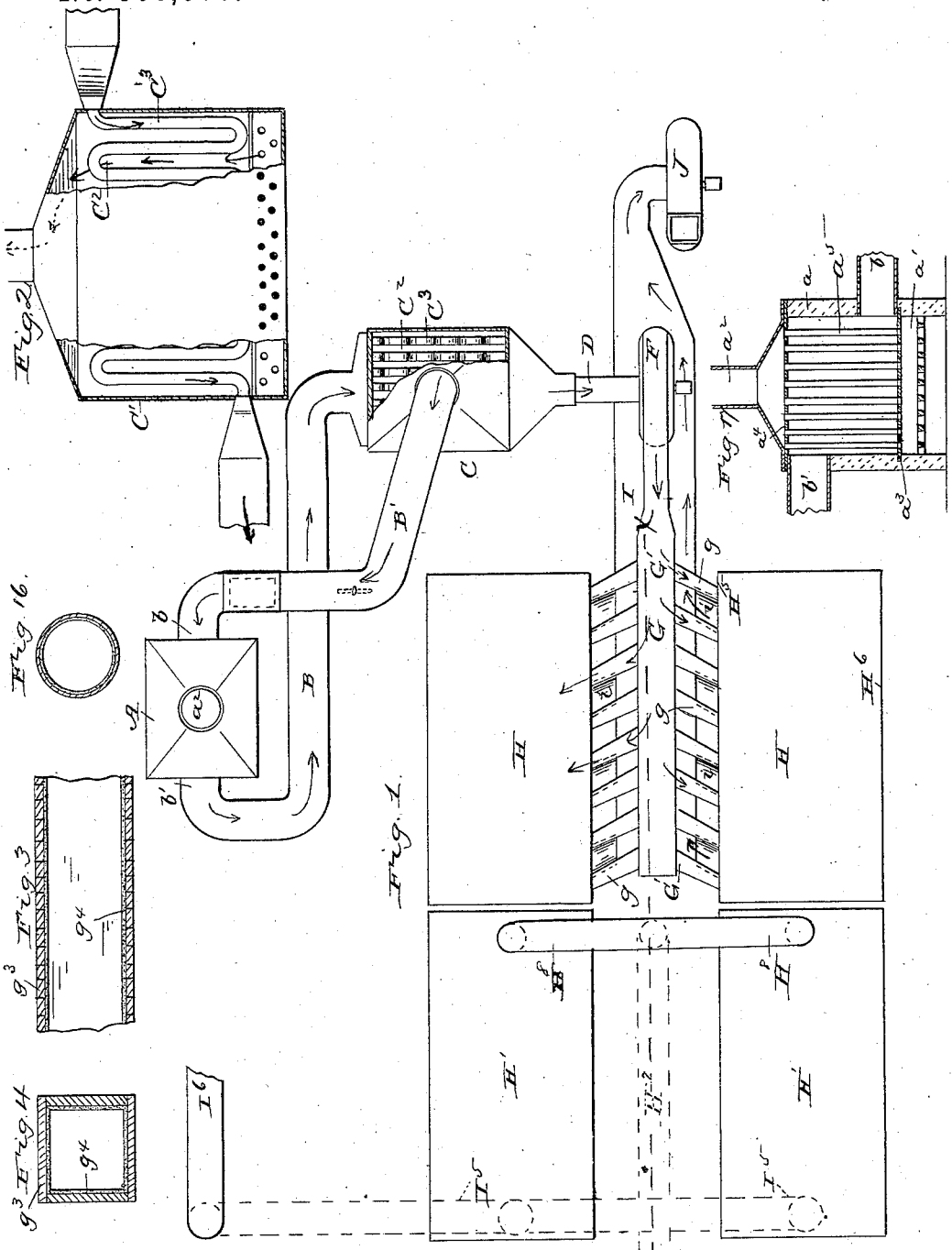
(No Model.) 4 Sheets—Sheet 1.

R. S. JENNINGS.

DRYING APPARATUS.

No. 306,080. Patented Oct. 7, 1884.



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(No Model.) 4 Sheets—Sheet 2.

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DRYING APPARATUS.

No. 306,080. Patented Oct. 7, 1884.

