Dec. 27, 1938. B. OFFEN 2,141,403

DRYING METHOD AND APPARATUS

Filed April 8, 1936

Fig. 1.

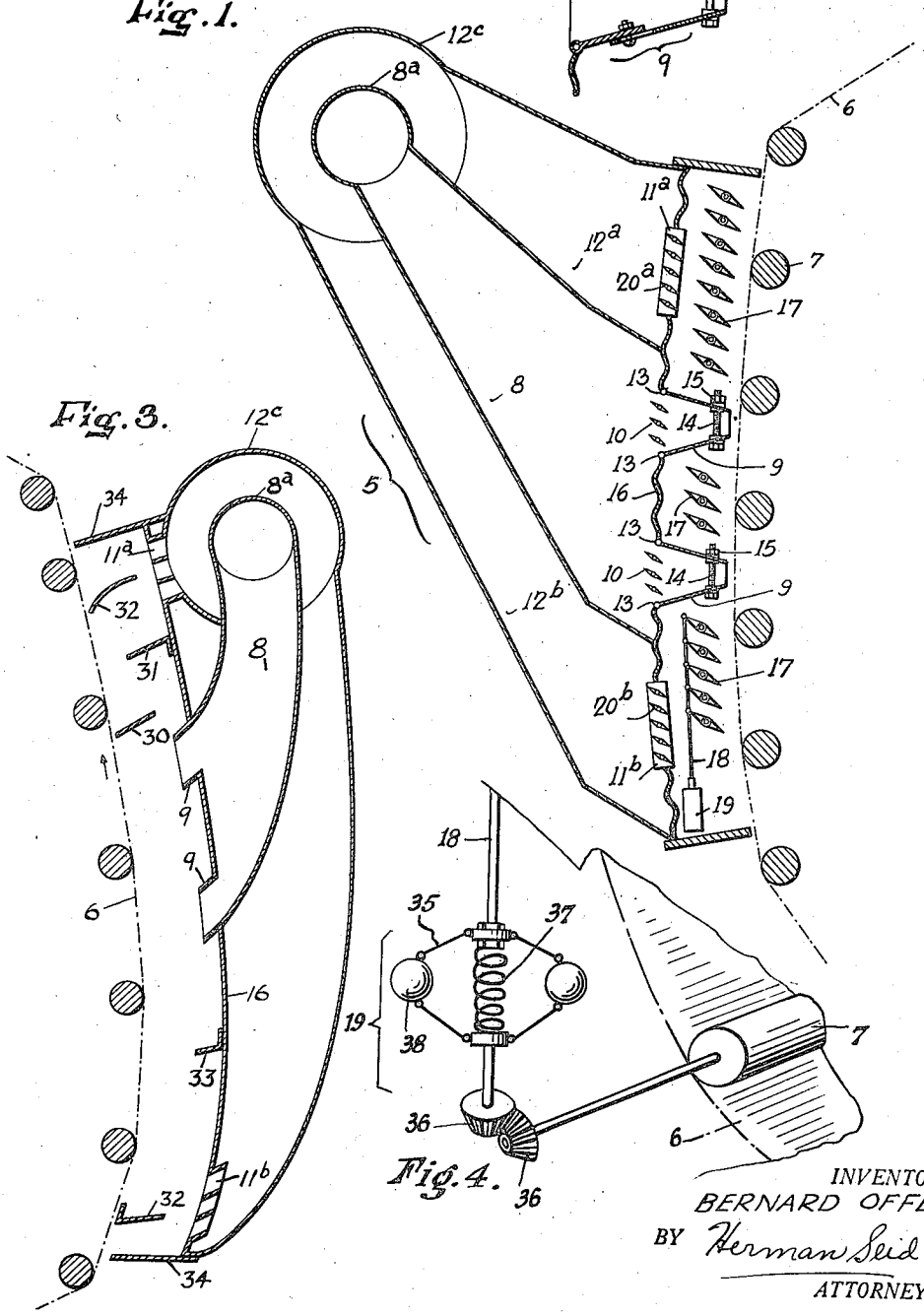


Fig. 2.

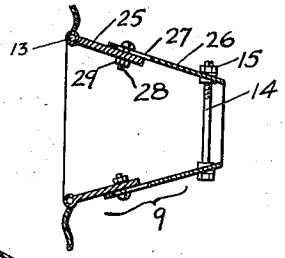


Fig. 3.

Fig. 4.

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DRYING METHOD AND APPARATUS

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7 Claims. (Cl. 34—48)

This invention relates to the art of drying and more particularly to a method of and means for drying sheet or web materials, such as freshly inked paper or the like.

This application is a continuation-in-part of my copending application, Serial No. 6,453, filed February 14, 1935, and my copending application, Serial No. 51,563 filed November 26, 1935, which issued July 12, 1938 as Patent No. 2,123,341.

The general object of the invention is to provide an improved method of and means for efficiently and economically drying sheet or web materials.

