Jan. 24, 1956

J. C. HARRIS, JR., ET AL
APPARATUS AND METHOD FOR SETTING
AND DRYING MOISTURE SETTABLE INK

2,731,732

Filed May 19, 1953

3 Sheets-Sheet 1

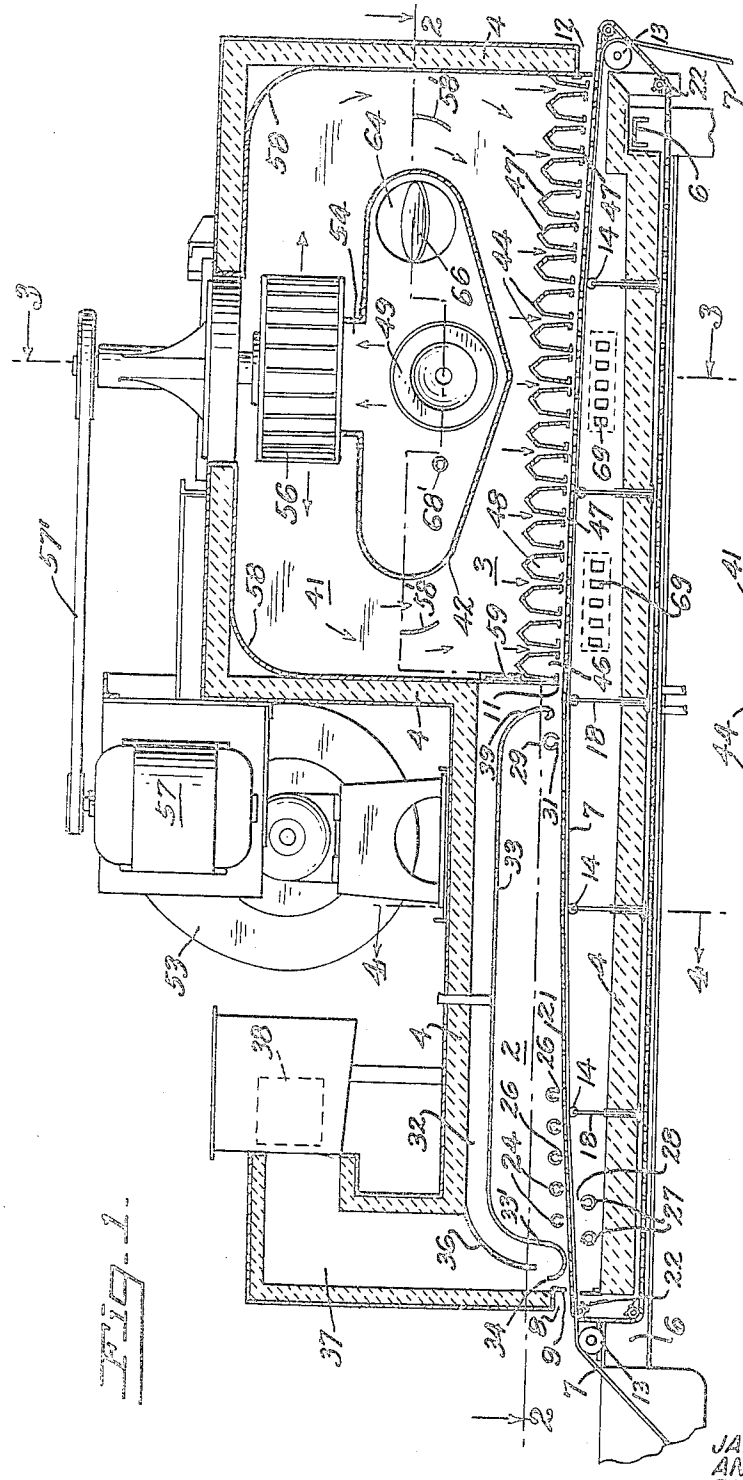


Fig. 1.