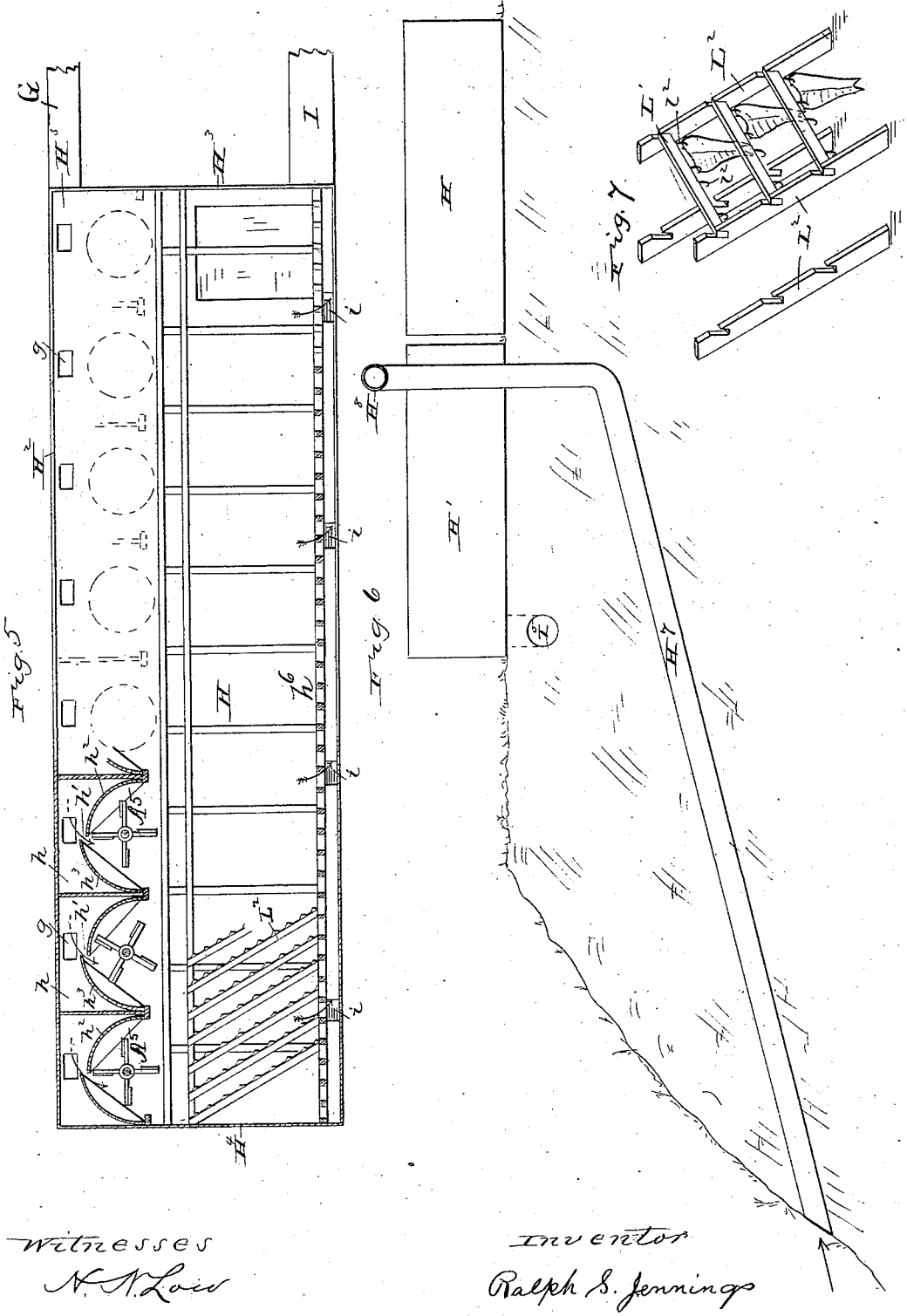

Fig. 5

Fig. 6

Fig. 7

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(No Model.) 4 Sheets—Sheet 3.