It has been general practice in the drying art to dry web materials by passing them under a hood or through a tunnel-like enclosure, to which air is supplied at predetermined temperatures to accomplish the required drying by absorbing solvent and water vapors from the web materials. The temperature of the air is varied in accordance with the nature of the material to be dried, the speed at which the material is to be dried, and the characteristics of the material with relation to heat.

The surface of a freshly inked web is rough and irregular due to the little crevices and spaces in between the various inked particles on the surface. When such a web passes through a drying tunnel at speeds of between 500 and 1500 feet per minute, as are encountered in modern printing practice, the web tends to carry a film of drying air along with it. This film, which blankets the web, becomes saturated quickly with solvents and water vapors from the freshly inked surface of the web, and retards the liberation of vapors from the surface. Heretofore, large air volumes have been required to effect penetration of this film, so that the freshly-introduced and relatively vapor-free air might pick up solvents and vapor from the surface. Moreover, because of the thermal insulating effect of this film, the temperature of the drying air has necessarily been relatively high, in order that the heat of the drying air might penetrate the blanketing film to cause vaporization of the solvents on the surface of the web.

It is an object of the invention to provide for the breaking up of this film in order to insure intimate contact between the introduced drying air and the printed surface of the web.

It is another object of the invention to dry web materials with relatively small air volumes and low drying air temperatures.

It is another object of the invention to prevent the escape of gases and fumes from a drying hood into the surrounding atmosphere.

It is another object of the invention to supply drying air to a surface to be dried, and to insure turbulent motion of the drying air while it is proximate the surface to be dried.

It is another object of the invention to provide means for supplying air to a surface to be dried, means for causing turbulent motion of air supplied to the surface, and means for controlling the operation of the turbulence-producing means.

A feature of the invention resides in supplying air to a web through one or more nozzles, and removing air which has contacted the web through exhaust ports on opposite sides of the supply nozzles.

Another feature of the invention resides in supplying drying air to a web to be dried through one or more nozzles, the discharge ends of which are relatively close to the web.

Another feature of the invention resides in impinging drying air against a web through nozzles which are adjustable, whereby the direction and velocity of the discharged air may be controlled.

Another feature of the invention resides in the provision of a drying hood in which the sides of the drying air passages comprise surfaces rendered irregular or rough by corrugation, or in any other suitable manner. This irregularity causes eddying and turbulence of air flowing through the passages, the turbulence breaking up the film and bringing the drying air into more intimate and effective contact with the web.

Another feature of the invention resides in the provision of a drying hood having baffles in its air passages for causing turbulent motion of air circulating within the hood.

Another feature of the invention resides in the provision of a drying hood having adjustable baffles in its air passages for causing turbulent air motion within the hood and means for controlling the position of the baffles in accordance with variations in operating conditions.

Another feature of the invention resides in the provision of a drying hood having baffles for scooping air having a high velocity from proximate the surface of a web being dried, and for impinging this scooped air against the web to prevent the formation of film.

Another feature of the invention resides in the provision of a drying hood through which drying air is circulated at high velocity, the hood hav-

ing baffles for preventing the escape of drying air, gases and fumes from the hood into the surrounding atmosphere and for directing such drying air, gases and fumes into the exhaust openings of the hood.

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

Fig. 1 represents a longitudinal section through a drying hood embodying the invention;

Fig. 2 illustrates a modified nozzle structure; and

Fig. 3 is a longitudinal section through a drying hood embodying a modification of the invention; and

Fig. 4 is a diagrammatic and fragmentary view, in perspective, of one form of apparatus adapted to vary the position of baffles within the hood in accordance with changes in the speed of travel of web passing beneath the hood.

Referring now to the drawing, the numeral **5** designates generally a drying hood under which is passed a freshly inked web or the like **6** carried on rollers **7**. Drying air from supply plenum **8**, served by supply duct **8***a*, is discharged against web **6** through one or more nozzles **9**, the discharge ends of which are relatively close to the web. The ends of the nozzles **9** are round and smoothly finished to prevent damage to the web in case of contact between the nozzles and the web. Dampers **10** control the supply of drying air from the supply plenum **8** to the nozzles **9**. Air which has contacted the web **6** is withdrawn therefrom through outlet ports **11***a* and **11***b* at opposite extremities of the hood. The air withdrawn through ports **11***a* and **11***b* passes through discharge chambers **12***a* and **12***b* respectively of the hood, and through discharge duct **12***c*, and is then exhausted to the outdoor atmosphere or is suitably prepared for a repetition of its drying function.

The sides of the nozzles **9** are hinged at **13** so that the directions of the nozzles and their discharge areas may be varied, thus to control the direction and velocity of air discharged therefrom. Threaded bars **14** and their associated nuts **15** hold the sides of the nozzles in desired spaced relation. Generally it is preferable to adjust the nozzles **9** so that their discharge areas are relatively small. Thus the air discharged from the nozzles has a relatively high velocity, and its impingement against the web effectively prevents the formation of any surface film. If the web passing under a nozzle opening should carry with it a film of solvent laden air, the high velocity of the air discharged by the nozzle will break up the film. Having the discharge ends of the nozzles close to the web is of advantage in two ways: First, this insures that the air discharged from the nozzles will impinge against the web before its velocity has been dissipated. Moreover, since the nozzles protrude through the back **16** of the hood into the air passages, considerable eddying occurs in the air passages. This eddying is highly effective in preventing the formation of film, and thus expedites drying of the web.

