

Dec. 2, 1941.

B. OFFEN

2,264,329

DRYING APPARATUS

Filed July 24, 1937

2 Sheets-Sheet 1

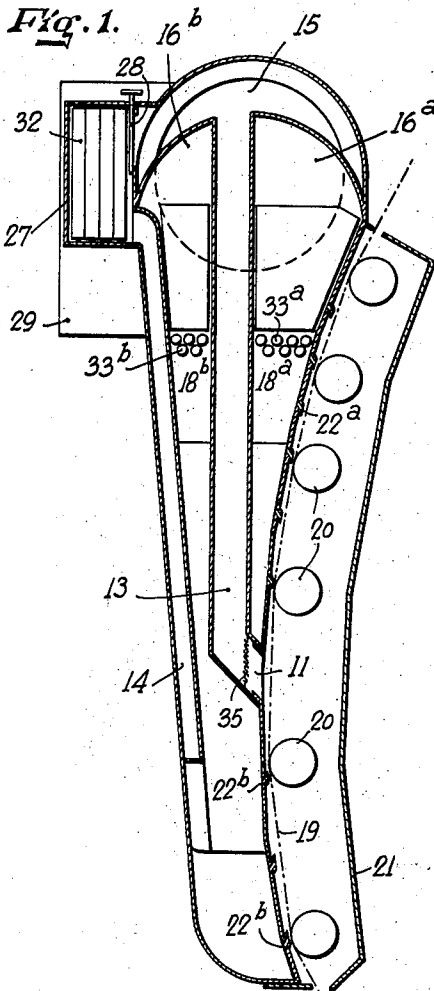


Fig. 4.

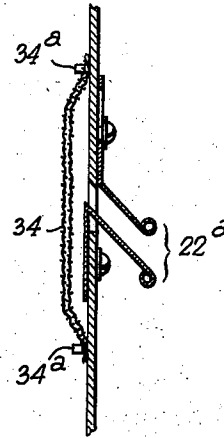


Fig. 5.

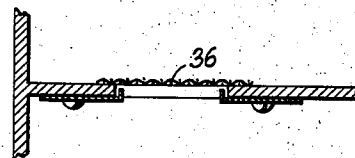
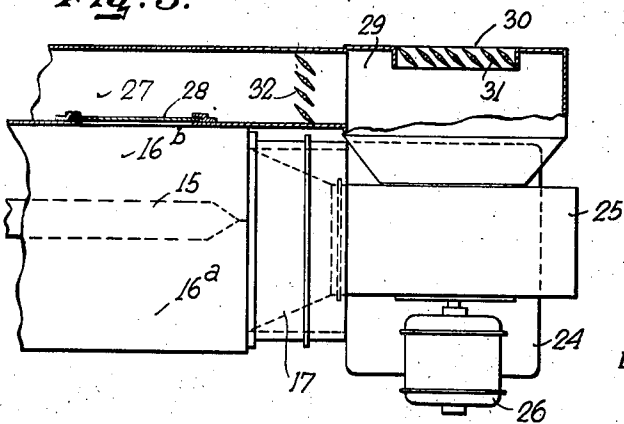


Fig. 3.



INVENTOR.
BERNARD OFFEN,
BY *Herman Seid*
ATTORNEY.

Dec. 2, 1941.

