

No. 693,488.

Patented Feb. 18, 1902.

T. BOYD.

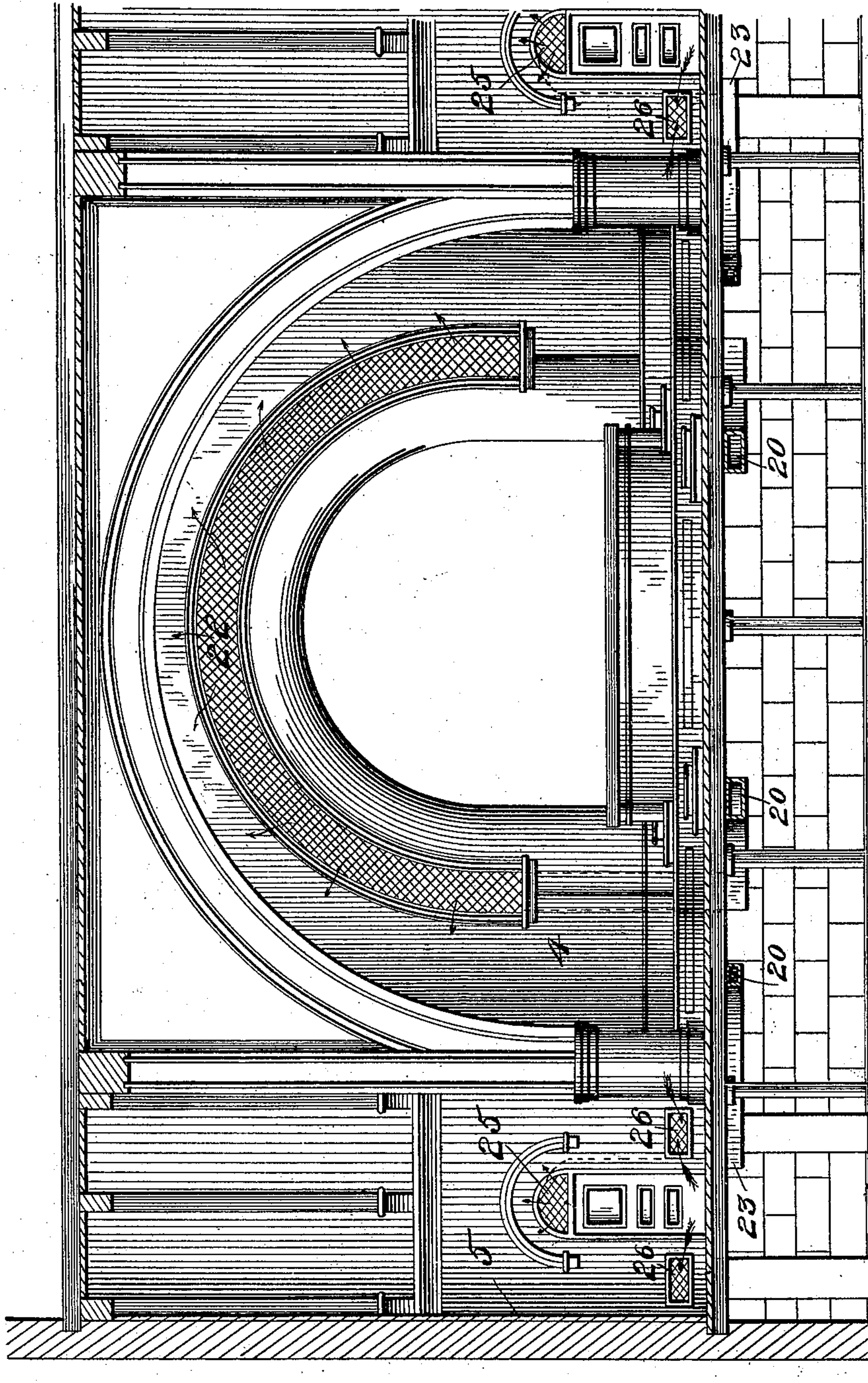
MEANS FOR REFLECTING AND DISTRIBUTING SOUND AND VENTILATING AUDITORIUMS

(Application filed Sept. 11, 1901.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.



Witnesses:

C. C. Duffy
C. Hugh Duffy

Inventor
Thomas Boyd.

per *C. C. Duffy* ATT'Y.