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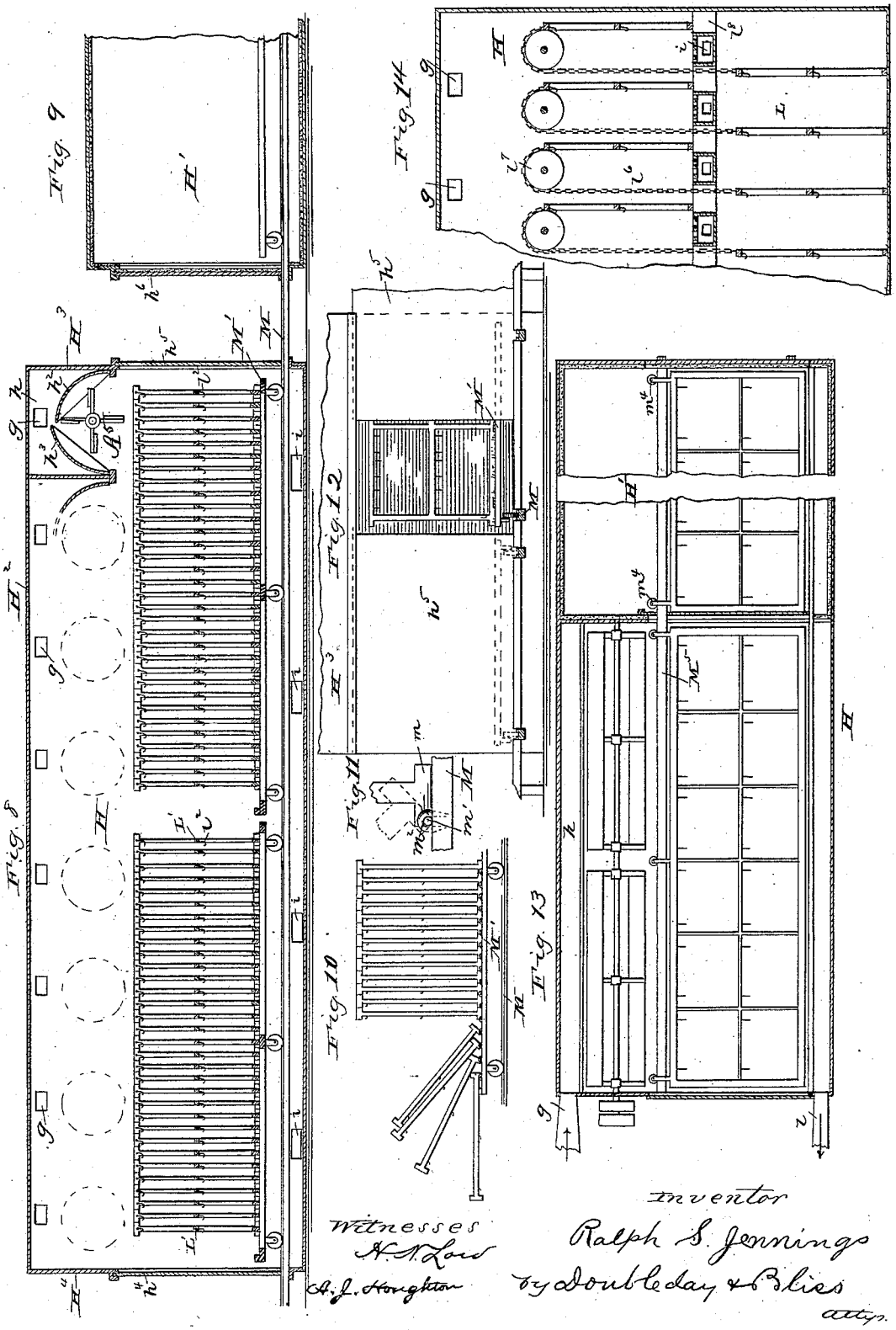
DRYING APPARATUS.

No. 306,080. Patented Oct. 7, 1884.



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(No Model.) 4 Sheets—Sheet 4.

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DRYING APPARATUS.

No. 306,080. Patented Oct. 7, 1884.

Fig. 1.

