(No Model.) 7 Sheets—Sheet 1.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

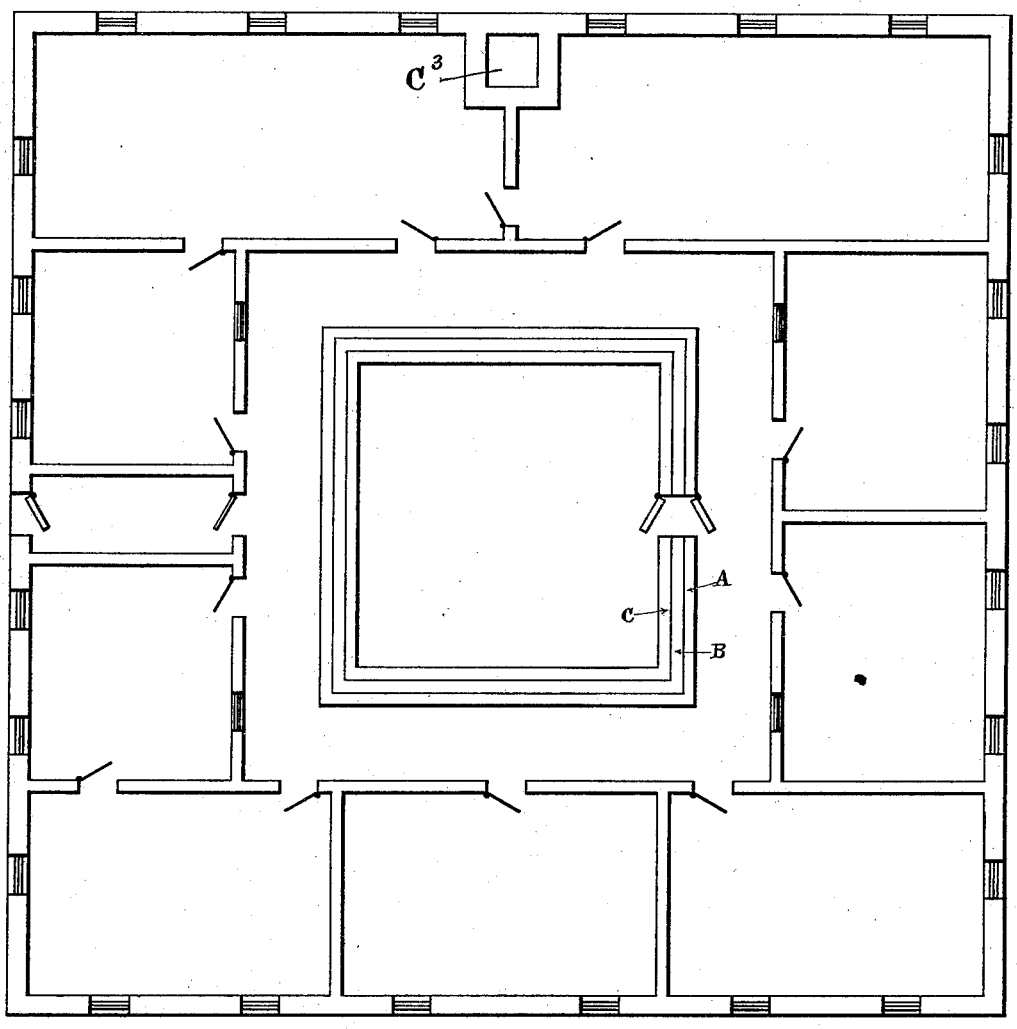


Fig. 1.

Witnesses:
Jacob Kettner
John E. Hall

Inventor:
Saml Darling

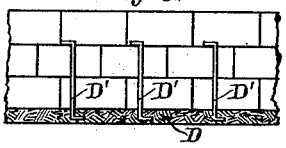
(No Model.) 7 Sheets—Sheet 2.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

Fig. 3.