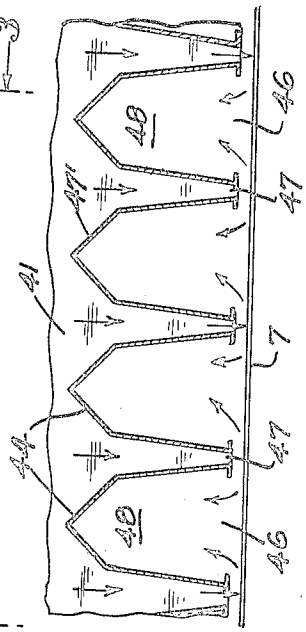


Fig. 5.

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3 Sheets-Sheet 2

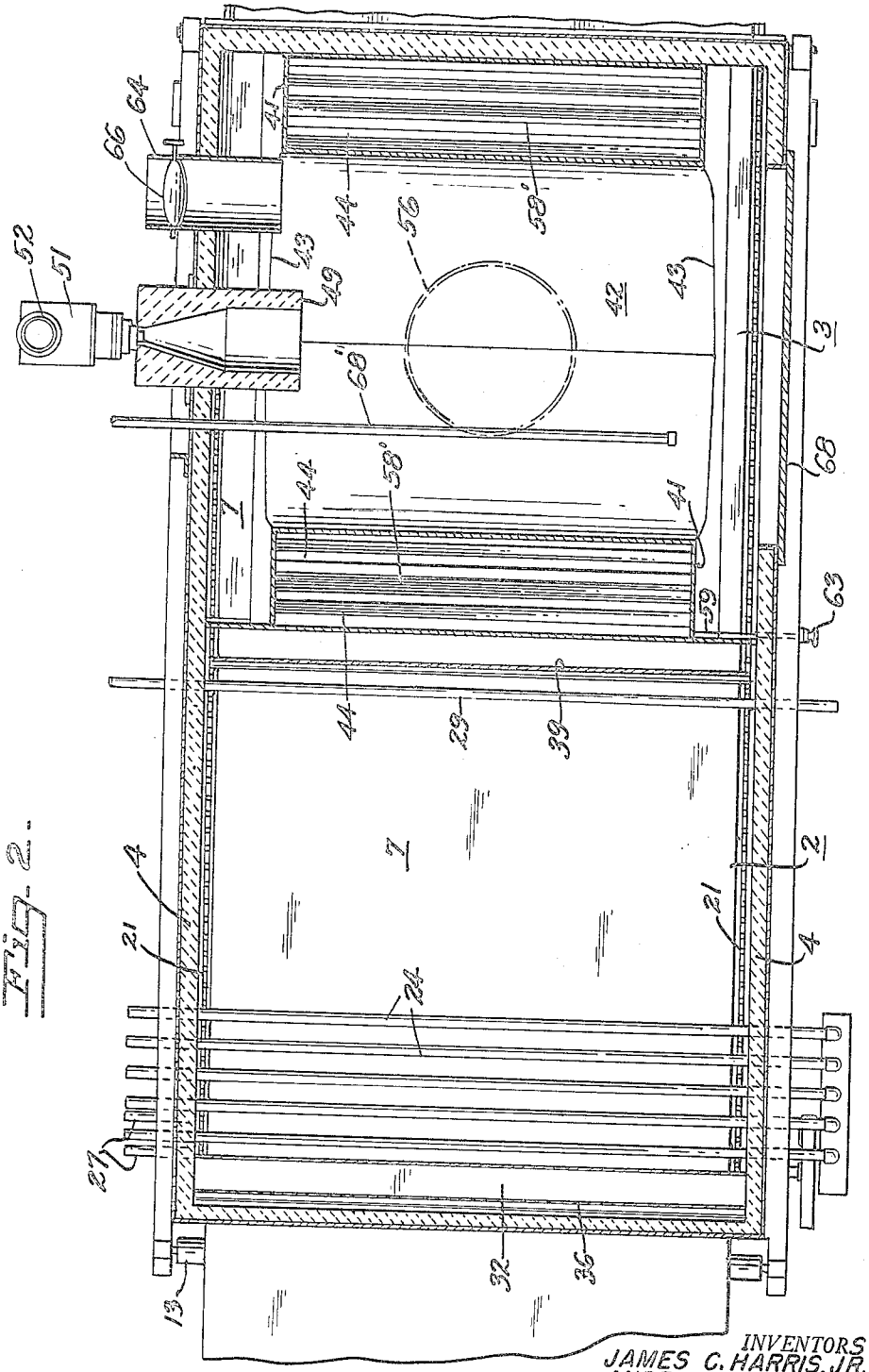


Fig. 2.