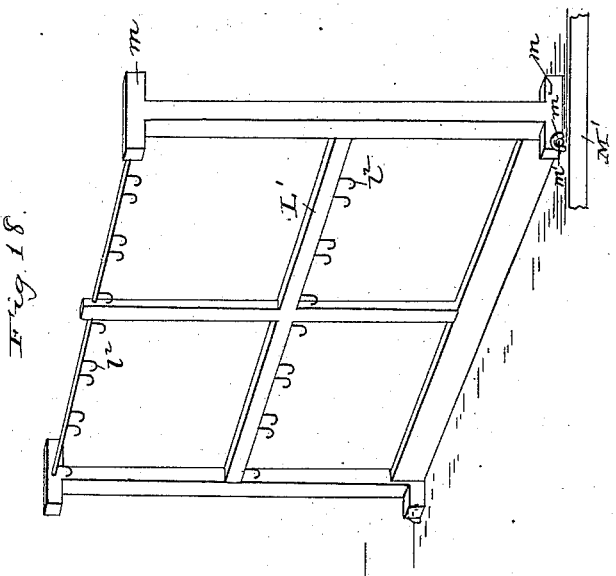
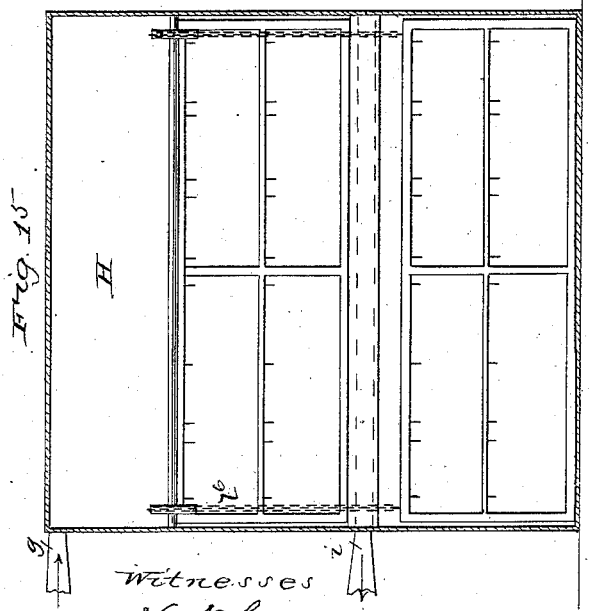


Fig. 2.



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UNITED STATES PATENT OFFICE.

RALPH S. JENNINGS, OF BOSTON, MASSACHUSETTS.

DRYING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 306,080, dated October 7, 1884.

Application filed February 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, RALPH S. JENNINGS, a citizen of the United States, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Drying Apparatus, of which the following is a specification, reference being had therein to the accompanying drawings.

Figure 1 is a top plan view of a set of appliances embodying my improvements. Fig. 2 is a view, partly in section, partly in side elevation, of the condensing or cooling apparatus. Fig. 3 is a longitudinal section of a part of one of the air-ducts. Fig. 4 is a cross-section of the same. Fig. 5 is a longitudinal section of a drying-room. Fig. 6 is a view on the line *x x* of Fig. 1, the inlet and outlet ducts for the drying air not being shown. Fig. 7 shows a modified form of the racks for supporting the articles to be dried. Fig. 8 is a longitudinal section of a modified form of the drying-room, this figure showing, also, a series of supporting-racks mounted on trucks. Fig. 9 is a partial sectional view of a cooling-room, to which the articles can be taken from the drying-room to lower their temperature. Fig. 10 shows one of the trucks detached, it illustrating, also, the method of manipulating the racks. Fig. 11 is an enlarged view of the bottom of one of the racks. Fig. 12 is a partial end view of the drying-room shown in Fig. 8, one of the end doors being partially removed, showing in end elevation the interior series of racks upon a truck. Fig. 13 is a sectional view of a drying-room and an adjacent cooling-room, the cooling-room in this case being situated by the side of instead of at the end of the drying-room, and the racks being suspended from ways independently of each other. Fig. 14 is a partial longitudinal sectional view of a modified form of drying-room, the latter being elevated somewhat, and having below it a room for loading the racks, which, in this case, are suspended from wheels or rollers in the drying-room by means of chains, one or more racks balancing one or more others, so that when one is raised another will be lowered. Fig. 15 is a cross-section of the construction shown in Fig. 14. Fig. 16 is a cross-section of a modified form of air-duct. Fig. 17 is a sectional view of the furnace. Fig. 18 is a perspective of one of the racks shown in Fig. 8.