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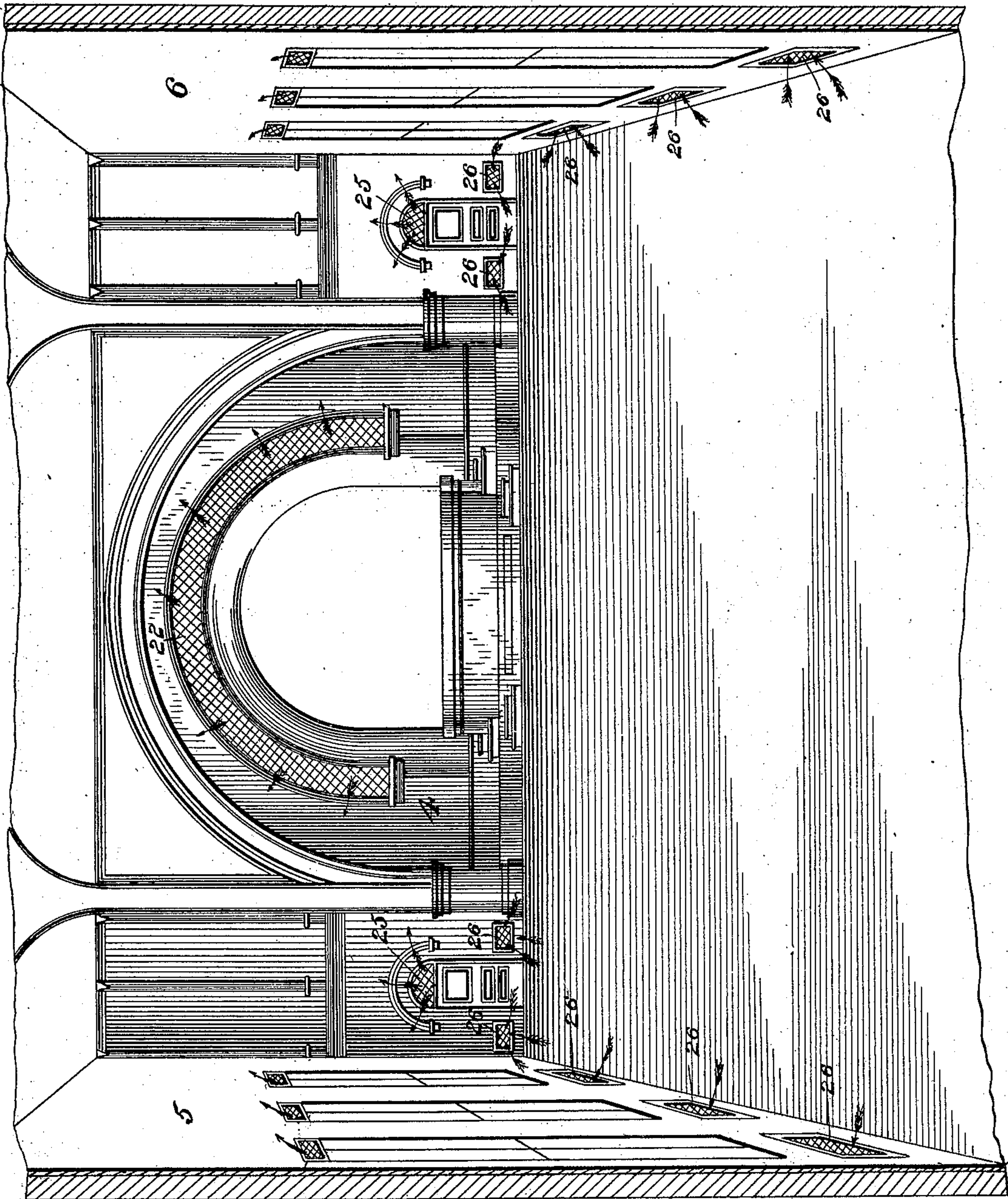


Fig. 2.

Witnesses:

E. E. Duffy

C. H. Duffy

per

Inventor
Thomas Boyd,

E. E. Duffy

Att'y.

