

Aug. 6, 1929.

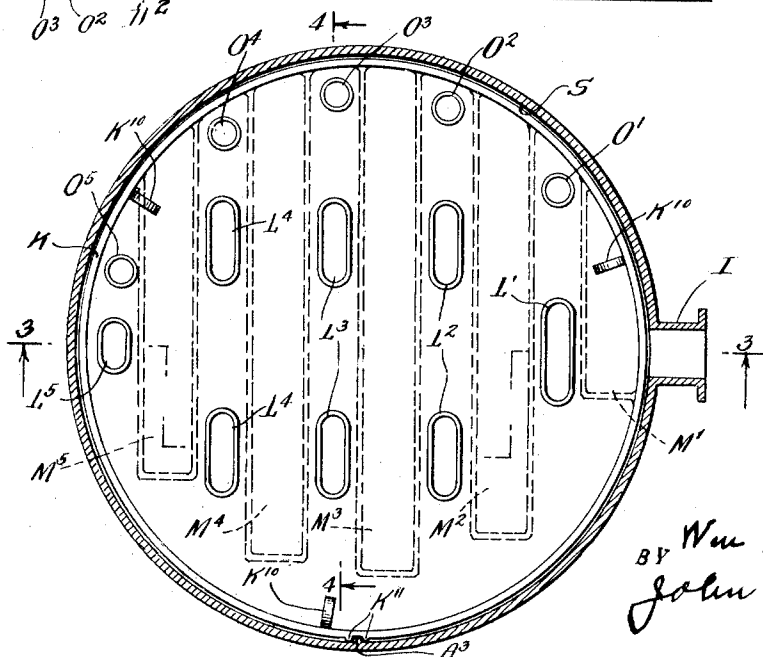
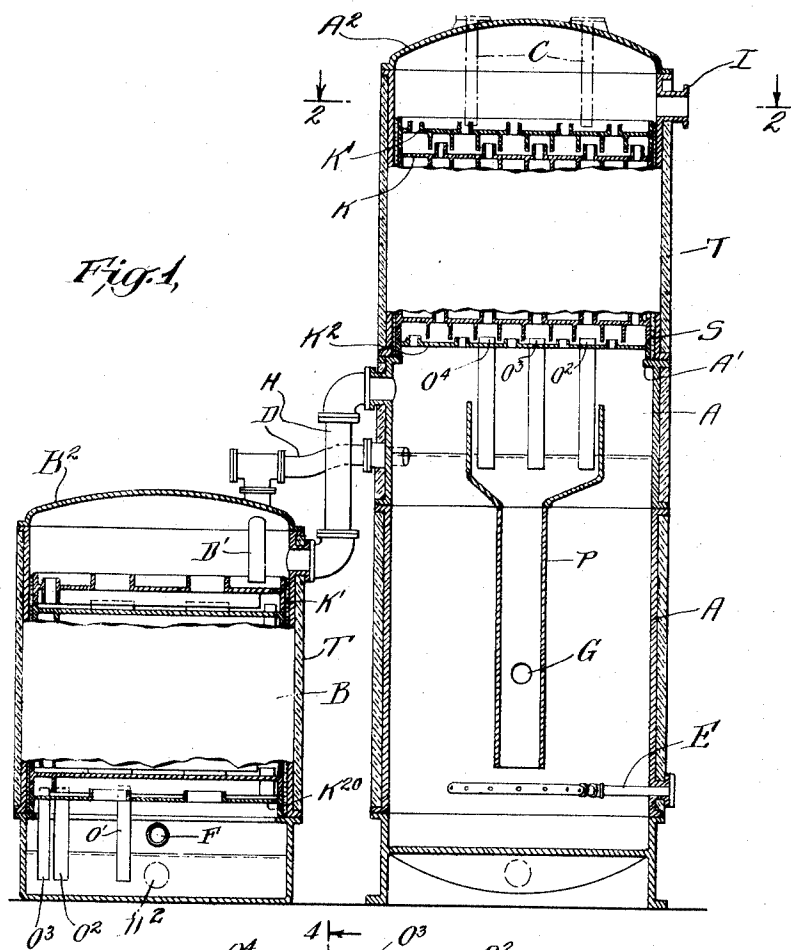
W. H. PAVITT

1,723,657

STILL CONSTRUCTION

Filed March 11, 1922

2 Sheets-Sheet 1



INVENTOR
Wm H Pavitt
BY John E Hubbell
ATTORNEY

Aug. 6, 1929.