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3 Sheets-Sheet 3

Fig. 3.

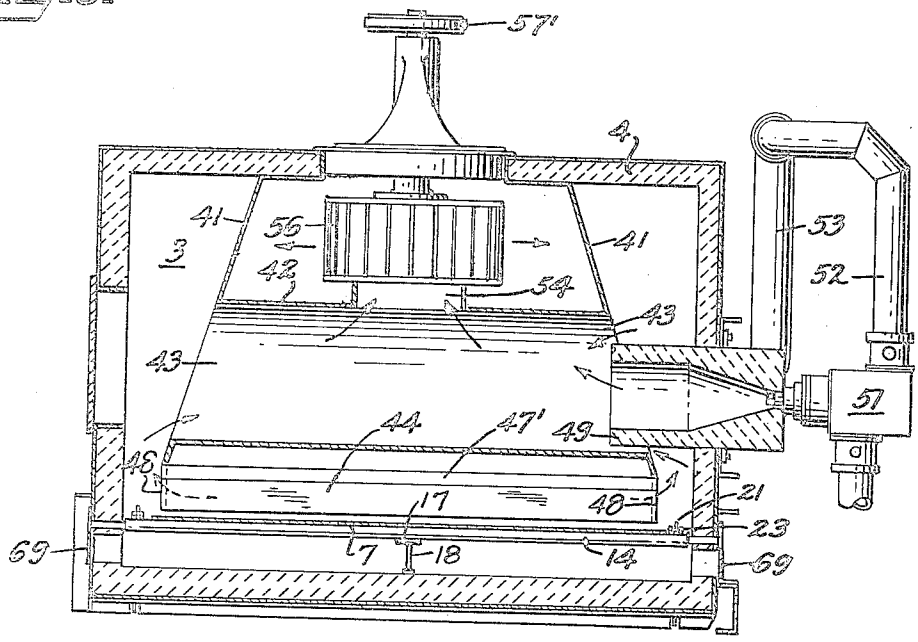


Fig. 7.

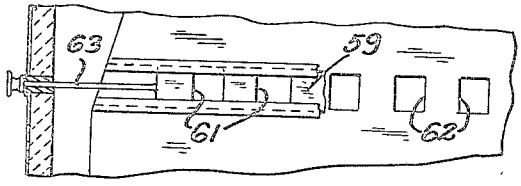


Fig. 4.

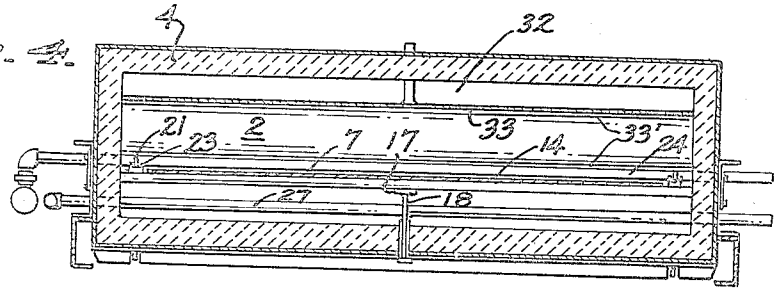
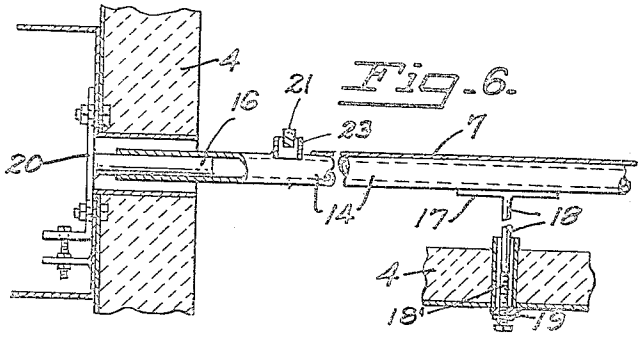


Fig. 6.