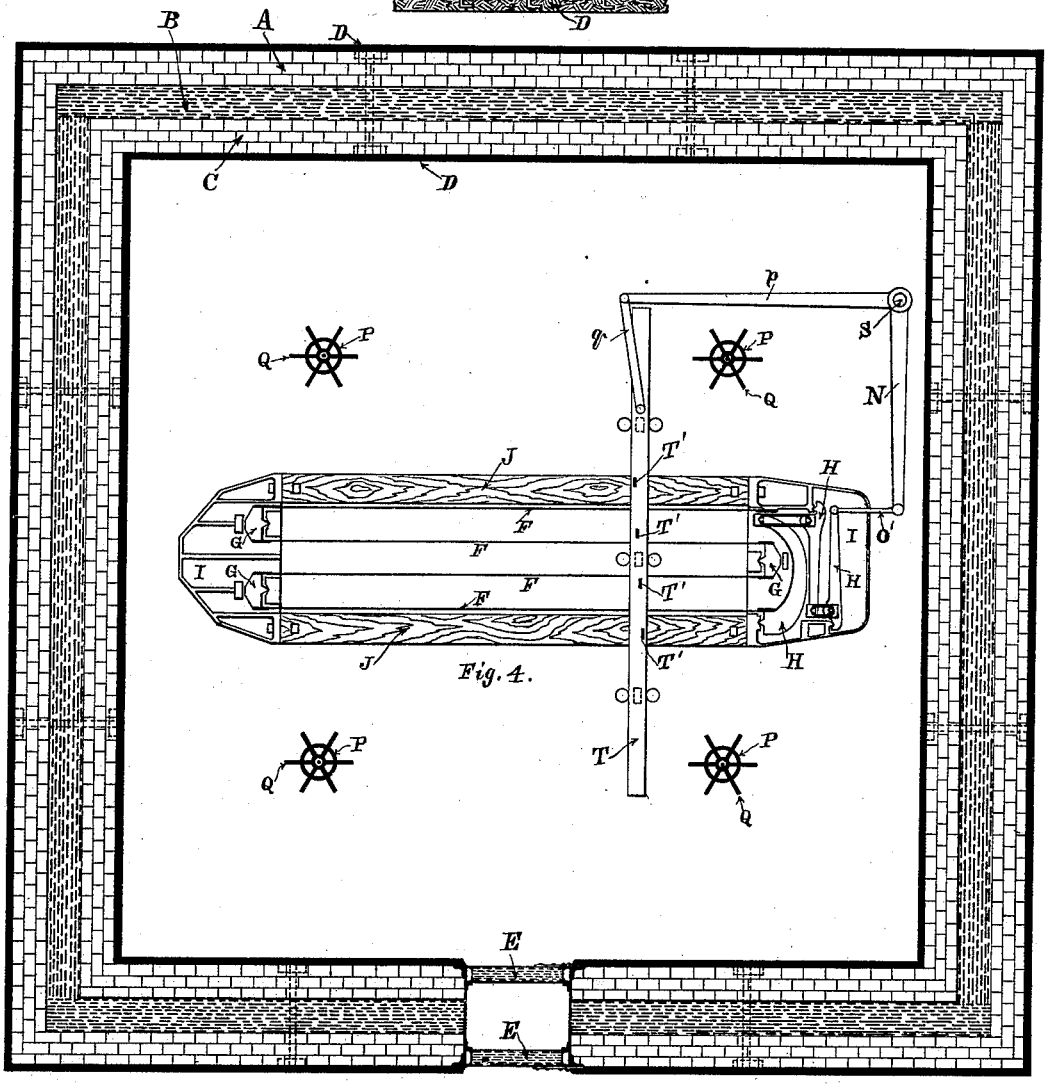


Fig. 2.

Witnesses:
Jacob Kettner.
John E. Hall.

Inventor:
Saml. Darling.

(No Model.) 7 Sheets—Sheet 3.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

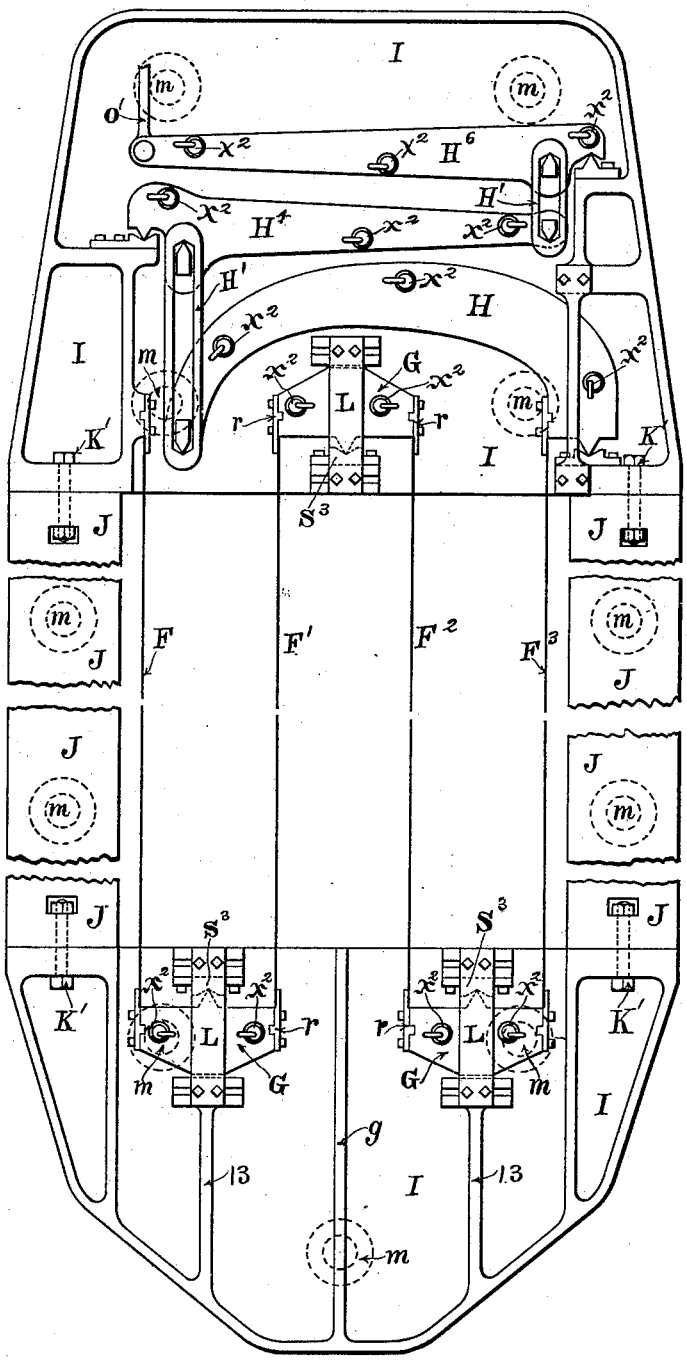


Fig. 5.