W. H. PAVITT

1,723,657

STILL CONSTRUCTION

Filed March 11, 1922

2 Sheets-Sheet 2

Fig. 3,

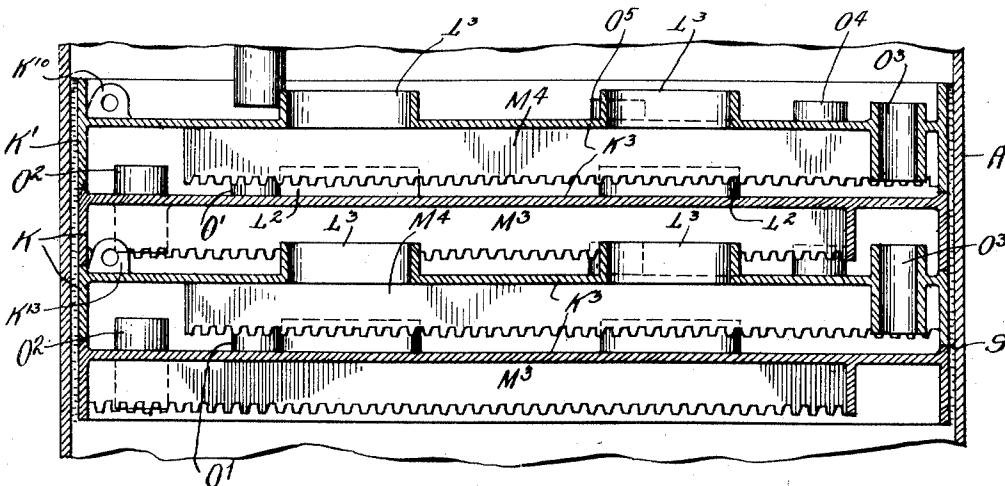
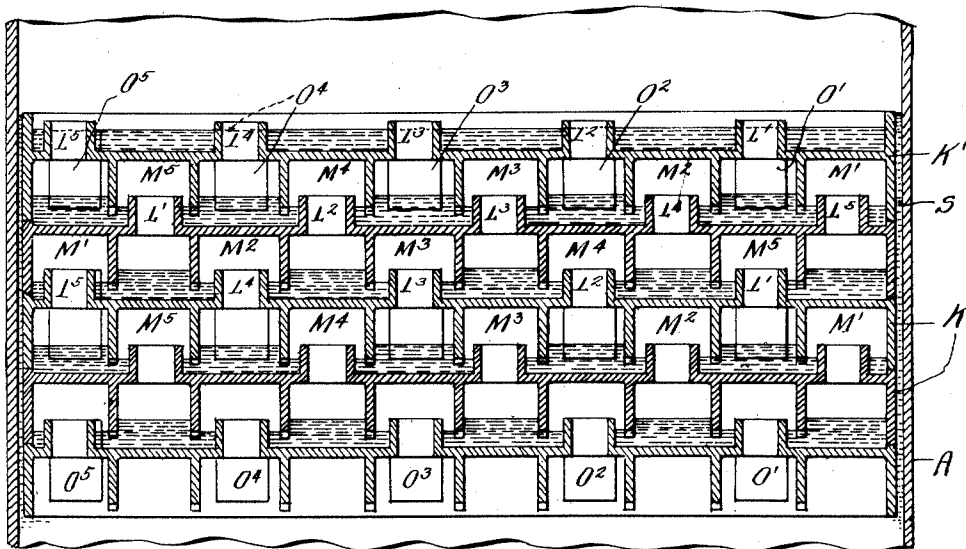


Fig. 4,

INVENTOR
 BY *Wm H Pavitt*
John E. Hubbell
 ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIAM H. PAVITT, OF BROOKLYN, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO WILPUTTE COKE OVEN CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF MAINE.

STILL CONSTRUCTION.

Application filed March 11, 1922. Serial No. 542,902.

My present invention relates to stills and particularly to column stills of the type commonly employed in recovering ammonia from the gas liquor obtained from coal distillation gases.