B. OFFEN

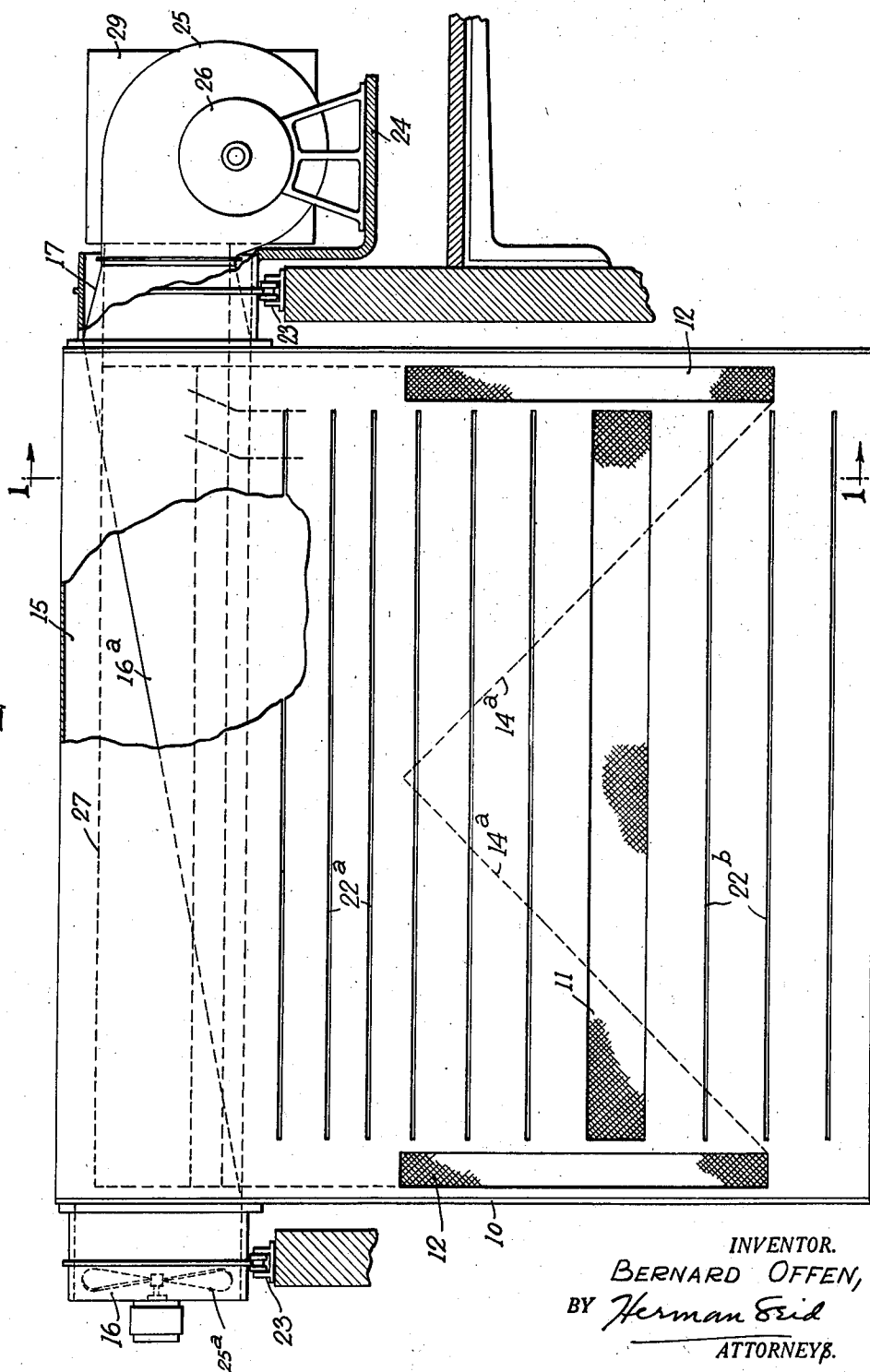
2,264,329

DRYING APPARATUS

Filed July 24, 1937

2 Sheets-Sheet 2

Fig. 2.



INVENTOR.
BERNARD OFFEN,
BY *Herman Frid*
ATTORNEY.

UNITED STATES PATENT OFFICE

2,264,329

DRYING APPARATUS

Bernard Offen, Chicago, Ill.

Application July 24, 1937, Serial No. 155,514

4 Claims. (Cl. 34-155)

This invention relates to the art of drying web materials and the like.

This application covers improvements upon the apparatus set forth in my copending applications Serial No. 6453, filed February 14, 1935, Serial No. 51,563, filed November 26, 1935, Serial No. 73,197, filed April 8, 1936 and Serial No. 139,831, filed April 30, 1937.

The general object of this invention is to provide an improved apparatus for drying web materials, and more particularly for drying such materials as freshly inked paper and the like.