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2,731,732

APPARATUS AND METHOD FOR SETTING AND DRYING MOISTURE SETTABLE INK

James C. Harris, Jr., Berkeley, Andrew A. Caridis, Daly, and Burt C. Kendall, Menlo Park, Calif., assignors of one-half to Crown Zellerbach Corporation, San Francisco, Calif., a corporation of Nevada, and one-half to Heat and Control, Inc., San Francisco, Calif., a corporation of California

Application May 19, 1953, Serial No. 355,964

12 Claims. (Cl. 34—18)

This invention relates to the setting and drying of moisture settable ink which has been printed on a web of material such as paper; and more particularly to a type of apparatus designed for the method of first effecting setting of such ink by moisture, and as a separate or independent step subsequently drying the ink. This method is disclosed more completely in a co-pending application of one of the co-assignees hereof, by Burt C. Kendall and Mossom A. Burr, for "Method of Setting and Drying Moisture Settable Ink," Serial No. 356,058, filed May 19, 1953. The applicant, Burt C. Kendall hereof is also a co-applicant of such application.

As is disclosed in the co-pending application, moisture settable inks are well known. They generally contain a glycol as a hydroscopic solvent, such as diethylene glycol, a resinous material, such as a maleic acid type resin, as a binder, and the usual ink pigments. They are commonly employed for printing on various types of papers, for example, frozen food and bread wrappers which are generally sulphite papers. When such type of ink is applied to the paper, it can be rapidly set to a non-smudging and non-off-setting condition by supplying moisture thereto. This causes the glycol solvent in the ink to take up a sufficient amount of water; and when this occurs, the binder is rendered insoluble in the solvent and water, resulting in precipitation of the binder and pigment with consequent setting of the ink to a firm mass. Examples of such inks are known as "Hydry" inks by General Printing Ink Corporation, and "Diene Vapo Set" inks by International Printing Ink Co.

Heretofore, in the art of printing a paper web with such ink, apparatus has been employed which simultaneously supplies the moisture and effects drying in the same chamber or zone, and at the same time. The setting of the ink under such conditions has been found not to be complete because the heat of drying effects evaporation of the moisture and consequently does not give the moisture sufficient time to act.

Summarizing this invention, it is designed to provide one chamber in which the ink on a moving web of paper or the like is first set by moisture supplied to the chamber; and then after the ink has set, the moving web is then dried as a separate step in an independent drying chamber which is provided with drying means therein. By providing the ink setting chamber and the independent drying chamber, the ink can be completely set to a firm state prior to drying, and then the subsequent drying chamber effects the drying of the firmly set ink. This results in an improved printed product.

Steam is employed to supply the moisture in the ink setting chamber which is open to the atmosphere. Consequently the steam may condense as discrete water particles on inside wall portions of the apparatus in the ink setting chamber. This condensed steam (water) may result in dripping on the paper causing excessive wetting which is undesirable. To preclude condensation of the steam on the portions of the apparatus in the ink setting chamber, a passageway is provided therein through which

hot gas is conducted; the hot gas passageway extending substantially the entire width and length of the ink setting chamber and covering the steam supply means in the ink setting chamber. In the embodiment of the invention illustrated, the hot gas passageway forms the top of the ink setting chamber.

Hot gases are supplied in the drying chamber to effect the drying; and the above described hot gas passageway is in communication with the drying chamber so that some of the hot gas from the drying chamber may be conducted through the passageway. The drying chamber is provided with hot gas circulating means, and also distributing means to direct such gas against the entire surface of the inked paper moving through the drying chamber, to thus obtain uniform drying.

Referring to the drawings:

Fig. 1 is a longitudinal vertical sectional view, partly in elevation, of the apparatus;

Fig. 2 is a horizontal section taken in planes indicated by line 2—2 in Fig. 1;

Fig. 3 is a transverse vertical section taken in a plane indicated by line 3—3 in Fig. 1;

Fig. 4 is a transverse vertical section taken in a plane indicated by line 4—4 in Fig. 1;

Fig. 5 is an enlarged vertical longitudinal sectional view through a portion of inverted gas distributing troughs in the drying chamber of the apparatus.

