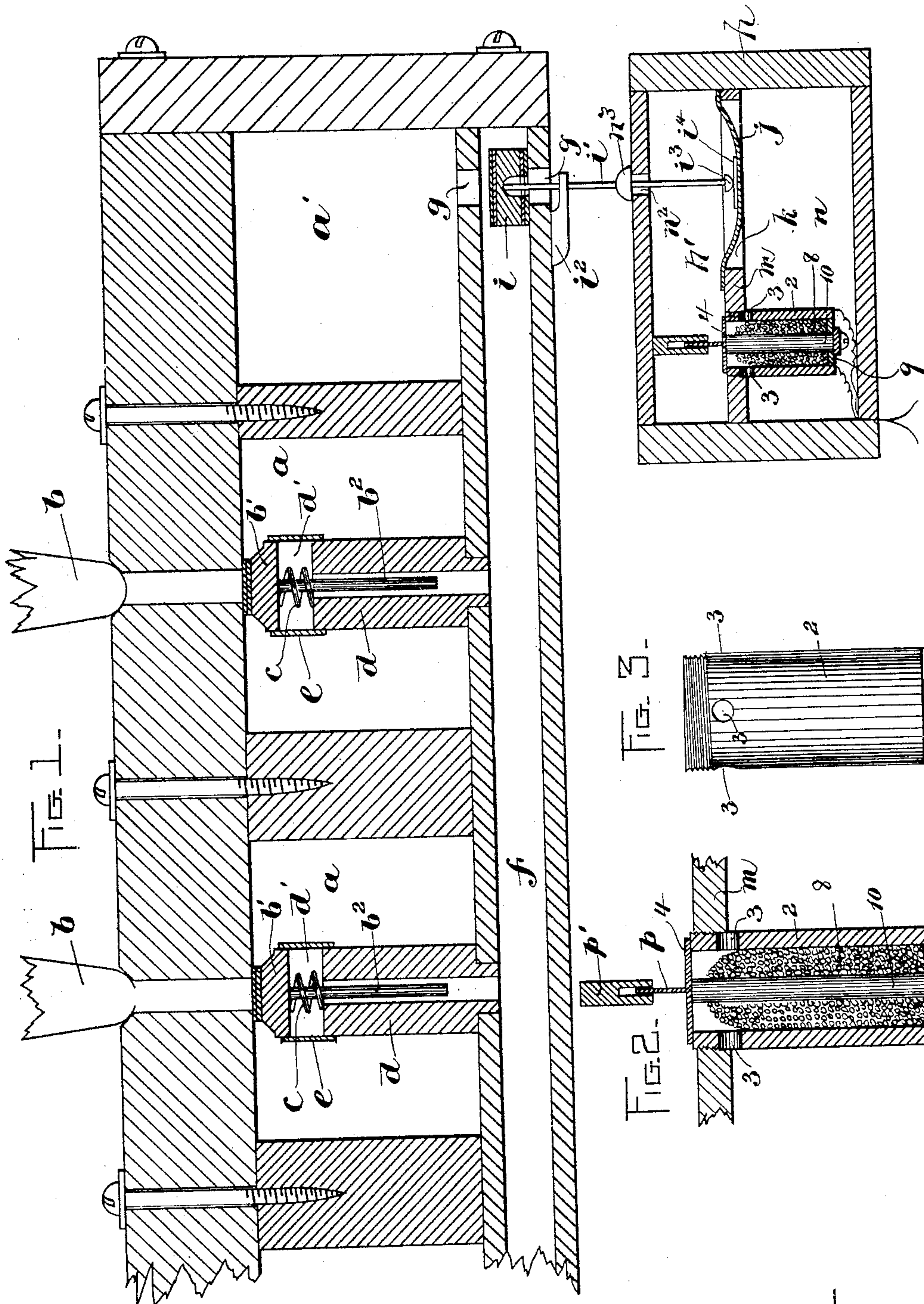


(No Model.)

F. H. HASTINGS & F. J. FLAHERTY.
ELECTROPNEUMATIC ORGAN ACTION.

No. 578,925.

Patented Mar. 16, 1897.



WITNESSES:
A. D. Hanson.
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UNITED STATES PATENT OFFICE.