It is another object of the invention to provide an improved drying apparatus capable of effecting highly efficient drying of printed surfaces and the like, which uses a relatively small quantity of drying air.

It is another object of the invention to provide a drying apparatus for drying freshly printed surfaces and the like, in which provision is made for recirculating through the apparatus at least a portion of the air withdrawn from contact with the surface, all of the air-circulating apparatus being built into and comprising part of a drying hood.

It is another object of this invention to provide a drying apparatus for drying freshly printed surfaces and the like, in which provision is made for the recirculation of air having a relatively low solvent vapor content after contact with the surface to be dried, while other air which has contacted with the surface to be dried and having a higher solvent vapor content is exhausted to the outdoor atmosphere.

It is another object of the invention to provide an improved apparatus for drying freshly printed surfaces and the like, having novel and improved means for controlling the recirculation of drying air which has contacted with the surface to be dried.

It is another object of the invention to provide a drying hood having integrally associated therewith a fan for circulating air through the hood and in contact with the surface to be dried, and means within the hood and comprising a part thereof for recirculating to the fan a portion of the air which has contacted with the surface to be dried.

It is another object of the invention to provide apparatus for drying material such as freshly printed webs which is substantially self-contained and extremely compact, while providing for recirculation of air which has contacted with the surface to be dried and for desired control of such recirculation.

It is another object of the invention to provide an improved apparatus for drying materials such as freshly printed webs which substantially reduces the hazards of fire and explosion.

A feature of the invention resides in forming integrally with a drying hood an air supply and circulating system including a fan. Thus, much of the external ductwork which has heretofore been required may be dispensed with, making the installation of applicant's drying hood simple, quick and more economical than the installation of drying hoods heretofore available. Moreover, the absence of external ductwork makes it possible to install applicant's hood without difficulty in spaces so limited as to preclude or seriously interfere with the installation of hoods heretofore known.

Another feature of the invention resides in the provision of a drying hood having a plurality of exhaust ports, different of the ports being connected to different exhaust passages, one of said exhaust passages being adapted to discharge air to the outdoor atmosphere or to a solvent recovery apparatus or the like, while another of said exhaust passages is adapted to deliver air for recirculation through the hood.

Another feature of the invention resides in the provision of a drying hood having a plurality of exhaust ports, different of the ports being connected to different exhaust passages, one of said exhaust passages being adapted to discharge air to the outdoor atmosphere while another of said exhaust passages is adapted to deliver air for recirculation through the hood and/or for discharge to the outdoor atmosphere.

Another feature of the invention resides in the provision of a drying hood having supply and exhaust ports across which are extended screens of wire or the like, of relatively fine mesh. Heretofore, the hazards of fire and explosion in connection with the operation of drying hoods, particularly hoods used for drying printed surfaces, have been very great. These hazards have been increased by the fact that explosive and combustible gases within the hood are necessarily present in considerable quantities. Any sparks or flames beneath the hood are very apt to have, and have had, the effect of igniting and exploding great volumes of gas within the hood, with disastrous consequences. Applicant's screens placed across the ports of the hood effectively prevent any flames from entering within the hood, and thus give assurance against the combustion and explosion of gases therewithin.

The safety of applicant's hood is increased fur-

ther by his novel arrangement of exhaust ports and exhaust passages. According to the invention, the exhaust ports which receive most of the solvent vapors evaporated from the surface to be dried are connected with an exhaust passage which leads to the outdoor atmosphere, and thus these vapors are discharged. If desired, of course, these vapors may be recovered in a solvent recovery system, as is well known. This air having a high solvent vapor content is not recirculated, and thus the concentration of solvent vapor in air circulated through the hood is kept well below the explosive range. The air which is recirculated through the hood comes from an independent exhaust passage which connects to other exhaust ports adapted to draw off air having a lower concentration of solvent vapors than the air drawn off through the first-mentioned ports. The air of low solvent vapor concentration is suited readily to absorb solvent vapors from the surface to be dried upon recirculation in contact therewith; and furthermore, recirculation of this air, because of its low solvent vapor concentration, will not result in reaching an explosive concentration of solvent fumes. Thus, applicant's provision of separate exhaust passages and separate circulatory systems in connection therewith results not only in safer operation but also in more efficient drying.