Fig. 6 is a fragmentary transverse sectional view, partly in elevation and partly broken away to disclose more clearly the construction, of web supporting means in the apparatus.

Fig. 7 is a fragmentary elevational view, partly broken away to disclose more clearly the construction, of an adjustable damper for controlling flow of gas from the drying chamber into the ink setting chamber.

The apparatus comprises ink setting chamber 2 and independent drying chamber 3 adjacent thereto both having suitable insulated walls 4; the chambers being mounted on a suitable frame-work 6. A continuously moving web of paper 7 is conducted through the entire apparatus from the printing press (not shown) in which the ink is applied to the upper surface of the paper with reference to Fig. 1. Movement of the paper through the apparatus is effected by suitable conventional winding mechanism (not shown) which forms no part of the apparatus.

One end of ink setting chamber 2 is provided with a relatively narrow entrance 8 for the paper, the entrance being shielded by adjustable shield means 9. At its opposite end, chamber 2 is provided with an exit 11 leading into drying chamber 3 which has a similarly shielded paper exit 12 through which the dried paper passes. A suitable idler roller 13 is provided at each of entrance 8 and exit 12. The paper is supported in the apparatus as it is continuously moved therethrough, by means of spaced apart transversely extending cross bars 14 over which the web of paper slides as it is moved.

With reference to Figs. 4 and 6, each of bars 14 is tubular, and is supported on its ends by means of rods 16 fitting within the bar. Intermediate its ends, each cross bar 14 is fixedly secured by welding to a saddle 17 fixedly mounted at the upper end of a rod 18 which rests on an adjustable screw 18' enabling the vertical position of the cross bar to be adjusted within desired limits; the screw being locked in the position by means of lock nut 19 and rods 16 being mounted on vertically adjustable brackets 20.

Means is provided for initially threading a web of paper through the apparatus when this is desired. Such means comprises a pair of endless chains 21 each of which is mounted at a side of the apparatus and passes over suitable sprockets 22 at the two ends of the apparatus. A pair of sprockets at one end of the apparatus is mount-

ed on a common shaft, which can be turned by a handle (not shown) to move simultaneously both of the chains through the apparatus; the chains being slidably guided in channel members **23** mounted adjacent the ends of respective cross bars **14**.

When it is desired to move a fresh web of paper through the apparatus, this can readily be done by securing the free end thereof to the chains, and then moving the chains until the free end passes through exit **12** whereupon such free end can be secured to the winding mechanism (not shown). In this connection, it is understood that the chains **21** have no part in effecting movement of the web through the apparatus while the apparatus is operating as such movement is accomplished solely by the winding mechanism.

Steam piping is provided in the ink setting chamber **2** to supply the necessary moisture for setting the ink. Such piping comprises a plurality of transversely extending pipes **24** adjacent entrance **8** closely adjacent the upper or printed side of the web as it passes therethrough, and having spaced apart steam ejection orifices **26** at the underside thereof for supplying the steam directly onto the inked side of the web. The moisture supplied by pipes **24** serves primarily to set the ink.

Also, the piping includes a plurality of pipes **27** adjacent entrance **8** and positioned closely adjacent the unprinted side of the web, and extending transversely of the web. Pipes **27** are provided with ejection orifices **28** on their upper side which eject the steam upwardly against such under-surface of the web for the purpose of supplying moisture to replace any moisture that the glycols in the ink may absorb from the web of paper, and also to enhance firm setting of the ink. Pipes **24** and **27** have been found to be most advantageously located when positioned closely adjacent the paper as this insures rapid effect of the moisture. A distance of about an inch from the web has been found very advantageous for positioning of the piping, although this distance is not too critical as long as the piping is relatively closely adjacent the paper. Steam issuing from the piping may be reduced to a pressure of between 4 to 35 lbs. depending on the type of paper; the steam being initially of approximately 125 lb. boiler pressure.

