D with the lower weighted-end valves *h* of the main tubes, for producing the automatic opening of the same by the forcing in of the air, as described.

2. The combination, with the branch pipe L, of a flexible movable tube, M, for exhausting the smoke and other gases in newly-opened parts of the mine, in the manner specified.

FRANCIS MURPHY.

Witnesses:

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