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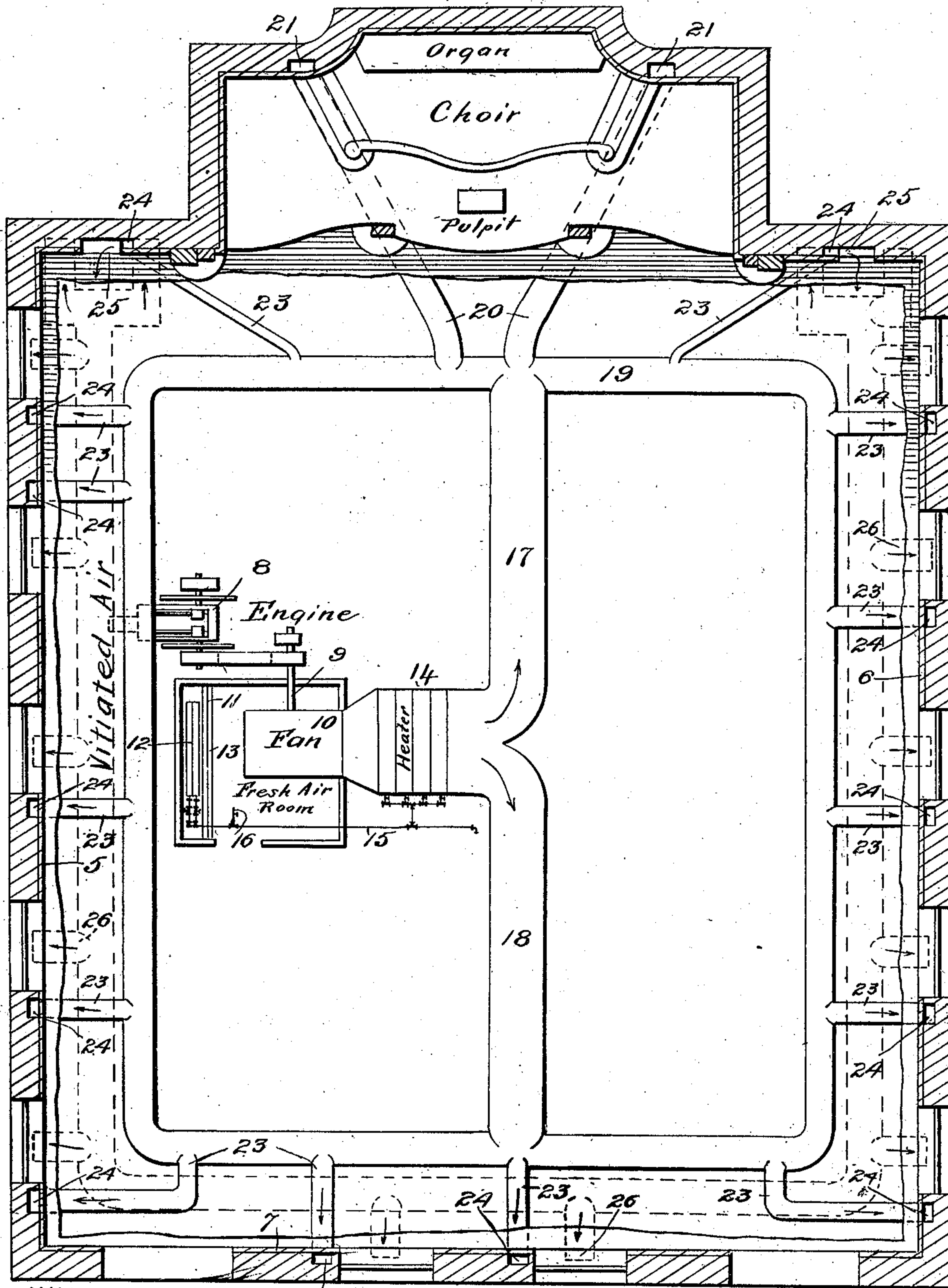
T. BOYD.

MEANS FOR REFLECTING AND DISTRIBUTING SOUND AND VENTILATING AUDITORIUMS.

(Application filed Sept. 11, 1901.)

(No Model.)

3 Sheets—Sheet 3.



Witnesses:

24 Fig. 3.

Inventor

Thomas Boyd,

C. E. Duffy

C. Hugh Duffy

per C. E. Duffy

UNITED STATES PATENT OFFICE.

THOMAS BOYD, OF PITTSBURG, PENNSYLVANIA.

MEANS FOR REFLECTING AND DISTRIBUTING SOUND AND VENTILATING AUDITORIUMS.

SPECIFICATION forming part of Letters Patent No. 693,488, dated February 18, 1902.

Application filed September 11, 1901. Serial No. 75,096. (No model.)

To all whom it may concern:

Be it known that I, THOMAS BOYD, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Means for Reflecting and Distributing Sound and Ventilating Auditoriums; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the acoustics and ventilation of churches, halls, and auditoriums in general.