I prefer to employ devices for treating the air substantially similar to those which I have made the subject-matter of other applications heretofore filed—namely, No. 65,006, June 23, 1882, and No. 86,026, filed February 23, 1883. Therefore a detailed description of devices suitable for this purpose need not herein be given; but, for convenience, I have shown an apparatus in the drawings.

A represents a furnace or air-heating apparatus; B, a duct; C, a cooler; D, a duct; F, a fan; H, drying-rooms; G, the main inlet-duct to the room; I, a main outlet-duct, and J an exhaust-fan.

The air-treating devices, as shown, consist of the following parts: *a* is the furnace wall or casing; *a'*, the fire-chamber; a^2, the smoke-exhaust; a^3 a^4, diaphragms; a^5, tubes therein; *b*, an air-inlet to the chamber around the tube a^5; *b'*, an outlet therefrom communicating with the duct B. C' is a casing; C^2, a chamber therein; C^3 C^3, pipes in the chamber communicating with duct B and outlet D. Air enters the chamber C^2 at the bottom and passes up around the pipes C^3, keeping them cool, and, if desired, it may be carried to the furnace through a pipe, B'. However, I do not claim herein any of the features relating to the treatment of the air, broadly considered; nor do I wish to be limited to the use of an apparatus of this sort, for some of the various features of the invention pertinent to this case may be attained without the employment thereof.

At F is situated a fan, which, by suction, compels the air to take the course which has been above described, and which forces it onward toward the drying-rooms through the main inlet-duct G. This fan at F may be of any preferred character.

I will now describe the means which I have devised for rendering the air-tempering and moisture-condensing devices above described especially applicable for use in the drying of fish in large numbers.

In the drawings I have shown two drying-rooms, H H, arranged opposite to each other, and in such manner that both may be, at the same time, supplied with air from a common air tempering, condensing, and forcing mech-

anism. Each of these can be constructed in the following manner, reference now being had more particularly to Figs. 1 and 5.

H^2 represents the top; H^3, one of the ends; H^4, the opposite end; H^5, the inner side, and H^6 the outer. Preferably, these walls are constructed in such manner as to avoid the transmission of heat in either direction, so that a uniform temperature may be maintained inside. In the upper portion of the drying-room there are formed a series of chambers, *h*, which are preferably isolated one from another by partitions, though I do not wish to have the other features of my invention limited to this. In the construction shown there are eight of these chambers *h*, and they communicate with the lower part of the drying-room through slots or apertures at *h'*. Preferably, the lower sides are formed by arches h^2 and h^3, being so related that the slots or apertures *h* shall be between their upper edges. Each of the chambers *h* communicates with the main inlet-duct G by a branch duct, *g*. These are preferably formed in the manner and situated as shown—that is to say, situated on lines inclined to the main duct and formed with flaring or enlarged outer ends, as at G. By arranging them upon inclined lines there is much less resistance experienced than if the air were compelled to turn at a right angle, and by flaring the outer ends a free passage of the air is still further assisted. As it is desirable to employ a current of great volume, and as the traveling of the air to large drying-rooms is over a long distance, it is necessary to have large ducts for carrying it. These ducts have generally been constructed of sheet-metal pipes; but these are very expensive, and, moreover, when used in making ducts of large surface, permit considerable variations of the temperature of the air passing through them, and these variations are undesirable and are overcome by ducts made according to the method of construction which I have devised. I construct them of wood, and, owing to the material which I combine with the wood, I can employ boarding of a very thin and cheap kind for this purpose.

The manner of constructing the ducts is illustrated in Figs. 3 and 4, the board-casing being indicated by g^3. With this I combine sheets (more or less continuous) of paper or pasteboard, which not only make the joints of the duct perfectly tight, but which, moreover, prevent the passage of heat in either direction, the paper being tacked or otherwise caused to adhere to the interior surfaces of the duct, as shown at g^4. After the air has reached the chambers *h* it is forced downward over the articles to be treated.

It is well known that for drying purposes there should not only be a copious supply of the air which is to carry away the moisture, but there should be a rapid circulation of the air in direct proximity with the articles being treated.