Piping for supplying steam is also provided adjacent exit **11** of ink setting chamber **2**, comprising a transversely extending pipe **29** having downwardly directed spaced apart steam ejection orifices **31** and also positioned closely adjacent the printed side of the web substantially the same distance away from the web as the other pipes. The steam supplied by pipe **29** insures that all the ink will be set, and supplies sufficient moisture to the paper to insure against excessive drying which might otherwise occur in drying chamber **3**. Although the described arrangement of pipes **24**, **27** and **29** has been found to produce most advantageous results, other arrangements can be utilized as it is only necessary to supply moisture to the paper and ink thereon to set the ink.

Ordinary boiler or saturated steam is supplied by the described piping in the ink setting chamber. Although the piping is desirably at the locations related, the steam issuing therefrom maintains the stem setting chamber completely full of steam. To prevent the steam from condensing on the walls of the apparatus, and falling on the paper as discrete water particles, thus unduly wetting it, means is provided in the ink setting chamber to maintain the steam substantially entirely in the vapor state.

Such means comprises a passageway **32** forming the top or roof of and extending substantially the entire width and length of ink setting chamber **2**, and which is positioned over all the previous described piping to completely cover the same. Hot gas at a temperature well above 212° F., preferably between 300° F. and 350° F,. is conducted through passageway **32** to provide the necessary heat for preventing formation of condensate, and such hot gas is obtained from the drying chamber **3** in a manner to be subsequently described.

The top wall of passageway **32** is formed by the top of setting chamber **2** and the lower wall **33** by means of galvanized iron sheeting suitably secured in the apparatus. Wall **33** adjacent entrance **8** extends downwardly at **33'** and is provided with upwardly extending lip **34** which forms a trough sloping toward one end from which drainage may be collected. A curved baffle **36** cooperates with lip **34** to provide egress of gas in passageway **32** into stack **37** which is connected to an exhaust fan (not shown) for removing the gas. A slide damper **38** is associated with stack **37** to provide a control, if so desired, in cooperation with the other controls to be described for regulating the draft of the flowing gas. At exit **11**, wall **33** is provided with downwardly extending portion **39** which substantially completely covers pipe **29**.

Downwardly extending end portions **33'** and **39** of wall **33** are positioned closely adjacent the moving web **7** to confine the heat in the entire space into which steam is injected, for preventing formation of condensate. In this connection, it will be noted that underside of passageway **32** adjacent the web is in close proximity to the web to provide a relatively small volume in setting chamber **2** which is maintained heated by the gas in passageway **32**, thus maintaining the steam vaporized with minimum heat energy. For this purpose it is desirable to have passageway **32** as close to the steam piping as possible but not close enough to have any substantial heating or drying effect on the paper. The higher passageway **32** is above the piping the more heat energy that has to be supplied to preclude condensation of the steam. Wall **33** is preferably approximately 8 inches from the web at the location of pipe **29**, and approximately 10 inches from the web at the location of the left hand pipe **24** appearing in Fig. 1. It is understood that steam is continuously supplied by all the steam piping.

Drying chamber **3** is provided with means to direct hot gas directly against the web and over the entire surface area thereof as it is moved through the chamber, to thus dry the web thoroughly. For this purpose, chamber **3** has fixedly supported therein spaced apart side walls **41** which extend the length thereof. Supported by these walls and extending crosswise thereof is a so-called plenum **42** which is tubular in shape and open at both its opposite ends **43**.

A plurality of closely spaced apart inverted troughs **44** extending transversely of the chamber and fixedly supported at the bottom of walls **41** is also provided. With particular reference to Figs. 1 and 5, it will be noted that troughs **44** are open at their bottoms **46** and are closely apart at their bottoms, as indicated at **47**. The tops of the troughs are preferably provided with triangularly shaped portions **47'**; and each of the opposite ends **48** of each trough is open. However, the cross sectional shape of the troughs is not particularly critical, as long as they are relatively close together.

A gas burner nozzle **49** communicates with one end of plenum **42** and supplies hot combustion gas into the plenum; nozzle **49** being connected to gas mixing chamber **51** which is supplied with the usual combustion air by means of conduit **52** connected to blower fan **53**. The top of plenum **42** is provided with an opening **54** positioned under a suitable continuously driven exhaust fan **56** which is preferably a squirrel cage type fan; the fan being continuously driven by electric motor **57** through belt drive **57'**.