Experience has demonstrated that all walls of audience-rooms vibrate with every sound, and to the varying of the extent of such vibrations the success or failure of the acoustics of the room is due. The three principal defects met with in the acoustics of public halls are dispersion, resonance, and echo. The first is met with in large lofty buildings, a greater or less proportion of the sound-waves being dispersed or swallowed up among the rafters, arches, galleries, and transepts, leaving only a small portion to reach the ears of the people in the body of the hall. Resonance is encountered in domed and vaulted buildings, empty houses, and tunnels with hard solid walls and ceilings and is often combined with echo, with which it should not be confounded, although the two are seldom, if ever, found apart. Echo or reproduction of sound, the third and most serious defect, is the arrest and throwing back of sound-waves from walls, ceilings, and other solid surfaces, causing a clashing interference with the sounds, destroying the audibility of a speaker or singer, and giving rise to discords and false combination called "woolliness of outline."

The object of the present invention is to overcome the defects hereinbefore enumerated and to take advantage of the availability of water as a conductor of sound, and in experimenting to carry out this object I have learned by actual experiment that forming a wall in an auditorium with hard solid plaster near the source of the sound made by a speaker or musical instrument will intensify the original sound many times and will not interfere with the original sound, the

sound being carried on the air. Walls plastered with soft material—such as wood fiber, wood sawdust, cork, asbestos fiber, and the like—will absorb the original sound and will prevent resonance or echo from being carried forward, so as to conflict with the original sound, allowing only the original sound to be carried through the audience-room. I have found that a wall having a hard solid surface will vibrate and reproduce the original sound striking against it, throwing it back in the form of echo. I have also found by experiment that a wall having a soft resilient surface will absorb all sounds striking against it, and therefore all walls close to the speaker or source of sound should be made hard and solid, while all other walls, ceilings, domes, and transepts should be made soft and flexible, so as to absorb the original sound and prevent echo, and that air is only a conductor of sound, and therefore if the air is brought in at or near the source of sound and carried back and drawn down over the audience the sound will be much clearer and stronger than if the air was moving in the opposite direction.

With all these objects and discoveries in view my invention consists in the improved means and apparatus or constructions herein-after fully described, and afterward particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a transverse vertical sectional view of an auditorium, the upper portion being broken away and the end of the room with the rostrum being shown in elevation. Fig. 2 is a perspective view of the interior from a somewhat elevated central position in the rear of the room, the side walls being shown in section. Fig. 3 is a horizontal sectional view on the plane indicated by the broken line 3 3 of Fig. 1, the main floor being broken out to show the basement or cellar in plan.

Like numerals of reference mark the same parts wherever they appear in the several figures of the drawings.

Referring to the drawings by numerals, 4 indicates the end of the room in which the rostrum or pulpit is located, the wall being plastered with hard rock-plaster, while the sides 5 and 6 and back wall 7 are plastered with wood sawdust and a soft flexible mortar.

The hard plaster will reflect or throw the sound-waves toward the audience in the room, while the soft plaster of the sides and rear walls will absorb them and prevent resonance or echo.

8 indicates an engine or motor of any description designed to propel a fan mounted on a shaft 9 and inclosed in a casing 10. The fan is located in a fresh-air room 11, supplied from any suitable source, such air passing over preliminary heaters 12 and through saturated screens 13 before reaching the fan. From the fan the air is forced over heaters 14, in this instance shown as radiators supplied from steam-pipe 15, leading from a boiler, (not shown,) the pipe passing through room 11 to supply steam to preliminary heaters 12 and being provided with a jet-cock 16 in the fresh-air room. By permitting a jet of steam to escape through cock 16 into room 14 the air may be thoroughly moistened before being distributed by the fan. From the heaters 14 the air passes through conduits 17 18 into a large pipe or conduit 19, extending around the room, (basement or cellar,) from which branches 20 20 lead to conduits 21 21 in the end 4 of the room, said conduits discharging into the room by means of registers 22, located in a semicircle above the pulpit, rostrum, or organ. Other branches 23 from pipe 19 lead into vertical conduits 24 in the side and rear walls, said conduits discharging into the room through elevated registers 25 in said walls.

The foregoing is a description of means whereby my invention may be carried out so far as supplying an auditorium with suitable plaster and discharging moist air into the room from all sides above the heads of the audience; but I desire it to be understood that the specific construction and arrangement shown and described is not absolutely essential so long as the broad principles of the invention are adhered to, it being possible to vary the construction and arrangement of parts indefinitely, according to the tastes and desires of the architect or builder.