A primary object of my present invention is to simplify and improve the construction and operation, and to facilitate the cleaning of a column still of the type comprising a scrubbing section consisting of a series of ported diaphragms arranged one above another with cooperating bell chambers and tubular projections surrounding the ports in the diaphragms for causing the gas and vapor flowing upward through the stack of diaphragms to bubble through bodies of liquid held on the different diaphragms, the liquid overflowing from one diaphragm on to the diaphragm beneath it.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with it, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is an elevation with parts broken away and in section of an ammonia still system of the kind employed in recovering ammonia from gas liquor;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Figs. 3 and 4 are fragmentary sections on the broken lines 3—3 and 4—4, respectively, of Fig. 2.

In the drawings I have illustrated the use of my invention in apparatus of the type commonly employed for treating the ammonia liquor obtained from the coal distillation gases. This apparatus comprises a primary or free ammonia still section A, and a secondary or fixed ammonia still section B. The still A comprises a vertically elongated tank or outer shell into the upper end of which the ammonia liquor to be treated is introduced through one or more inlet pipes C. The ammonia liquor trickles down through the scrubbing section of the still A and eventually reaches a liquid storage space in the bottom of the tank or chamber from which liquid overflows through the connec-

tion D into the top of the secondary still B, which also comprises a tank or outer shell and a scrubbing section therein intermediate its top and bottom. The liquor introduced into the top of the still B through the connection D trickles down through the scrubbing section of the still B into the reservoir space at the bottom of the latter from which the spent liquor is withdrawn through the outlet D². Steam is introduced into the body of liquor in the bottom of the still A through a steam supply pipe E, and steam is introduced into the lower portion of the secondary still B through a steam supply pipe F. Lime or other chemical for breaking up the so-called fixed ammonia is introduced into the body of liquor in the lower portion of the still A through the inlet G. Steam and gaseous ammonia pass from the top of the secondary still B through the conduit H which opens from the still B above the scrubbing section in the latter, and discharges into the still A below the scrubbing section but above the liquid level therein. Gaseous ammonia and any steam or water vapor admixed therewith, finally leave the distillation apparatus through the outlet I which opens from the primary still A above the scrubbing section therein.

Insofar as above described the distillation apparatus shown in the drawings comprises nothing novel with me, but, on the contrary, is of the type commonly used in obtaining ammonia from the ammonia liquor recovered from the gases of distillation in by-product coke oven plants. The present invention is primarily concerned with the construction of the scrubbing sections of the stills A and B.

The scrubbing section of the still A is formed by a series of trays K stacked one on top of another between a top tray K' and a bottom tray K². Each of the trays K comprises a cylindrical rim and a horizontal web or diaphragm portion K³ provided with ports and with vertical tubular projections surrounding the ports as hereinafter described. The ports through the diaphragm K³ of each tray K comprises a set of elongated gas ports L', L², L³, L⁴ and L⁵. In the preferred construction shown these ports are arranged in parallel rows, so to speak, with one port L' in the row at one side of the tray, and one port L⁵ in the row at the opposite side of the tray, and

two each of the ports L^2 , L^3 or L^4 in each of the three intermediate rows. Each of these gas ports is surrounded by a corresponding upwardly extending tubular projection from the diaphragm portion K^3 of the corresponding tray. At the underside of the web or diaphragm portion K^3 of each tray K , vertical flanges or ribs are provided which unite with the circular rim of the tray to provide a series of bell chambers, M^1 , M^2 , M^3 , M^4 , and M^5 . These chambers are elongated in the same direction as the rows of gas ports are extended and are laterally displaced from the latter to the right as the tray is seen in Figs. 2 and 3 in the particular arrangement shown. The lower edges of the flanges or ribs forming the bells are preferably serrated as shown in Fig. 4. The web K^3 of each tray K' is also formed with a series of liquid drainage ports O^1 , O^2 , O^3 , O^4 and O^5 which are surrounded above and below the diaphragm by vertical tubular projections from the web K^3 .