Witnesses:
Jacob Kettner
John E. Hall

Inventor:
Sam'l Darling

(No Model.) 7 Sheets—Sheet 4.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

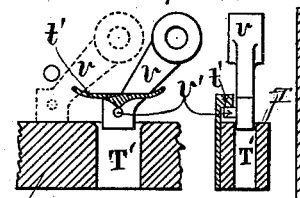


Fig. 7. Fig. 8.

Fig. 6.

Witnesses:
Jacob Kettner
John E. Hall

Inventor:
Sam't Darling

(No Model.) 7 Sheets—Sheet 5.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

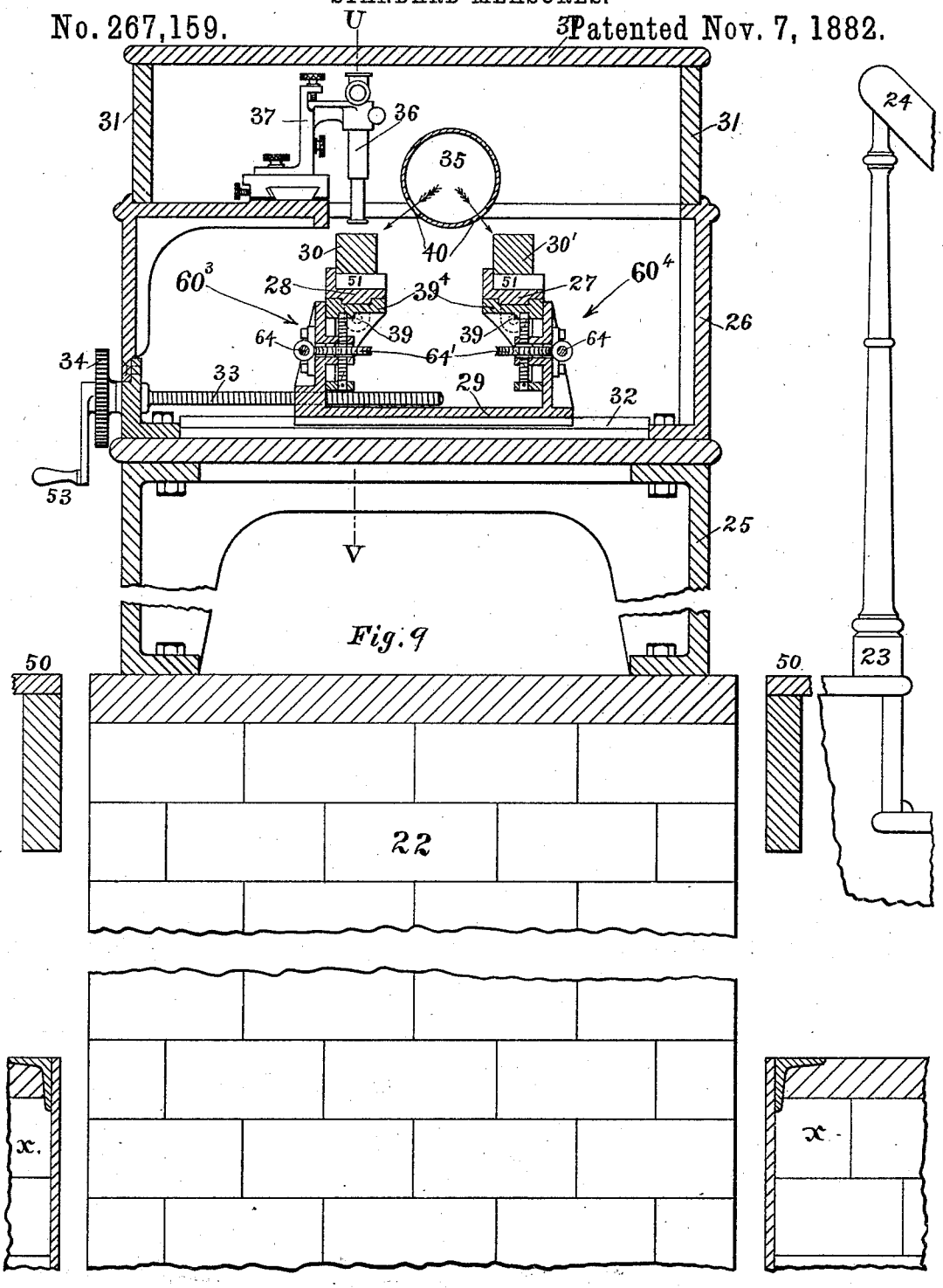


Fig. 9

Witnesses:
Jacob Kettner
Johan E. Hall

Inventor:
Gamt Darling

(No Model.) 7 Sheets—Sheet 6.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