Air having been forced into the room on all sides from elevated registers or inlets, the sound-waves will be accelerated and caused to be thrown down in the center of the room, from whence the vitiated air will pass out through registers 26 near the floor into suitable conduits leading to the open air through a chimney or stack, if desired. The air mingled with aqueous vapor upon being forced into the room from elevated registers will on account of the moisture be a much better conductor of sound than dry air, and as the moisture will to a certain extent be condensed the air will fall down upon the central part of the audience, thus carrying the sound produced by a speaker, singer, or musical instrument to be delivered in full force in the center of the room, a point where the acoustics of auditoriums are generally most defective. The currents of air are indicated as far as possible by means of arrows, the di-

rection of entrance and exit being thus pointed out. By means of the hard plaster behind the rostrum and on each side thereof the original sound is intensified and not absorbed. The soft plaster on the side and rear walls, on the contrary, will absorb the original sound, preventing resonance and echo and allowing no reproduction or rebounding of the original sound-waves. The air-currents accelerate and control the movement of the sound-waves, and by my arrangement of currents the sound is carried over the audience and drawn down upon it, thus making the sound much clearer and louder, the hard walls vibrating, thereby reflecting the original sound, the soft walls absorbing the sound and preventing resonance and echo, the air-currents maintaining the intensity of the sound and the aqueous vapor increasing its velocity.

Although I have shown means for heating the air prior to its introduction into the auditorium, it will be obvious that cooling devices might be substituted for the heating devices or the air may be introduced without either heating or cooling.

I desire it to be understood also that I do not confine myself to the exact means for moistening the air, as various other means might be used for accomplishing this purpose.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an auditorium the combination of a stage or pulpit, as a location for a source of sound, openings above such location, means for producing a forced current of air and aqueous vapor, conduits connecting such means with the openings, and openings for withdrawing vitiated air from the auditorium near the floor, substantially as described.

2. In an auditorium, the combination of a stage or pulpit for the location of a source of sound, openings above such location, means for producing a forced current of warm air and aqueous vapor, conduits connecting such means with the openings, and openings for withdrawing vitiated air from the auditorium near the floor, substantially as described.

3. In an auditorium, the combination of a stage or pulpit for the location of a source of sound, hard walls, located behind said source of sound, openings above said source of sound, means for producing a forced current of air and aqueous vapor, conduits connecting such means with the openings, and openings for withdrawing vitiated air from the auditorium near the floor, and soft walls located in front of and above the source of sound, substantially as described.

4. In an auditorium, the combination of a stage or pulpit for the location of a source of sound, hard walls located behind said source of sound, openings above said source of sound, means for producing a forced current of warm air and aqueous vapor, conduits connecting such means with the openings, and openings for withdrawing vitiated air from the auditorium near the floor, and soft walls

located in front of and above the source of sound, substantially as described.

5 In an auditorium the combination with a rostrum as a location of a source of sound, of hard-surfaced walls for reflecting sound, opposing soft walls for absorbing it, means for forcing currents of air commingled with aqueous vapor into the auditorium in the neighborhood of and above the location of
10 the source of sound, and openings for discharging it near the floor, substantially as described.

6 In an auditorium the combination with a rostrum as a location of a source of sound, of hard-surfaced walls for reflecting sound, opposing soft walls for absorbing it, means for forcing currents of warm air commingled with aqueous vapor into the auditorium in the neighborhood of and above the location
15 of the source of sound, and openings for discharging it near the floor, substantially as described.

7 In an auditorium the combination with a rostrum as a location of sound, of hard-surfaced walls adapted to vibrate and placed be-
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hind the location of the source of sound, opposing soft walls located in front of the location of the source of sound, means for forcing currents of air into the auditorium in the neighborhood of and above the location of the
30 source of sound, and openings for discharging it near the floor, substantially as described.

8 In an auditorium the combination with a rostrum as a location of a source of sound, of hard-surfaced walls adapted to vibrate and
35 placed behind the location of the source of sound, opposing soft walls, located in front of the location of the source of sound, means for forcing currents of warm air into the auditorium in the neighborhood of and above
40 the location of the source of sound, and openings for discharging it near the floor, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

THOMAS BOYD.

Witnesses:

H. T. WATSON,
GEO. E. ALTER.