The top tray K' is substantially identical with the trays K except that the tubular projections surrounding the ports O^1 , O^2 , O^3 , O^4 , and O^5 should, and do terminate below the level of the tops of the tubular projections surrounding the ports L^1 , L^2 , L^3 , L^4 , and L^5 in the case of the top tray K' , while in each tray K it is convenient to have all the corresponding tubular projections terminating at the same level. In the preferred construction illustrated, the cylindrical rim of the tray member K' extends above the web portion K^3 of the tray approximately to the level of the tops of the tubular lips surrounding the gas ports L^1 , L^2 , L^3 , L^4 , and L^5 , while in each tray K the cylindrical rim portion projecting above the web portion K^3 , terminates at a level appreciably below the level of the corresponding tubular projections surrounding the ports L^1 , L^2 , L^3 , L^4 and L^5 .

The bottom tray K^2 differs from the trays K in the omission of the bell forming ribs or flanges at its underside, in the omission of the liquid drainage ports O^1 and O^5 , and in the greater elongation of the downwardly extending tubular projection surrounding the liquid drainage ports O^2 , O^3 and O^4 of the tray K^2 . The last mentioned projections extend into the enlarged upper end of the usual open ended conduit or channel P provided to carry the drainage liquid from the scrubbing section down to the bottom of the body of liquid in the bottom of the still A . The lime supply pipe G discharges as usual into the conduit P .

In the assembled still A , the trays K , K' and K^2 are stacked up with the bottom edge of the cylindrical rim of each upper tray resting on the upper edge of the rim of the tray immediately beneath. In the assembled stack adjacent trays are angularly ro-

tated with respect to one another through an angle of 180° so that, as shown in Fig. 3, the ports L of alternate trays are in line with one another, whereas the ports L' of immediately adjacent trays are at opposite sides of the still. With this arrangement the tubular projections surrounding the ports L^1 , L^2 , L^3 , L^4 and L^5 on the upper side of the diaphragm K^3 of each lower tray extend into the open lower ends of the bell chambers M^5 , M^4 , M^3 , M^2 and M^1 , respectively, of the tray immediately above. The ports are so proportioned that the lower edge of each bell chamber is appreciably below the level of the top of the tubular gas port surrounding projections extending into it from the tray below, and so that the lower ends of the downwardly extending tubular projections surrounding the drainage ports O^1 , O^2 , O^3 , O^4 and O^5 are located at or about the same level as the bottoms of the bells carried by the same tray. The ammonia liquor supply pipes C as shown in Fig. 1 advantageously extend down to a level below the tops of the upwardly extending tubular projections surrounding the ports O^1 , O^2 , O^3 , O^4 and O^5 of the tray K' so that the lower ends of the pipes C are liquid sealed.

The trays K^2 and thereby the superimposed trays K' and K are supported, as shown, by an internal flange or ledge A' provided for this purpose on the inner wall of the tank body or outer shell of the still A . The upper portion of the still chamber A is normally closed by a removable top or head section A^2 . The cylindrical shell formed by the rim sections of the trays K , K' and K^2 is separated from the outer shell of the still A by a narrow annular space or chamber S open at its top but closed at its bottom by the ledge A' . In operation this annular space is quickly filled with liquid by leakage or vapor condensation, thus providing a liquid seal for the joints between the rims of adjacent trays. Any small liquid leakage through these joints that may occur will do no particular harm, and in practice such leakage will ordinarily not occur except during short periods after the initial starting of the apparatus into operation, or after the apparatus has been cleaned. After such periods of operation the joints will be sealed by lime and the like depositing in and over the joints. The location of the top edge of the rim portion of each lower tray at a level but slightly above the level of the corresponding tray diaphragm has the advantage that when the trays are removed from the still for cleaning, the liquid above the diaphragm of each tray drains off into the still chamber over the top edge of the rim of the tray as the latter is lifted out of its normal position.

The trays K , K' and K^2 are advantageous-

ly provided on their upper sides with apertured ears K^{10} for engagement by a suitable hoisting device for lowering the trays into place or removing them from the still chamber A when the top head A^2 of the latter is removed. The ears K^{10} are each bevelled off adjacent the rim of the section to provide guide surfaces for the rim of the tray above which center the latter as it is being lowered into place. To facilitate the proper setting of the trays in place the trays are each provided at one side with lugs K^{11} on the outer portion of its cylindrical rim section which straddles a vertical guide rib A^3 formed on the inner wall of the outer shell of the still A. Except for the disposition of the lugs K^{11} the various trays K as shown are exact counterparts of one another.