Heretofore in drying-rooms very inferior results have been obtained from the fact that reliance has been placed merely upon external means for forcing the air into the room, or upon means for withdrawing air therefrom.

I have succeeded in obtaining very superior results by employing distributing devices within the drying-room, which operate to drive the air directly toward the articles therein. As shown in the drawings, these consist of rotating fans A^5, mounted upon transverse shafts, there being one beneath each chamber *h* and slot or aperture *h'*. The fans are so situated relatively to the apertures *h'* that they operate to suck or draw the air through them and force it downward over and through the material in the drying-room in strong sharp currents. This is facilitated by having the arches h^2 and h^3 arranged to operate as a casing for the fan. Under some circumstances these fans can be relied upon to the exclusion of the blower-fan at F to produce a sufficient movement of the air through the heating, tempering, and condensing apparatus and into the drying-room, though when a large volume of air is desirable it may be necessary to employ the blower-fan in the manner which has been described. After the air has been thrown or driven down by the distributing devices, and after it has absorbed the moisture which it will take up, it is withdrawn by means of the suction or exhaust fan at J, which is shown as connected with the bottom of the drying-room by the main exhaust-duct I and the branch ducts *i*, substantially similar to those at *g*. (See Figs. 1 and 5.)

h^6, Fig. 5, is a false floor or grating for the drying-room, through the openings in which the air passes to the exhaust-ducts *i*. By having the chamber which initially receives the air and the distributing-fan situated above the space in which the articles are exposed, and having the fans mounted horizontally, I can insure that the air, after becoming moisture-laden, shall be allowed to pass away from the drying-room with the least resistance, and by combining with the parts thus arranged the rotary fan below the perforated or false flooring I can withdraw the moist air much more rapidly than is the case under many circumstances when the parts are otherwise arranged.

The articles to be treated may be supported in the drying-room in any preferred manner; but I will now describe those means which I have devised for supporting fish in a superior manner while being dried.

Heretofore it has been customary to dry fish by exposing them to the action of sun and air upon flakes, these consisting of horizontally-arranged wooden bars, triangular in section, fastened to suitable frames.

I have found that very much of the moisture will escape from the fish by placing the flakes in the drying-room at an angle of from sixty to eighty degrees, as shown in Fig. 5, the flakes shown in said figure being substantially like those which have been used in open-air drying, except that they have always been in the

latter process situated horizontally. The position of the flakes which I have shown is superior, in that, while on the one hand the fish cannot slip off therefrom and they can be very readily placed in proper position thereon, yet at the same time the water, with which they are more or less charged, is allowed to escape from them, and thus assistance is rendered to the operation of drying.

I am aware of the fact that racks and holders of various sorts have been used in the drying of glue, malt, &c. These are arranged horizontally in substantially the same way as are the racks or flakes now used in drying fish.

I have found that when fish are exposed in this way the drying action is much slower than it is when they are arranged as I have shown in Fig. 5. This is owing to the fact that when the fish are lying horizontally the water which they contain (in large quantities, and which, as they are laid upon the rack, drips freely from them) is prevented from escaping by gravity, and therefore the drying is effected only by evaporation. I assist the devices which introduce and withdraw the air by inclining the fish so that their surfaces are at an angle to the horizon. When so situated, the water in them and upon their surfaces tends to escape by gravity and flow downward, and either drops away from them or is so exposed that the currents of air can immediately take up the moisture and carry it away. Moreover, by thus inclining the holders the air, which is driven downward by the circulating-fans, moves relatively to them to greater advantage than if they were horizontal, for in the latter case the air tends to bound upward away from them, whereas, when inclined, as shown in said figure, the air rolls over and over in contact with the fish in its downward movement, and therefore each part of the air is more thoroughly charged with moisture than if the air be blown more perpendicularly against the fish. Racks thus arranged can be used also in the drying of other materials where it is to be exposed in the form of sheets or layers, for they operate substantially as do the fish to compel the air to remain longer in contact to the exposed surfaces than when arranged horizontally.

The flakes L^2 can be supported in any suitable way, preferably, when a construction like that in Fig. 5 is being used, by means of lugs, against which the upper ends of the flakes rest, and which hold them at the proper inclination.