In operation, fan **53** continuously exhausts hot gas from plenum **42** through opening **54** therein, and the exhausted hot gas is discharged over the top of plenum **42** and is deflected downwardly through the narrow spaces **47** between troughs **44** so that the gas is directed uniformly over the entire surface area of the web being dried. To guide the flow of gas, curved deflectors **58** are provided between side walls **41** at the upper end portions thereof; and also curved deflectors **58'** are provided between walls **41** and adjacent the ends of the plenum. Because of the

narrowness of spaces 47 between troughs 44, the gas is directed at a relatively high velocity against the web in the form of spaced sheets, making for efficacious and rapid drying.

The gas forced through spaces 47 expands and is pocketed in the inverted troughs 44. Since such troughs are open at their opposite ends 48, the gas pocketed in the troughs is then exhausted through such open ends 48 and into the end openings 43 of the plenum, by means of fan 56 so that the gas is continuously heated and recirculated. The flow of gas is indicated by direction arrows.

A portion of the gas in drying chamber 3 is continuously withdrawn into passageway 32 by the fan (not shown) connected to stack 37. To control the draft between drying chamber 3 and passageway 32, a conventional transversely extending slidably mounted damper 59 is provided at the location where passageway 32 communicates with chamber 3. Damper 59 has a plurality of ports 61 adapted to cooperate with ports 62 in the wall adjacent the entrance to passageway 32. The damper is adjustable from the outside of the apparatus by means of adjusting rod 63.

A fresh air inlet 64 controlled by damper 66 communicates with one end of plenum 42; and adjacent the opposite end of the plenum, a removable inspection door 68 is provided in the wall of the apparatus. Also a steam injection pipe 68' is provided in plenum to introduce steam therein when desired for obtaining control of humidity. In this connection, sufficient steam is introduced into the plenum from time to time as required to prevent excessive drying out of the paper. Suitable slide dampers 69 of a type similar to damper 59 are also provided in drying chamber 3 below the path of travelling web. By adjustment of various dampers, the desired draft and recirculating conditions can be obtained; and in this connection, the dampers are so regulated that there is an indraft all the time through entrance 8 and exit 12.

As is explained more fully in the aforementioned copending application, in which the method of treatment of the inked web paper is claimed, the ink setting chamber is maintained in an atmosphere of steam which is maintained against condensation by the hot gases in passageway 32; the temperature of gas in such passageway being around 300° F. to 350° F., while the temperature of hot gas in the drying chamber 3 approximately 400° F. to 450° F. The residence time of the paper in each of the chambers is approximately one second. Conventional automatic controls and temperature indicating mechanisms (not shown because they form no part of the present invention) can be provided with the apparatus.

We claim:

1. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber, means in said ink setting chamber for supplying steam therein, an independent drying chamber, means in said drying chamber for supplying hot gas therein, a passageway in and extending through said ink setting chamber communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber to prevent condensation of the steam, and means for supporting said web as it is moved through said chambers.

2. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber, pipes in said ink setting chamber for supplying steam therein, an independent drying chamber, means in said drying chamber for supplying hot gas therein, a passageway in said ink setting chamber over said pipes and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber, and means for supporting said web as it is moved through said chambers.

3. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber, an independent drying chamber, means for supporting said web as it is moved through said chambers, piping in said ink setting chamber positioned relatively closely adjacent and transversely of said web for supplying steam to said web, means in said drying chamber for supplying hot gas therein, and a passageway in said ink setting chamber over said piping and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber.

4. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber, an independent drying chamber, means for supporting said web as it is moved through said chambers, piping in said ink setting chamber positioned relatively closely adjacent and transversely of said web for supplying steam to said web, means in said drying chamber for supplying hot gas therein, and a passageway in said ink setting chamber over said piping and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber, said passageway extending substantially the entire width and length of said ink setting chamber with opposite ends thereof closely adjacent said web, and the side of said passageway adjacent said web being in close proximity thereto.

5. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber having an entrance for the web at one end thereof and an exit for the web at the opposite end, an independent drying chamber adjacent said ink setting chamber and having an entrance for the web communicating with said exit, means for supporting said web as it is moved through said chambers, piping in said ink setting chamber adjacent the entrance thereof positioned at each side of and relatively closely adjacent and transversely of said web for supplying steam to said web, additional piping in said ink setting chamber adjacent the exit thereof positioned over and transversely of said web for supplying steam to said web, means in said drying chamber for supplying hot gas therein, and a passageway in said ink setting chamber over all of said piping and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber.

6. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber having an entrance for the web at one end thereof and an exit for the web at the opposite end, an independent drying chamber adjacent said ink setting chamber and having an entrance for the web communicating with said exit, means for supporting said web as it is moved through said chambers, piping in said ink setting chamber adjacent the entrance thereof positioned at each side of and relatively closely adjacent and transversely of said web for supplying steam to said web, additional piping in said ink setting chamber adjacent the exit thereof positioned over and transversely of said web for supplying steam to said web, means in said drying chamber for supplying hot gas therein, and a passageway in said ink setting chamber over all of said piping and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber, said passageway extending substantially the entire width and length of said ink setting chamber with opposite ends thereof at said entrance and exit of said ink setting chamber closely adjacent said web, and the side of said passageway adjacent said web being in close proximity thereto.

7. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber, having an entrance for the web at one end thereof and an exit for the web at the opposite end, an independent drying chamber adjacent said ink setting chamber and having an entrance for the web communicating with said exit, means for supporting said web as it is moved through said chambers, piping in said ink setting chamber adjacent the entrance thereof positioned at each side of and relatively closely adjacent and transversely of said web for supplying steam to said web, additional piping in said ink

setting chamber adjacent the exit thereof positioned over and transversely of said web for supplying steam to said web, means in said drying chamber for supplying hot gas therein, a passageway in said ink setting chamber over all of said piping and communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber, and means for controlling flow of gas from said drying chamber through said passageway.

8. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber having moisture supplying means therein, an independent drying chamber, spaced walls in said drying chamber, a plenum open at both ends between said walls, means for introducing heated gas into said plenum, and means for circulating and recirculating said gas in said drying chamber comprising an exhaust fan to withdraw gas from said plenum and a plurality of spaced apart inverted troughs positioned over said web between said spaced apart walls.

9. Apparatus for setting moisture settable ink on a moving web of material comprising an ink setting chamber having moisture supplying means therein, an independent drying chamber, spaced walls in said drying chamber, a plenum open at both ends between said walls, means for introducing heated gas into said plenum; means for circulating and recirculating said gas in said drying chamber comprising an exhaust fan to withdraw gas from said plenum and a plurality of spaced apart inverted troughs positioned over said web between said spaced apart walls; and a passageway in said ink setting chamber communicating with said drying chamber for conducting hot gas from said drying chamber through said ink setting chamber.

10. The method of preventing steam from condensing in an enclosed zone wherein steam is supplied for effecting setting of moisture settable ink on a web of material moving through said zone, and the inked web is subsequently dried in an independent enclosed drying zone, which comprises utilizing hot gas for subsequently drying said web in said drying zone, providing a passageway in said ink setting zone, and causing flow of some of said hot gas through said passageway to prevent condensation of steam in said ink setting zone.

11. The method of preventing steam from condensing in an enclosed zone wherein steam is supplied over a web of material moving through the zone for effecting setting of moisture settable ink on the web, and the inked web is subsequently dried in an independent enclosed drying zone, which comprises utilizing hot gas for subsequently drying said web in said drying zone, providing a passageway over said web and extending through said ink setting zone, and causing flow of some of said hot gas through said passageway to prevent condensation of steam.

12. In apparatus of the character described, a drying chamber, means for supporting a moving web of material therein, spaced apart walls in said drying chamber, an open ended tubular shaped plenum extending crosswise between said walls, means for introducing heated gas into said plenum, a plurality of spaced apart inverted troughs extending crosswise between said walls and positioned over said web and below the bottom of said plenum, and means for circulating and recirculating said gas in said chamber by withdrawing hot gas from said plenum and directing it between said troughs against the web whereby the gas becomes pocketed in said troughs and is withdrawn from their ends into the open ended plenum.

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