The scrubbing section of the still B may be identical in construction and arrangement with the scrubbing section of the still A. The ports D' of the liquid supply connections D entering the top of the still B are preferably extended down below the tops of the liquid drainage ports of the top tray K' so that the lower ends of the portions D' are water sealed. In the bottom tray, K^{20} of the still none of the drainage ports O' , O^2 , O^3 , O^4 and O^5 need be omitted, and the tubular projections surrounding the lower portions of these extend below the liquid level in the storage space in the bottom of the still B.

In operation there is a constant downflow of liquor through the liquid drainage ports O' , O^2 , etc., of each of the various trays K , K' , K^2 and K^{20} of the two stills, and an upward flow of gas through the gas ports L' , L^2 , L^3 , L^4 and L^5 of the trays. The disposition of the drainage ports in adjacent trays insures a distributed flow of liquid in parallel lines along the upper side of each tray and a desirably great elongation and good distribution of the lower edges of the various bell chambers under which the ascending gas and vapor must bubble. The relatively large gas and liquid contact surfaces thus provided adds to efficiency and increases the capacity of the apparatus.

Aside from the advantages just referred to, the still construction disclosed herein possesses very important practical advantages over stills now in common use for obtaining ammonia from gas liquor, in respect to the ease and labor cost of cleaning, space requirements and cost of construction. In the most commonly used type of still for obtaining ammonia from gas liquor the diaphragms of the scrubbing section are connected to or supported by the outer shell of the still and are not removable for cleaning. The bell chambers, however, are separate elements which are removable for cleaning through clean-out openings provided for the purpose in the shell of the still. Usually there are several of these

openings provided between each pair of diaphragms, and in operation each clean-out opening must be closed by a corresponding cover or door which is bolted in place. When the ordinary removable bells are employed it is necessary to clamp them in place, usually by means of wooden or metal wedges, since the excess of gas pressure on the inner side of each bell as compared with the gas pressure on the outer side of the bell would displace the bell unless so clamped in place. The bell clamping provisions required with removable bells adds appreciably to the trouble and labor involved in cleaning the still. The ease and labor cost of cleaning a still are important items, because of the frequency with which it is necessary to clean the interior of a still of the type disclosed. Largely because of lime deposits, it is ordinarily necessary to more or less thoroughly clean the scrubbing section of a fixed ammonia still, such as the still B, once a month or so, and to clean the scrubbing section of the free ammonia still such as the still A once every three or four months or so. With the removable bells, the bells proper may be easily cleaned when once removed from the still structure, but the unclamping of the bells and reclamping them into position at the beginning and end of each cleaning operation is a laborious and unpleasant operation. The operation of cleaning the non-removable diaphragms through the cleanout opening after the bells are removed, is also a difficult and laborious operation.

With the present invention, when cleaning is necessary, all that it is necessary to do is to remove the top head A^2 or B^2 of the still section to be cleaned, and remove the various tray sections and deposit them on the floor of the still house or other convenient place for cleaning. The trays can then be cleaned with comparative rapidity and ease after which they are again stacked up in the still shell and the removable head of the latter is secured in place. The still heads A^2 and B^2 and the various trays can be removed and replaced with comparative quickness and ease by the use of suitable overhead hoist apparatus. With the bell chambers formed as integral portions of the trays, in accordance with the present invention, bell or tray clamping or locking devices, become quite unnecessary since the weight of each tray is ample to prevent any disturbance or dislocation of the tray by the differential gas pressures to which different portions of the tray are subjected. The omission of removable bells and bell clamping devices permits of a closer spacing of adjacent diaphragms without any operating disadvantage. This permits of a substantial reduction in height of a column still of

given capacity, and in addition to the space saving thus effected, directly reduces the weight and construction cost of a still of given capacity.