FRANCIS H. HASTINGS AND FREDERICK J. FLAHERTY, OF WESTON, MASSACHUSETTS, ASSIGNORS TO THE HOOK & HASTINGS COMPANY, OF SAME PLACE.

ELECTROPNEUMATIC ORGAN-ACTION.

SPECIFICATION forming part of Letters Patent No. 578,925, dated March 16, 1897.

Application filed March 12, 1896. Serial No. 582,848. (No model.)

To all whom it may concern:

Be it known that we, FRANCIS H. HASTINGS and FREDERICK J. FLAHERTY, of Weston, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Pipe-Organs, of which the following is a specification.

This invention relates chiefly to pipe-organs, and the object is to provide a simple and effective electrically-controlled valve for use in a so-called "electropneumatic organ-action," the admission of air to the pipes of the organ being brought about by the closing of electric circuits by manipulation of the keys of the organ. Such an action is chiefly advantageous in providing for quick response by the pipes of the organ to the action of its keys; especially when the latter are unusually remote from the pipes, very slight and easy movement of the keys being sufficient to produce the desired result.

The invention consists in the improvements which will be found recited in the appended claims.

The drawings which accompany and form part of this specification illustrate an embodiment of the invention, especially as applied in the electropneumatic form.

Figure 1 shows a sectional view of a sufficient portion of an organ to illustrate the invention. Fig. 2 shows an enlarged view of the electrically-controlled valve detached. Fig. 3 shows a side view of the casing of the electromagnet.

The same letters and numerals of reference indicate the same parts in all the figures.

In the drawings the letter *a* designates a stop-chamber in a wind-chest, from which rises an organ-pipe *b*, said chamber being supplied with "live" air, or air under pressure, from the bellows. Within the stop-chamber there is arranged a valve *b'*, normally closing the lower end of said pipe where it enters the chamber and presses against its seat by a light spiral spring *c*, interposed between its back and the upper end of a stand-pipe *d*. The space between the back of the valve and the top of said stand-pipe forms an air-chamber *d'*, which is separated from the chamber *a* by a flexible wall *e* of leather or other suitable material in the form of a band fastened to the valve and to the stand-

pipe. The valve is preferably provided with a stem *b²*, which extends down into the stand-pipe for guiding purposes.

The interior of the stand-pipe forms a channel or windway *d²*, providing communication between the chamber *d'* and the main windway *f*, which extends across the wind-chest along a number of stop-chambers similar to that marked *a*, and at one end may communicate with the atmosphere through a port *g*, and through another port *g'*, opposite the latter, with a live-air chamber *a'*. A double-faced valve *i* is placed in the windway *f* between the two ports and normally rests by its own weight upon the bottom of the windway, closing the exhaust-port *g* and opening the other port *g'*, so that live-air pressure from the chamber *a* reaches the chamber *d'* through the windways *f* and *d²* and supplements the spring *c* in holding up the valve *b'*.

A tappet rod or stem *i'* is loosely engaged at its upper end with a socket in the under side of the valve *i*, and passes through a suitable guide *i²*, and near its lower end carries a nut *i³*, which rests upon a bearing-plate *i⁴* on a diaphragm *j*. The diaphragm *j* is affixed to a partition *m* in the casing *h* and covers an orifice *k* in said partition, the diaphragm and partition subdividing the casing *h* into two chambers *n* and *n'*, the chamber *n* being common to all notes of the series and being supplied with live air from the bellows, while the chamber *n'* is again subdivided into chambers, one for each note, each having an air outlet or vent *n²* which is closed by a valve *n³* on the rod *i'*, when the diaphragm is depressed by the weight of the valve *i* and rod *i'* and its connections.

A passage is provided through the partition *m*, and a valve 4 is arranged to either close said passage or permit the passage of live air through it, said valve being controlled by a key of the organ, so that when the key is depressed by the organist the said passage is closed, the pressure above the diaphragm in chamber *n'* is relieved, (provision being made for a slight leakage in the valve *n³*,) and the live-air pressure in the chamber *n* raises the diaphragm, and with it the stem *i'*, which is thus caused to open the exhaust-port *n²* and the port *g* and close the port *g'*. Air is therefore permitted to escape from the cham-

bers d' , and the valves b' are opened by the live-air pressure on the external surfaces of the flexible walls e . When the key is released, the valve 4 becomes loose, so that live
 5 air may pass freely from the chamber n to the chamber n' , equalizing the pressure in said chambers and permitting the diaphragm to fall, so that the valve i closes the port g' and opens the port g' , while the valve n^3 closes
 10 the exhaust-port n^2 , whereupon the live air enters the chambers d' and assists in closing the valves b' .