Other objects, features and advantages of the invention will be more apparent from the following description to be read in connection with the accompanying drawings, in which:

Fig. 1 is an elevational sectional view through a drying apparatus in accordance with the invention, taken on the line I—I of Fig. 2;

Fig. 2 is a front elevational view of the apparatus of Fig. 1;

Fig. 3 is a plan view of a portion of the apparatus of Figs. 1 and 2;

Fig. 4 diagrammatically illustrates a supply nozzle having a screen through which all of the air passing to the supply nozzle passes, and

Fig. 5 illustrates diagrammatically a fire screen covering one of the exhaust ports.

Referring now to the drawings, numeral 10 designates generally a drying hood. Formed in the face of the hood and extending substantially across the width thereof in substantially horizontal direction, at a point near the central portion of the hood, is formed exhaust port 11. At opposite sides of the face of the hood and extending lengthwise of the hood are exhaust ports 12. This arrangement of exhaust ports and the considerations which render its utilization advantageous are set forth in copending application Serial No. 139,831, filed April 30, 1937, and above referred to. It is to be understood, however, that the present invention is not limited to this particular arrangement of exhaust ports, but for the reasons set forth in said copending application it is preferable to use this arrangement. Exhaust port 11 connects with an exhaust passage 13 formed within the hood, and exhaust ports 12 connect with another exhaust passage, 14, formed within the hood. Formed in the upper portion of the hood is an exhaust chamber 15 into which exhaust passage 13 discharges. Exhaust chamber 15, in turn, discharges through exhaust connection 16 which is adapted to discharge to the outdoor atmosphere air passing therethrough, or to supply such air to a solvent recovery system. Since solvent recovery systems are well known in the art and do not, per se, form part of this invention, no further description of or reference

to them is deemed necessary here. It is to be understood, moreover, that whenever reference is made herein, in either the description or the claims, to exhausting air to the outdoor atmosphere, this expression shall be understood to include and cover supplying air to a solvent recovery or similar system.

Also formed within the upper portion of the hood 10 are supply chambers 16a and 16b. As shown in Figs. 1 and 3, supply chambers 16a and 16b are separated by a space forming part of exhaust chamber 15, so that throughout the width of the hood supply chambers 16a and 16b are independent of each other. As best seen in Fig. 2, the supply chambers 16a and 16b taper gradually across the width of the hood. Thus, air delivered to supply chambers 16a and 16b through supply connection 17 is equally distributed across the width of the hood.

Supply chamber 16a communicates with supply passage 18a and supply chamber 16b communicates with supply passage 18b. It will be noted that exhaust passage 13 is interposed between supply passages 18a and 18b, and that supply passage 18b is interposed between exhaust passages 13 and 14.

The freshly inked surface to be dried, 19, is routed upwardly adjacent the hood 10 over rollers 20. Preferably, sealing member 21 is provided to enclose the rollers in a manner well known and understood in the art. At the face of the lower portion of the hood are provided a plurality of nozzles 22b adapted to discharge air from supply passage 18b against the surface 19. Preferably, the nozzles are arranged to discharge air against the web and in an upward direction. At the face of the upper portion of the hood are provided a plurality of supply nozzles 22a adapted to discharge air from supply passage 18a against the web and in a downward direction. Thus, nozzles 22a and 22b both discharge air toward the central portion of the hood. In a preferred form of the invention, the nozzles 22a and 22b extend across the width of the hood to form relatively long narrow slots, but it is to be understood that, if desired, any other type of nozzle formation may be used.

Mounted upon the hood 10, and adapted to be rotated therewith upon rollers 23 of the supporting structure, is a pedestal base 24. Base 24 carries a fan 25 and a driving motor therefor, 26, the discharge of fan 25 being directed through supply connection 17.