5 The removal of the top heads A² and B² of either still column is a very simple operation in comparison with the removal of all the cleanout doors with which it is necessary to provide each still column as heretofore
10 ordinarily constructed, since the number of clamping bolts required to secure a still top head in place is only a small fraction of the number of bolts required to secure the various cleanout doors of the older construction in place. While I consider it generally desirable to pass the liquor supply
15 connections to a still through the removable top head of the still shell, and this necessitates opening a pipe joint in each liquor supply line to remove the top head, this is a comparatively simple operation as the liquor supply pipes are small diameter pipes. The larger ammonia gas pipe connections to the still shells need not be disturbed in
20 opening up the still for cleaning. Another advantage resulting from the omission of cleanout openings in the side of the still shell arises from the fact that it is desirable from the standpoint of heat economy to encase the still in heat insulation material T. The required heat insulation obviously can readily be applied and maintained in a still constructed in accordance with the present invention, which is not the case with a still
25 having a multiplicity of lateral cleanout doors which must be removed at relatively frequent intervals for cleaning.

30 While in accordance with the provisions of the statutes I have illustrated and described the best form of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the method and apparatus described without departing from the spirit of my invention as set forth in the annexed claims.

45 Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

50 1. In a column still, the combination with an outer still shell, of a scrubbing section therein formed of removable trays stacked one on top of another and each comprising a horizontal diaphragm portion and a marginal rim which rests at its lower edge on
55 the top edge of the rim of the tray beneath it, said diaphragm being formed with gas ports surrounded by upwardly extending tubular projections from the diaphragm, and with liquid drainage ports surrounded by upwardly and downwardly extending tubular projections from the diaphragm, and with depending transverse flanges or ribs which unite to form parallel bell cham-

65 bers at the underside of each tray all so disposed that the upper ends of the tubular projections surrounding the gas ports of each lower tray extend upwardly into the bell chambers of the tray immediately above.

2. In a column still, the combination with 70 an outer shell provided with a removable top section and with a scrubbing section located in said shell and formed of trays stacked one on top of another and each comprising a horizontal diaphragm with ports 75 therethrough and having vertically extending projections forming upwardly extending tubular portions surrounding said ports said diaphragm having bell chambers therebeneath all so disposed that the said tubular 80 projections on each lower tray enter the bell chamber at the underside of the tray above, said trays being removable from said shell when the top section of the latter is removed, ammonia liquor supply connections to the 85 removable top section of the still shell, and ammonia gas outlet pipe connections to said shell below the removable top section thereof and above the top of the scrubbing section therein. 90

3. In a column still comprising a scrubbing section, the combination with an outer shell provided with an internal ledge at the bottom of the scrubbing section of the still, of a stack of trays resting on said ledge and 95 each formed with a marginal rim section and with a transverse ported diaphragm section, each of said diaphragm sections having vertically extending tubular projections surrounding said ports and bell chambers 100 therèbeneath so disposed that the tubular projections of each lower tray extend into the bell chambers of the tray above, and said rim sections uniting to form a continuous shell enclosing the spaces between 105 the diaphragms and separated from the outer shell by an annular chamber open at its upper end and being adapted to hold liquid, the bottom and side walls of which are normally sealed against the ingress and 110 egress of liquid whereby the liquid accumulating in said chamber forms an external seal for the joints between the different tray rims.

4. In a column still comprising a scrubbing section, the combination with an outer shell provided with a removable top section and with an internal ledge at the bottom of the scrubbing section of the still, of a stack 115 of trays resting on said ledge and each comprising a horizontal diaphragm section with ports therethrough and having vertically extending projections forming upwardly extending tubular portions surrounding said 120 ports, said diaphragms having bell chambers therebeneath, all so disposed that the said tubular portions on each lower tray enter the bell chambers at the underside of 125

the tray above and vertically extending projections providing a marginal tray rim projecting upward to a level below the top edge of said tubular portions.

5 5. In a column still, a scrubbing section formed of trays stacked one on top of another and each comprising a horizontal diaphragm having ports therein, vertically extending projections forming upwardly extending tubular portions surrounding said
10 ports, and vertical ribs therebeneath extending transversely of said diaphragm and arranged to form a plurality of parallel bell

chambers, a vertical marginal flange extending above said diaphragm a distance 15 less than said tubular portions and below said diaphragm a distance greater than said vertical ribs, said trays being so disposed that the said marginal flanges of the trays contact and the said tubular projections on 20 each lower tray enter the bell chambers at the underside of the tray above.

Signed at New York, in the county of New York and State of New York, this 9th day of March A. D. 1922.

WILLIAM H. PAVITT.