By means of the above-described devices, and with a pair of drying-rooms thirty-two feet long, eight feet high, and sixteen feet wide, I have succeeded in effecting the thorough drying of cod at the rate of from two to three thousand an hour, which, under the most favorable circumstances, would require by the method heretofore followed from two to four days, and, as is well known, it is often the case that these fish must lie sometimes for weeks waiting for suitable conditions of temperature, atmosphere, sun, &c.

Heretofore it has been customary, after fish have been treated by the ordinary method above alluded to, to immediately and hurriedly pack them in tight boxes for shipment. In a great number of cases the fish are packed at a high temperature, and, as a result, vast quantities of them, as is well known, spoil in transit and after reaching their various destinations, it being a very common thing for cod and similarly-treated fish to "turn red"—that is, to undergo more or less of a decomposing action; and, according to the method heretofore followed, and with the appliances heretofore used, it has been impossible, except at great expense, to so treat the fish before packing them that these evil results can be avoided. I treat them in a superior manner before packing and transportation at comparatively little cost or trouble. Before packing them I subject them to the tempering action of a cooling-room, into which they are taken after they have been removed from the drying-room, and in which they can be subjected to the action of air at any necessary or desirable temperature. Preferably, I have the cooling or tempering room immediately adjacent to the drying-room, so that the fish can be instantly transferred from one to the other.

In the drawings I have shown several methods of carrying out this part of my invention.

Referring to Figs. 1 and 6, H′ H′ represent cooling-rooms, each situated at the end of a drying-room, H. These cooling-rooms can be constructed in any suitable way, preferably with non-conducting walls, and they can be supplied with cool air by any of the known appliances. I have shown a submerged duct, H^7, with branch ducts H^8 running to the tops of the cooling-rooms, the outer end of the duct H^7 communicating with the open air. The air passing into and through the duct H^7 will be tempered by the surrounding earth in a manner now well known, and in this way the cooling-rooms can be kept at an equable temperature the year round. The air can be withdrawn from these cooling-rooms in any suitable way. Thus I have shown exhaust-ducts I^5, (see dotted lines, Fig. 1,) adapted to withdraw the air from the bottom of the cooling-rooms and carry it off to any point. The fish can be kept in this cooling-room long enough to thoroughly cool them, or at least reduce them to the proper point for packing.

In Fig. 7 I have shown a method of supporting the fish in the drying-room, which, in many respects, is superior to that shown in Fig. 5, it consisting in attaching the fish to separate bars L′, provided with tenter-hooks l^2, to which the fish are attached. The bars L′ are adapted to be seated in recesses or sockets formed for them in a stationary bar or frame, as at L^2, which latter is inclined so that the several bars L′ shall be situated in different vertical planes. As a result, the moisture-laden air from the upper fish is not allowed to come in contact with the lower ones, but is immediately drawn away from the fish (which it

has more or less dried) to the exhaust-ducts *i;* or, instead of either of these methods of support, others may be used of the character shown in Figs. 8, 13, and 14.

In Figs. 8, 9, 10, 11, and 12 I have shown how the fish can be placed in the drying position in large quantities outside of the drying-room, and can then be introduced.

M represents a track, preferably arranged lengthwise through the drying-room, and upon which trucks M′ are adapted to run. Upon these trucks are arranged racks to carry the fish, which can be supported in any preferred manner. I have shown the racks as being detachable one from the others, to permit the hanging and unhanging of fish, but so that they can be arranged in a compact series upon the truck. They should be as narrow or open as possible at the top, to permit the free passage of air downward, and this may be effected by having the cross parts made of wire or thin bars. They can be spaced by having plates or lugs, as at *m*, at the top or bottom, and these, if at the bottom, can be utilized for flexibly joining the racks to the trucks. By examining Figs. 10 and 11 it will be seen that they can be hinged in a very simple but convenient way at one edge by pins *m′* and staples or eyes m^2, secured to the truck. This permits the racks to be turned down, as shown in Fig. 10, so that the fish from the whole series may be quickly removed and another lot as quickly attached. The track M in Figs. 8 and 9 is shown as extending continuously from the drying-room to the cooling-room H′.

h^4 represents a sliding door at the end of the drying-room H, by which can be closed the entrances through which the trucks are pushed in.

h^5 represents a sliding door at the other end of the drying-room, and h^6 is a similar door at the end of the cooling-room. Doors h^5 h^6 being opened, a truck can be moved instantly from the drying-room to the cooling-room, after which said doors are closed.