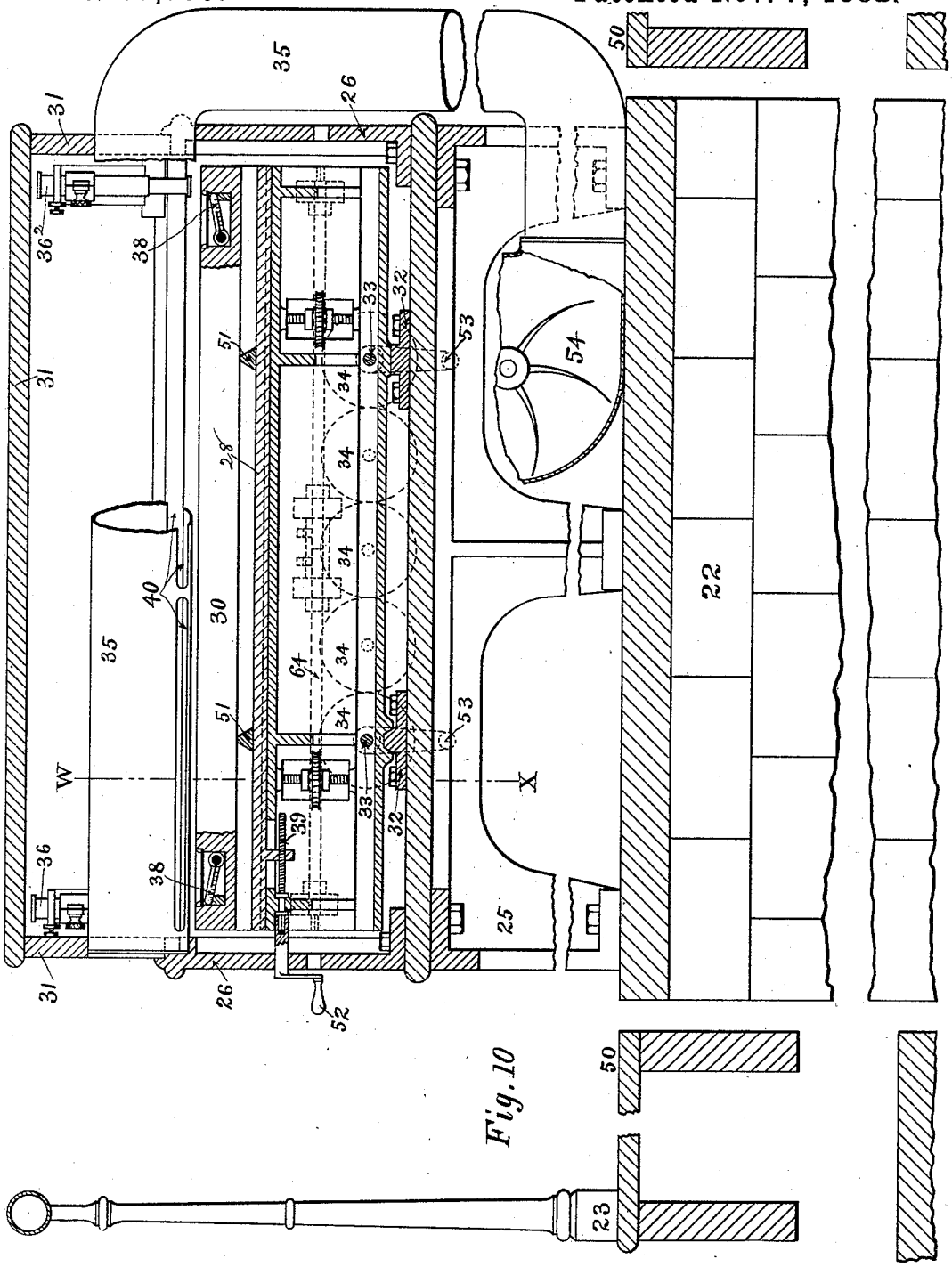


Fig. 10

Witnesses:
Jacob Kettner
John E. Hall

Inventor:
Sam'l Darling

(No Model.) 7 Sheets—Sheet 7.

S. DARLING.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

No. 267,159. Patented Nov. 7, 1882.