The improvements above described, relating to the valves b' and i , are set forth and
 15 claimed in the application of Francis H. Hastings, one of the present applicants, filed concurrently herewith.

Our invention relates to the electrically-controlled means next described for holding and
 20 releasing the valve 4. Said means include an electromagnet of which the valve 4 is the armature, said valve being a thin disk of soft iron. The magnet comprises a tubular casing 2, of soft iron, screw-threaded at one end to
 25 engage the surface of a hole formed for its reception in the partition m and provided with orifices 3 3, arranged to conduct air from the chamber n through the open end of the casing 2, the latter opening into the chamber n' .
 30 The casing 2 contains a helix 8 and a core 10, which is secured to the casing by a cross-bar 9, the helix being included in a circuit adapted to be closed by the depression of a key. The upper end of the casing is flush with the
 35 upper end of the core, so that the armature-valve 4 rests simultaneously on the casing and core, the casing constituting a part of the magnet and serving also as a seat for the valve. When the magnet is energized, the
 40 armature-valve is held firmly closed by both the casing and the core, and when the magnet is demagnetized the valve rests lightly and loosely on its seat and yields quickly to any excess of pressure on its under side, so
 45 that an equilibrium of pressure is immediately established in the chambers n n' , with the result above described.

It will be seen that the valve is not required to control both the supply and the ex-
 50 haust to operate the diaphragm and that it lies loosely against an electromagnetic seat, so that it has practically no distance to move when the electromagnet is energized. Hence it operates instantaneously and with great
 55 precision and certainty and requires only a light electric current.

The magnet and its armature-valve may be applied to control either the supply or the ex-
 60 haust air and may be used in various other ways and relations without departing from the spirit of our invention.

In place of a diaphragm a small bellows or other equivalent device may be employed to be operated by the air-pressure, as a pneu-
 65 matic motor.

The armature-valve may be guided in its movements and kept in its operative relation

to the magnet by any suitable means, such as a pin p , affixed to the valve and movable in a fixed guide p' .

The method of attaching the magnet by a screw-thread and other details of construction here specified are not essential to the embodiment and use of our invention, there being various other methods to effect the same
 75 result without departure from the spirit of our invention.

We claim—

1. In an apparatus of the character specified, an electromagnet comprising a tubular
 80 casing constructed to form a wind-passage between two chambers, a core and helix within said casing, and a loose armature formed as a valve adapted to close said wind-passage when the magnet is energized and to permit
 85 the movement of air in one direction there-through when the magnet is demagnetized, the said armature-valve arranged to rest by gravity in closing position against the end of the casing and core.

2. In an apparatus of the character specified, the combination of a live-air chamber, a chamber separated therefrom by a partition having an air-passage, a loose armature-valve
 90 formed to close said passage, and arranged to rest by gravity in closing position and an electromagnet arranged to attract said valve and hold it in position to close said passage.

3. In an apparatus of the character specified, the combination of a live-air chamber, a chamber separated therefrom by a partition having an air-passage, a loose armature-valve
 100 formed to close said passage, an electromagnet arranged to attract said valve and hold it in position to close said passage, a pneumatic motor adapted to be operated by air-pressure when the valve is attracted by the magnet, and a valve closing the exhaust-port of the said second-named chamber and adapted to be opened by the operation of
 110 said motor.

4. In an apparatus of the character specified, the combination of a live-air chamber, a chamber having an exhaust-port and separated from the live-air chamber by a parti-
 115 tion having an air-passage, an electromagnet having a tubular casing inserted in said passage, a loose armature formed as a valve adapted to close the passage, a diaphragm arranged to be moved by pressure in the live-air chamber when the valve is closed, an operating-rod connected with said diaphragm, and an exhaust-valve on said rod which closes the said exhaust-port when the diaphragm is depressed.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 15th day of February, A. D. 1896.

FRANCIS H. HASTINGS.

FREDERICK J. FLAHERTY.

Witnesses:

C. F. BROWN,

A. D. HARRISON.