Exhaust passage 14 discharges into an exhaust passage 27 which preferably extends across the width of the hood at the top thereof. Exhaust passage 27 is separated from exhaust chamber 15 by a plate or the like, 28, which is preferably removable. An end of exhaust passage 27 is adapted to communicate with and to supply air to mixing chamber 29 at the inlet to fan 25. Mixing chamber 29 is also adapted to receive, through opening 30, air from the ambient atmosphere. Thus, there is no need for providing ducts as has been commonly done heretofore, although auxiliary supply ductwork may be used in connection with the invention, if desired. The supply of air through opening 30 is adapted to be controlled by adjustable dampers 31, while dampers 32 control the supply of air from passage 27 to mixing chamber 29. Thus, by controlling the setting of dampers 31 and 32, the proportions of fresh and recirculated air supplied to the fan may be variably controlled.

Central exhaust port 11, being relatively large,

and being disposed crosswise of the hood at the central portion thereof, is adapted to receive the greater portion of the fumes evaporated from the surface 19, while exhaust ports 12 withdraw air having a lower concentration of solvent vapor. Accordingly, the air withdrawn through ports 12 and their communicating passage 14 is adapted for recirculation, while the air withdrawn through port 11 and its associated passage 13 is not adapted for recirculation. If desired, air exhausted through passage 13 may be throttled, as by suitable dampers, so that a greater volume of air will be available for recirculation.

If it is desired to recirculate air from passage 14, the removable plate 28 is positioned as shown in Fig. 1, to provide separation between passages 27 and 15, and the dampers 32 are opened. Thus, the air from passage 27 will be recirculated at a rate determined by the relative positions of dampers 31 and 32 which control the intake to the fan 25. Fan 25 recirculates to the hood air withdrawn from passage 27 and supplies thereto air withdrawn from the ambient atmosphere. An auxiliary fan 25a is preferably provided in duct 16 to effect the discharge through duct 16 of vapor-laden air passing through port 11 and passages 13 and 15.

In applications where it is desired to exhaust all of the air which has contacted the web and to recirculate none, the dampers 32 may be closed and the plate 28 removed. In this case, air from passage 27 will be delivered into exhaust chamber 15 and passed therefrom to exhaust duct 16, along with air from exhaust passage 13.

Should it be desired to recirculate only a portion of the air from passage 14, while exhausting the remaining portion, plate 28 may be partially removed, and dampers 32 may be partially opened.

In systems heretofore known, the usual method of recirculating has been to draw off from a common exhaust chamber one portion of air to be exhausted and another portion of air to be recirculated. This arrangement has proven unsatisfactory since it necessarily pits the recirculation fan and the exhaust fan against each other.

To illustrate the inadequacy of the common exhaust passage arrangement, let it be assumed that exhaust passages 13 and 14 both feed into the exhaust chamber 15 and that chamber 15 is connected to both the exhaust duct 16 and the inlet to mixing chamber 29. Under this condition, the exhaust fan, in order to exhaust air from the system, would have to create a negative pressure within the exhaust chamber 15. Thus, the fan supplying air to the hood would, in order to effect recirculation, have to draw air from the chamber 15 which was at a negative pressure. Thus, the recirculating fan would require an additional amount of power to overcome the negative pressure within exhaust chamber 15, if this fan is to circulate air through the hood in the intended manner.

A further disadvantage of this arrangement would be the necessity for automatically controlling the recirculating dampers 32. It is general practice in the operation of drying hoods to operate only the exhaust fan at the time when the presses from which the web is fed to the hood are started up. The exhaust fans are started before the presses in order to insure against the accumulation of explosive gases within the hood. The circulation of air created by the operation of the exhaust fans is sufficient,

during this starting-up period, to effect required drying of the web. As the speed of web travel is increased, the supply fan becomes operative to increase the rate at which air is supplied to the web in order that the web may properly be dried beneath the hood. During the starting-up period, when the exhaust fan alone is operative, it is essential that the recirculation dampers be closed if the common exhaust arrangement is used, because if they were not, air would travel through the fresh air inlet, through the recirculation dampers directly to the common exhaust chamber and thence out through the exhaust duct, without being circulated in contact with the web to be dried, thus trapping the fumes under the hood along the web, permitting an explosive condition to develop. As the web travel increases in speed, however, and as the recirculation fan becomes operative, the recirculating dampers may be open. But such operation of the dampers requires automatic control.