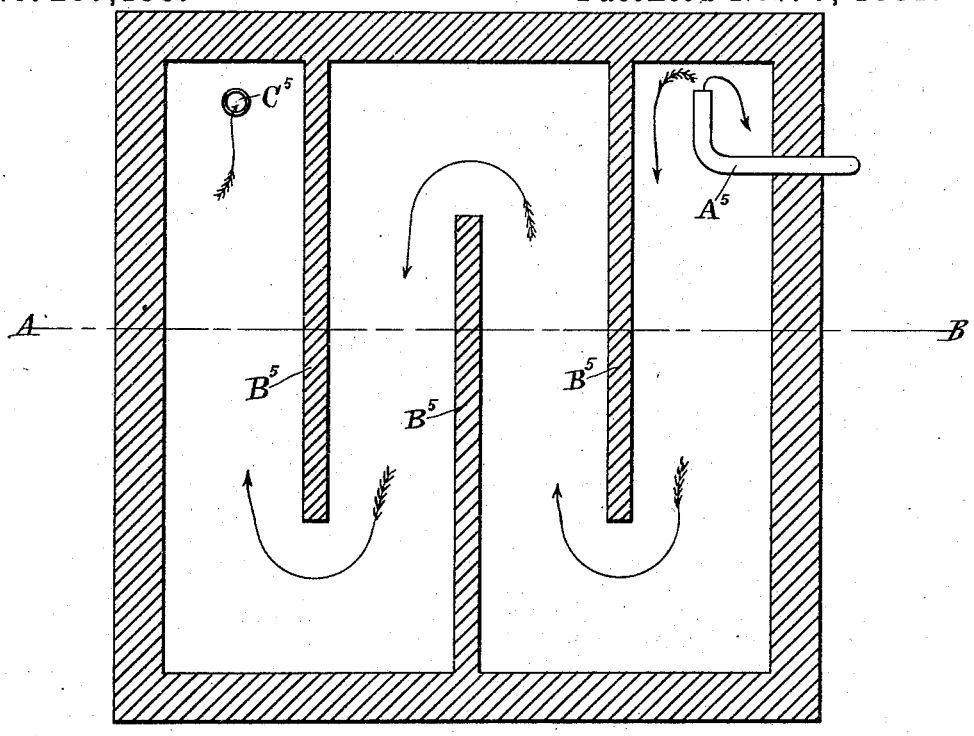


Fig. 11.

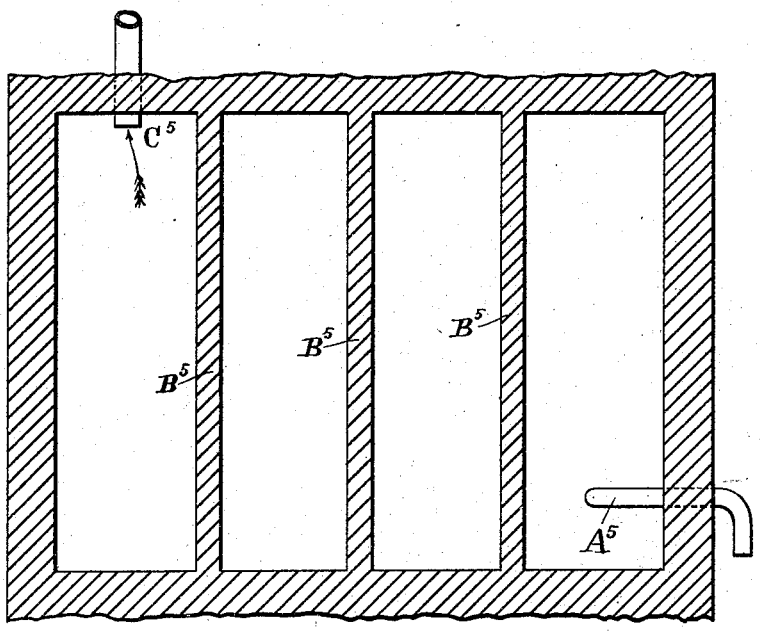


Fig. 12.

Witnesses:
Jacob Kettner
John E. Hall

Inventor:
Saml. Darling

UNITED STATES PATENT OFFICE

SAMUEL DARLING, OF PROVIDENCE, RHODE ISLAND.

BUILDING AND APPARATUS FOR KEEPING AND COMPARING STANDARD MEASURES.

SPECIFICATION forming part of Letters Patent No. 267,159, dated November 7, 1882.

Application filed May 31, 1882. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL DARLING, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented a new and useful improvement in buildings or apartments and in apparatuses to be used in conjunction with them for the purpose of regulating the temperature of the buildings or apartments and the temperature of the articles contained in them, such buildings, apartments, and apparatuses to be used for manufacturing and preserving standard measures of length and comparing them one with another and with other measures, and also for manufacturing, testing, and operating other mathematical instruments and fine machinery requiring great accuracy, of which the following is a specification.

The object of my invention is to so construct and arrange buildings or apartments and apparatuses to be used with the same that their temperature may be automatically or otherwise kept at a specified degree, as nearly as possible, aiming to keep it within one-tenth of a degree; and it consists in constructing a building to be used for offices or other suitable purposes, having an inner room especially arranged to be kept of a uniform temperature, the walls being made of a slow conductor of heat; in making the walls of the inner room in three or more parts, two of these parts being of fire-bricks, or their equivalent, and a space between them filled with dry earth or some very slow conductor of heat; in applying a layer of asbestus or some other slow conductor of heat—as, for instance, hair-felt—to the inside of the inner wall and to the outside of the outer wall, held by thin pieces of metal put into the wall for that purpose, or by other suitable means; in supplying this room with a refrigerator and a heater, the latter to be in the basement, (preferably,) communicating with the room through an opening in the floor, and the former in or near the ceiling of the room; in arranging in this room an apparatus or apparatuses by which the refrigerator and heater can be automatically opened and closed by a change of the temperature of the air in the room, with or without the use of power, and also by which they can be opened and closed by hand; in making an apparatus for opening and closing the refrigerator and heater by attaching thin metallic plates, that will be affected by a slight change of the temperature in the room, to beams and levers having knife-edge pivots; in using two or more thin metal plates with pivoted beams and levers to increase the motion produced by expansion.

It also consists in placing the standard measures and the devices for opening and closing the refrigerator and heater midway between the floor and the ceiling of the room, in the mean temperature of the air; in arranging the metallic plates in a wooden frame that cannot be affected by a change of temperature; in having vertical cylinders in the room, with a wheel at one end of each to produce a rapid circulation of air; in having fan-wheels to throw the air upon the thin sheets of metal when persons are occupying the room or anything is being done to change the temperature.