In Fig. 13 the cooling-room H′ is shown as being situated by the side of the drying-room and the racks are shown as being suspended upon tracks M in the upper part of the rooms, the suspending devices having anti-friction rollers, as at m^4. In this case narrow slots or doorways in the walls of the drying and cooling room, provided with doors or flaps, will permit the movements of the racks into and from the rooms, and can yet be used to prevent the escape of any material amount of air from either.

In Figs. 14 and 15 I have shown another modification of the means for introducing the fish to the drying-room, Fig. 14 being a portion of a longitudinal section, and Fig. 15 a transverse section. In this case the racks L are attached to ropes or chains l^6, which latter pass over rollers or wheels l^7. Two or more of the racks are arranged to counterbalance two or more others, ways or channels being formed at l^8 through the exhaust-chamber at the bottom of the drying-room, to permit the upward and downward passage of the racks. In this case the exhaust-chamber is made up of a number of small ducts or trunks, which communicate with the exhaust-duct I through the branch ducts shown at *i*, as in Figs. 14 and 15. In this latter-described construction the lower room may be used as the cooling-room, and the fish may be allowed to remain upon their respective racks long enough to be lowered to the required temperature.

While I have herein more especially described the invention as relating to the drying of fish, and have specifically mentioned the latter in some of the claims, I do not wish to be limited to such articles, for it will readily seen that many parts of the apparatus and of the process herein described and claimed can be utilized in the treatment of other materials.

I do not in this application claim the process herein set forth of treating fish, I preferring to make that the subject-matter of another application, filed June 8, 1883; nor do I herein claim the arrangement of the racks or holders relatively to the air-forcing devices which I have shown, preferring to make those features the subject-matter of claims in my application No. 106,832, filed September 19, 1883; nor do I herein claim the matters set forth in the claims in my other applications, Serial Nos. 65,006, 73,148, 86,026, 86,318, 87,468, 87,469, 97,493, 98,699, 106,070, 103,414, 106,832, 121,265, and 121,561, preferring to claim in this case the matters set forth in the following claims, and reserving to myself the right to claim the other patentable matters herein shown and described in the other applications.

What I claim is—

1. In a drying apparatus, the combination of a drying-room, an air chamber or duct which initially receives the air before entering the space wherein the articles are exposed, the distributing-fan, the casing which partially incloses said fan and has a curved wall, and a slot or aperture in the casing, arranged, substantially as set forth, to guide the air toward said curved casing, the fan-blade passing in close proximity to said apertures or slots, as described.

2. In a drying apparatus, the combination of a drying-room, the distributing-fan adjacent to the space wherein the articles are exposed, the arch h^2, composing part of a casing around the fan, the wall h^3, composing another portion of said casing, these last said parts being arranged, substantially as set forth, to leave a large open space on the side of the fan toward the articles under treatment, through which opening the air can pass, the air-apertures through the casing around the fan, and the duct through which air passes to said apertures, substantially as set forth.

3. In a drying apparatus, the combination of the drying-room, a chamber or duct which initially receives the air, a blast-fan which keeps air in said chamber or duct under press-

ure, a distributing-fan in immediate proximity to the space wherein are the articles to be dried, apertures or passage-ways through which the air passes from said duct or chamber to the distributing-fan, and an exhaust-fan which withdraws the air after the distributing-fans have thrown it against the articles and it has become laden with moisture, as set forth.

4. In a drying apparatus, the combination of an apartment in which the articles are exposed, a chamber above said apartment which initially receives the air that passes to the drying-apartment, and a fan or fans mounted horizontally and situated between the drying-apartment and the initial air-receiving apartment, the perforated or false flooring below the drying-apartment, and the rotary fan which withdraws said air from below said flooring, substantially as set forth.

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

RALPH S. JENNINGS.

Witnesses:

H. H. BLISS,

HENRY H. PAGE.