Another disadvantage of using a common exhaust chamber is that this arrangement renders it exceedingly difficult to obtain desired rates of air exhaust through the various exhaust ports of the hood. Thus, while it is desirable to maintain a relatively great rate of air withdrawal at that part of the hood where most of the fumes are given off, it is also desirable to maintain a lower rate of air withdrawal through ports serving portions of the hood where less fumes are given off. When, however, a common exhaust chamber is used to which all of the exhaust ports supply air, the pressure differential across each of these ports is approximately the same and hence the rate of air withdrawal through each port is approximately the same. While dampers at the ports may overcome this condition to an extent, to provide a degree of control, such construction necessarily complicates the design of the hood, increases the cost of its manufacture, renders its operation more complex, and should be avoided.

By providing separate exhaust passages serving different and independent exhaust chambers, applicant effectively overcomes the disadvantages just described. The exhaust fan and the recirculating fan, according to the invention, do not buck each other and thus the power input to applicant's fan motors is considerably less than in systems where a common exhaust chamber is used. Moreover, there is no need, in applicant's system, for providing automatic control of the recirculating dampers. These may be left in any desired position throughout all phases of operation, including the starting-up periods. During the starting-up period, while the exhaust fan is operative, all of the air exhausted by this fan will be circulated in contact with the web to be dried. Furthermore, applicant's arrangement provides for independently and closely controlling the rates at which air is withdrawn through the different exhaust passages and at which the air travels through the various parts of the hood. Thus, the air supply may be delivered at the proper velocity and may be properly distributed, and this air may then be withdrawn through each of different exhaust circuits in any desired proportions, for recirculation or for discharge from the system; and this may be accomplished, if desired, without recourse to dampers at the various exhaust ports but merely by controlling the speed of the exhaust and supply fans or by controlling dampers in passages 13 and 14. Applicant's arrangement, in which

separate passages are used for exhaust and for recirculation, permits the recirculation and exhaust to be substantially independent of each other, with the results that operation is much more economical and that a much greater degree of flexibility is provided than in conventional systems using common exhaust passages.

If desired, air at room temperature may be employed for drying the surface. However, it is preferred to provide heating coils 33a in supply passage 18a and heating coils 33b in supply passage 18b for heating air supplied to the surface 19, these heating coils being supplied with heating medium in any desired manner. The heating coils are preferably individually controlled. Individual control of the heating coils is of particular advantage where it is required to dry inks or varnishes or the like which tend to become tacky or sticky at temperatures above normal temperatures. In such applications only the coils 33b will be supplied with heating medium. Thus, the air delivered by nozzles 22b will be warm and effect rapid drying of the surface, while the air delivered from nozzles 22a will be of normal room temperature and will tend to set the inks and varnishes on the surface before the surface passes from beneath the hood. On the other hand, in drying materials which have a relatively great tendency to case harden, the reverse procedure might be used, heating coils 33a only being supplied with heating medium in such case. Thus, the material to be dried will be subjected first to relatively low temperatures and then, after most of the drying has been accomplished, the remainder of the drying will be accomplished at slightly higher temperature. This procedure completely avoids any case hardening of the material, while accomplishing efficient and complete drying.

As shown in Fig. 4, which illustrates one of the nozzles 22a, all the air delivered to the nozzle is passed through a screen 34. Screen 34 is preferably formed of metal and is preferably of relatively fine mesh, and it may be of double thickness. Screen 34 may be secured to the hood in any desired manner, as by studs 34a. The purpose of screen 34 is to prevent flames from the vicinity of the web from extending into the interior of passage 18a. The nozzles 22b are similarly protected for the same purpose and so also are the exhaust ports 11 and 12. The screen protection for exhaust port 11 is indicated at 35 and the screen protection for one of the ports 12 is shown at 36. Because air flows into the exhaust passages through these exhaust ports and because the air in the exhaust passages is, generally speaking, much more inflammable and explosive than air at the supply ports or elsewhere within and beneath the hood, it is extremely important that these screens be provided at the exhaust ports.