This invention is designed to meet the wants of national governments, and is also adapted to private use for preserving and testing standard measures of length, and for other purposes herein stated; and I have described and illustrated a building, devices, and arrangements embracing my improvements, with special reference to the wants of general governments.

Although the arrangements and devices herein described are apparently on too large a scale for private use, it is obvious that the invention can be applied and used in a smaller way, either by a government or by private parties. The room for the standards can be made without the surrounding building when that is not needed; but it is evident that having the standard-room in the center of a building must be an important help in regulating its temperature. When the surrounding building (as represented) is not needed there should be a heavy brick wall outside of the standard-room a short distance from it, and the space between may be filled with some non-conductor of heat, and the whole may be surrounded with a wooden building having a space between it and the wall, and arranged for the circulation of the air in warm weather.

The great accuracy now required in our standards, and the use of them in testing other measures, make it necessary for our Govern-

ment to avail itself of the most improved and reliable means within its reach for manufacturing, preserving, and comparing standard measures. It is well known that heating iron or steel red-hot permanently increases its size, and it is reasonable to suppose that the increase will be in proportion to the degree to which it is heated. For example, if a red heat, which is about 1,000°, permanently increases a piece of metal one-millionth of its size, heating it 100° would increase one-tenth of that amount. Whether this be correct theory or not, it would be very difficult to prove the contrary, and the safer way would be to act as if it were true. It is also held that metals are liable in time to undergo a change that affects their size and shape, and, if so, it is evident that such a change, if not caused entirely by great changes of temperature, would be more likely to take place and to a greater degree when the metals are subjected to such variations than it would were the temperature kept nearly at the same degree. Again, a piece of metal placed in a room of a different temperature does not change to the temperature of the room as soon as it has been supposed by many. In fact, according to pure theory, the temperature of the metal and that of the room could not be exactly the same in finite time unless something should change the temperature of the room besides the metal. Of course in time the difference between them would not be an assignable quantity, and practically they would become of the same temperature within a few hours, days, or weeks, according to the size of the article and other circumstances. In view of the above, it is advisable to keep a standard measure of length as nearly as possible at 1° of temperature, to accomplish which is one of the objects of this invention. It is known that 1° of heat increases steel or iron six-millionths of its size and brass ten-millionths, which increase in a steel yard-measure is one four-thousand-two-hundred-and-sixty-ninth ($\frac{1}{4269}$) of an inch, and in one of brass is nearly one two-thousand-seven-hundred-and-seventy-eighth ($\frac{1}{2778}$) of an inch. This effect of heat is the great and ever-present obstacle in the way of manufacturing and testing metallic measures of length and all articles of mechanism requiring great accuracy. The state of perfection now attained in the mechanic arts calls for greater accuracy in standards of length and more reliable means of comparing them one with another. Apparently the time is at hand when we should be able with certainty to divide yard-measures and compare them one with another and with other measures within an error, say, of one twenty-thousandth to one fifty-thousandth of an inch; and to do that the operator must have complete control of the temperature of the machinery and articles to be operated upon. That is the first thing to be provided for—the very foundation to the structure. Any attempt at such accuracy, or any uniformity in comparisons without such control of the temperature, is certain to result in failure, and those who have charge of government standards should beware of any theory or practice that conflicts with these self-evident facts.

Having been engaged in the manufacture of graduated scales for many years, I have become somewhat familiar with the management of our Government standards by the Treasury Department at Washington, and the facilities in possession of that Department for comparing standards one with another, and for testing other measures by them, and while I know the officers in charge of that Department to be eminently qualified for the duties of their office, and that they do as well as it is possible to do with the means at their command, myself and others familiar with the subject have been forced to the conclusion that sufficiently accurate and satisfactory comparisons cannot be made with the means now employed for that purpose. Hence the necessity and importance of the invention under consideration.

In the accompanying drawings I have made the following views of a building and apparatus embracing my improvements, viz:

Figure 1 is a plan of a building divided into different apartments surrounding the inner or standard room. A plan of the latter is shown in the center of this figure. Fig. 2 is a horizontal section of the inner standard-room and of the vertical cylinders and wheels, the plates, beams, and levers for opening and closing the refrigerator being shown in plan within the same, and marked Fig. 4; Fig. 3, horizontal section of a piece of the brick wall with asbestus or some other slow conductor of heat, showing the mode of securing the same to the wall; Fig. 4, top or plan view of the thin plates, beams, and levers for opening and closing the refrigerator and heater; Fig. 5, the same as Fig. 4, on a larger scale, except some small levers attached to the refrigerator; Fig. 6, vertical section of the floor and ceiling of the inner standard-room, refrigerator and heater, upright cylinders, and wheels, and an end view of the apparatus for opening and closing the refrigerator and heater; Fig. 7, vertical longitudinal section of slide and side elevation of arms attached to the shutters of the refrigerator; Fig. 8, cross-section of slide and edge view of one of the shutter-arms; Fig. 9, a vertical cross-section of the table, comparators, standards, wind-pipe, and floor through line W X, Fig. 10, and end elevation of the pier upon which the table rests; Fig. 10, a vertical longitudinal section through line U V of Fig. 9, and side elevation of wind-pipe and fan-wheel for blower; Fig. 11, plan of a room for freeing the air from dust before it enters the standard-room; Fig. 12, a vertical section of the room represented in Fig. 11 through the line A B.

Light may be admitted into the standard-room through a window facing the north, or through the roof and ceiling. The window should be as small as will answer the purpose,

and consist of three or more partitions of glass with a foot (more or less) of space between them, and suitable shutters should be attached to the outside and inside of the room, and kept closed when the room is not in use. The room may be ventilated by having a small opening leading into the chimney and means for admitting a sufficient amount of air into the room. To prevent dust from entering with the air, a room should be provided for the air to pass through sufficiently large for all dust to settle as the air passes through the room, so that no appreciable amount of dust will enter the standard-room.

I describe one method only of automatically opening and closing the refrigerator and heater, with or without power, but am aware that there are other ways by which it can be accomplished. I prefer to use the thin plates, beams, and levers herein described on account of their great durability and certainty of action.

To guard against accident two sets of the apparatus for regulating the temperature of the room should be kept in operation. However carefully the apparatus might be made there would be a possibility of some part getting out of order.

The building and apparatuses which I herein illustrate as one method of applying my improvement consist of a fire-proof building to be used for offices surrounding an inner room in which the standards are to be kept, made independent of the building and especially fire-proof. A plan of the building and standard-room is shown in Fig. 1. The outer building may be made in any of the known ways of constructing first-class fire-proof buildings. The wall of the standard-room as herein represented, Fig. 2, is made in three parts and faced on both sides with asbestus.

The letter A represents the outer and C the inner part of the wall, made of fire-bricks, one foot (more or less) thick; B, the space between the two parts A C, one foot wide and filled with dry earth, ashes, or some other very slow conductor of heat. The parts of the wall A and C are to be connected together by iron bolts to prevent the earth or contents of the space B from forcing them apart. The asbestus D, about two inches thick, is secured to the wall by thin pieces of iron bent at the ends and laid in the wall, as represented in Fig. 3, D′ D′ D′. The asbestus is to be laid on the wall evenly, and painted to make a smooth and neat finish. The floor and ceiling of the standard-room, Fig. 6, are made similar to the walls, being composed of bricks, dry earth, and asbestus. The upper part of the floor may be of any material found to be most desirable, the whole to be supported by iron girders *m′*. The object in making the room in this manner is that its temperature may be as little and slowly affected as possible by the temperature of the air outside of the building, in order that the heating and cooling apparatuses inside of the room may easily control its temperature.

A refrigerator, Y, is made in the ceiling of the room, that the warmest air may come in contact with it, and is so arranged that the air of the room shall not come directly in contact with the ice, to prevent the rusting of articles in the room. The parts O of the refrigerator that are exposed to the air in the room are made of copper, on account of its being a good conductor of heat. The copper will be nearly as cold as the ice. A small room, Z, is made over the refrigerator to protect it from the outside temperature. This small room and the covers *l* are made of a slow conductor of heat. Shutters *u*, made of a non-conductor of heat, are provided for closing the refrigerator to the standard-room. The shutters are attached to shafts, and an arm, *v*, is attached to each shaft, and all are moved by a slide, T, having mortises T′ to receive the end of the arms *v*, and thus move the shutters. When the shutters are fully opened or closed the arms will rest on the slide T. A pin, *v′*, is put into the end of the arm to throw it into the mortise as it passes under the guide *t′*, Figs. 7 and 8.

For warming the air in the standard-room I place a gas-heater, *a*, in the basement, which is connected with two pipes, *b* and *d*, one, *b*, leading up into the room and the other, *d*, into the chimney C^3. (See Fig. 1.) The heater is provided with a damper, *c*, to which is attached an arm, v^2, and slide T^2 for moving it. When the damper is moved to close tube *b*, that leads into the room, tube *d*, that leads into the chimney, is opened.

One method of operating by change of temperature in the standard-room the shutters to the refrigerator and damper in the heater-pipes is to use thin plates of metal attached to pivoted beams and levers. (Shown in Fig. 5.)

The letter I represents cast-iron heads, with elevated portions, to which the beams and levers are attached, and ribs to prevent deflection.

The thin plates F F′ F^2 F^3, I prefer to make of hard rolled copper or an alloy of silver and copper, on account of its great expansion by heat. They should be as thin as possible and have sufficient strength. The plates represented in the drawings are intended to be eight inches wide and twenty-five thousandths of an inch thick. They are made thin, that a slight change of temperature may affect them. The thickness will depend upon the force it takes to overcome the friction of the machinery and upon the elasticity of the plates. The heater is opened and the refrigerator closed by the contraction of these plates in cooling, and the heater is closed and the refrigerator opened by a weight, K, when the plates are expanded by heat. When properly made the friction of the moving parts will be very slight. The knife-edge pivots and the concave surface upon which they bear are to be made of the best cast-steel and as hard as possible, and the bearing-edge of the pivot should not be more than one-thousandth of an inch wide.