To provide for the withdrawal of air through all portions of exhaust ports 12 at a substantially equal rate, and to accommodate the volume of air withdrawn therethrough while conserving space, exhaust passage 14 is formed generally in the form of a rectangle, from the lower central portion of which there has been removed an isosceles triangular section. This is indicated by the dotted lines 14a in Fig. 2, which define the lower contour of passage 14.

By the term "hood" or "drying hood" is meant an organized assembly of apparatus as illustrated, for example, in Fig. 1, comprising an enclosure including air supply ports, air supply passages

serving said ports, exhaust passages for withdrawing air from the enclosure, means for passing a web through the enclosure, to be subjected to the drying action of the air delivered and removed through said passages, air supply and exhaust fans, and related structure combining all of the parts into a workable unit for the drying of inked webs, substantially as described.

Since many changes may be made in the invention without departing from its scope, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative only and not in a limiting sense, applicant limiting himself only as indicated in the appended claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a drying hood of the character described, means for supplying air to a surface to be dried, first exhaust port means adapted to withdraw air from said surface after it has contacted therewith, means forming a first exhaust passage connecting with said first exhaust port means, second exhaust port means adapted to withdraw air from said surface after it has contacted therewith, means forming a second exhaust passage connecting with said second exhaust port means, means for exhausting from the hood air from one of said exhaust passages, means for recirculating in contact with the surface air from the other of said exhaust passages, means for providing communication between said first exhaust passage and said second exhaust passage, and adjustable means for rendering inoperative said last mentioned means.

2. A drying hood of the character described, including means forming at least one air supply passage, means including a fan for delivering air through said passage to a surface to be dried, means forming a plurality of return ports, means forming a plurality of return passageways severally communicating with said return ports, a plurality of discharge chambers adapted respectively to receive return air from said different return passages, means for delivering air from one of said chambers to the inlet of said supply fan, an exhaust blower adapted to withdraw air from the other of said chambers, means providing communication between said exhaust chambers, and adjustable means in control of said last mentioned means.

3. A drying hood of the character described including means for supplying air to a surface of a web to be dried, first exhaust port means adapted to withdraw air from said surface after it has contacted therewith, said first exhaust port means extending through a wall of the hood and being arranged substantially crosswise of the hood and extending over substantially the entire width of the path followed by the web as it is moved through the hood to receive the greater portion of fumes evaporated from said surface by said air, means forming a first exhaust passage connecting with said first exhaust port means, second exhaust port means adapted to withdraw air from said surface after it has contacted therewith, said second exhaust port means being arranged longitudinally of the hood and substantially at the edges thereof and adjacent the ends of the first exhaust port means to receive air having a lower concentration of fumes evaporated from said surface, means forming a second exhaust passage connecting with said second exhaust port means, means for exhausting from the

hood air from said first exhaust passage, and means for recirculating in contact with the surface air from said second exhaust passage, and means to move a web through the hood.

4. In a drying hood of the character described 5 means for supplying air to a surface to be dried, first exhaust port means adapted to withdraw air from said surface after it has contacted there- with, said first exhaust port means being ar- 10 ranged to receive the greater portion of fumes evaporated from said surface by said air, means forming a first exhaust passage connecting with said first exhaust port means, second exhaust port means adapted to withdraw air from said sur-

face after it has contacted therewith, said sec- ond exhaust port means being arranged to re- ceive air having a lower concentration of fumes evaporated from said surface, means forming a second exhaust passage connecting with said sec- ond exhaust port means, means for exhausting from the hood air from said first exhaust passage, means for recirculating in contact with the sur- face air from said second exhaust passage, and adjustable means for providing communication between said first exhaust passage and said sec- ond exhaust passage.

BERNARD OFFEN.