Every part of the apparatus must of course be made in the nicest and most substantial manner. The beams G being assumed to be one foot long, the shorter arms of the levers H are shown in the relative proportions of three inches, and the longer arms of thirty inches in length. Each of the thin plates F F′ F², &c., is intended to be about fifteen feet long. The timbers J between the cast-iron plates, beams, and levers I preferably make of straight-grained, well-seasoned, hard southern pine twelve or fifteen inches square or round. They are secured to the iron heads by joint-bolts K′. The apparatus, as shown, is placed horizontally midway between the floor and ceiling, to be in the mean temperature of the air within the room, resting on pillars of wood or iron *m*. Should power be used continuously to produce a quick circulation of air in the room, the temperature would be the same in all parts, and there would be no necessity of raising the moving apparatus to the center. The weight of the beams G and levers H is to be balanced by corresponding weights, which may be done by attaching ropes or chains to the rings x^2, and running them over pulleys, with weights attached, in the common way of doing such work; or iron rods may be attached to the beams and levers, instead of ropes or chains, and to scale-beams overhead, instead of using pulleys and weights; and, in addition to the balancing-weights above, there may be nicely-adjusted wheels under the beams and levers, in which case their weight should not be quite taken up by the weight over them, allowing a very little of the weight to rest on the wheels below to hold the beams and levers in position. Supports should be put under the edges of the thin plates to prevent deflection. When made very thin the plates are to be soldered or brazed to thicker pieces of metal *r*, which have projections fitting into a recess in the end of the beam to hold them more firmly than they could be held by bolts alone. The bars L for strengthening the pivot-seats have similar projections, and are fitted in grooves in the same manner.

In Figs. 9 and 10, 22 represents a pier upon which the table 25 stands; 50, a platform around the table; *x*, the floor of the room; 23, posts that support the rails 24 of the stairs that lead to the platform 26; 31, a case inclosing two comparators, 60^3 and 60^4, mounted on a frame, 29.

In Figs. 11 and 12, A^5 represents a pipe for the passage of air into the dust-room; C^5, a pipe or opening for the passage of the air out of the dust-room into the standard-room, the dust-room being so large, compared to the inlet-pipe, that the movement of the air through the room will be very slow, and the dust will fall before it reaches the outlet where it enters the standard-room. This mode of freeing the air from dust was secured to me by Letters Patent No. 100,870, March 15, 1870, for the ventilation of railway-cars.

To prevent the mere presence of persons in the room from raising the temperature of the plates F F′, &c., above that of the room, or to prevent a change of their temperature because of any article being placed near them temporarily, and to keep the said plates of the same temperature as that of the room under any circumstance, I provide fan-wheels R R, Fig. 6, to force the air against the plates, which wheels may be driven by hand with a crank, or by belts *j j′* from power in the basement or outside of the building when the presence of persons in the room or any operation in the room may require it.

To prevent the least vibration I prefer to build a stone or brick pier, 22, independently of the floor of the room for the standard measures and comparators to rest upon, as other operations in the room may cause vibrations, and as the temperature of the air in the room must be kept the same in all parts of it by wheels Q when persons are in the room it will be necessary to make the pier or platform upon which the standards and comparators rest of a height that will bring the standard measures or other articles to be tested nearly midway between the floor and ceiling of the room, that they may constantly be in the mean temperature of the air in the room.

Having described my invention, it will be seen that it will supply what has long been needed, and when once put into use will be considered indispensable. In keeping the measures of the temperature at which they are standard length and at which they should be compared, the process of making reliable comparisons will be greatly facilitated.

What I claim as new, and desire to secure by Letters Patent, is the following, viz:

1. A building or apartment having a heater and a refrigerator, in combination with an apparatus that will by its expansion and contraction automatically open and close the heater and the refrigerator as the temperature of the apartment varies, and thereby keep its temperature uniform, substantially as described.

2. A building or room having thick walls made in three or more walls or parts, two of which are made of fire-bricks or equivalent material, with a space between them filled with dry earth or some other very slow conductor of heat, located within another building, but made independent of it, and especially constructed to be indestructible by fire, and with reference to keeping its interior of a uniform temperature by devices provided for that purpose, substantially as described.

3. A building or room having a heater and a refrigerator, in combination with an apparatus consisting of thin metallic plates attached to beams and levers, the heater and refrigerator being automatically opened and closed by the contraction and expansion of the plates as the temperature of air in the room varies, substantially as described.

4. A building or room having one or more

upright cylinders, each having a wheel at one of its ends for circulating the air to make it of a uniform temperature in all parts of the room, substantially as described.

5. A building or room having a heater and a refrigerator, in combination with an apparatus for automatically opening and closing such heater and refrigerator when such apparatus is placed nearly midway between the floor and ceiling in the mean temperature of the air of the room, substantially as described, and for the purpose set forth.

6. A building or room having a heater and a refrigerator, and having thin plates for opening and closing them, in combination with fan-wheels R, arranged to force the air of the room upon such plates to keep them of the same temperature of the room, substantially as shown and described.

7. A building or apartment having a heater and a refrigerator, in combination with an apparatus that will by expanding and contracting open and close such heater and refrigerator as the temperature of the apartment varies, and with a pier or elevated platform, 22, adapted to support the standard measures or other articles whose temperatures are to be preserved at an elevation midway between the floor and ceiling of the room, for the purpose set forth.

SAML. DARLING.

Witnesses:
JACOB KETTNER,
JOHN E. HALL.