To increase eddying of drying air circulating through the hood, applicant preferably corrugates back **16** of the hood.

Further to increase the eddying of air passing from the nozzles **9** to the outlets **11***a* and **11***b*, applicant provides baffles **17** in the path of air circulating through the hood. Baffles **17** may be of any desired shape, and may be adjustable or stationary. Adjustment of the baffles may be manually or automatically controlled. As illustrated in the lower portion of the drawing, the baffles **17** are pivotally mounted and are under the control of rod **18**. Rod **18** is actuated by a solenoid, air motor, or other control device **19**, the action of which is controlled responsive to variations in the speed at which the web is passed under the hood, or in any other suitable manner. As shown in Fig. 4, for example, the control device **19** comprises a fly-ball device **35** of conventional design connected through bevel gears **36** to one of the rollers **7** by which it is driven. Spring **37** tends to elongate the device **35** in an upward direction, thus tending to raise rod **18**. When operation of the printing and drying apparatus is started, the baffles will be in such position as to provide relatively great clearance between the web and the baffles, to allow for the flapping of the web which usually occurs when such operations are started. As the speed of the web increases, its oscillation decreases, and the baffles are moved so that they more closely approach the web. This is accomplished by the device **35** since the increasing rotative speed of the fly-balls **38** causes the device **35** to flatten out, so that rod **18** is lowered. Thus considerable eddying is caused to occur in the immediate vicinity of the web, where it is most effective in preventing the formation of film.

By suitably controlling the supply dampers **10**, the discharge dampers **20***a* and **20***b*, and the supply and exhaust fans, the escape of vapors and fumes from the hood into the ambient atmosphere may be effectively prevented, as explained in the copending applications set forth above.

Under certain operating conditions, and in drying webs having certain characteristics, it is desirable to adjust or vary the distance between the discharge end of the nozzles **9** and the web. Accordingly, as shown in Fig. 2, applicant provides nozzles adapted to be adjusted in this way. As illustrated, each side of the nozzle **9** consists of two members. The first of these, **25**, is hinged at **13**, as explained in connection with Fig. 1. The second of these, **26**, is slidable with respect to member **25**. Any desired construction may be used, and applicant does not limit himself to any particular nozzle construction. In practice, it has been found expedient to form a slot **27** in the member **26**. A bolt **28** extends through slot **27** and member **25** and, with nut **29**, holds the members **25** and **26** in fixed engagement in any desired position.

In the modification of the invention illustrated in Fig. 3, applicant provides a novel baffle arrangement which increases the drying efficiency of the hood and prevents the escape of odors and fumes from the hood into the surrounding atmosphere. The air discharged by nozzles **9** has considerable energy due to its pressure and velocity, and its velocity is increased by the friction between the air and the swiftly moving web. Applicant utilizes this energy of the air for breaking up the film which tends to blanket the web and insulate it from the freshly introduced drying air. A baffle **30** positioned relatively close to the web scoops swiftly moving air from the immediate vicinity of the web. This air is then redirected by baffle **31** against the web, and its impingement thereagainst at high velocity effectively breaks up any film which may have escaped the scraping action of baffle **30**. Any number

of pairs of baffles such as 30 and 31, may be provided.

Baffle 33 positioned proximate the back 16 of the hood, directs high velocity air moving toward the exhaust port 11b against the web. Thus, the air velocity proximate the web is increased, and the impinging action of the redirected air prevents the formation of film. Both of these factors increase the drying efficiency of the hood.

As explained in co-pending application Serial No. 6,453, filed February 14, 1935, applicant maintains a pressure differential between the supply and exhaust ports whereby a small amount of air from the outside atmosphere will be drawn into the hood at its extremities, and gas and fumes from the hood will be prevented from escaping into the outside atmosphere. When the drying air is supplied to the hood at relatively high velocities, this average pressure differential is sometimes insufficient to prevent the escape of gases and fumes into the surrounding atmosphere. This is because the high velocity of the air traveling through the hood tends to cause it to travel right on past the end seals of the hood and into the surrounding atmosphere, notwithstanding the pressure differential. Thus, where high air velocities within the hood are used, outside air may be drawn into the hood at one or more points while high velocity air and gas pass from the hood to the surrounding atmosphere at other points. Applicant's purpose is to prevent the escape of any air, gas or fumes, regardless of amount, from the hood to the surrounding atmosphere. To prevent the high velocity air and gas from "shooting past" the end seals 34 of the hood, applicant provides baffles 32. These baffles are positioned relatively close to the web near the ends of the hood and scoop high velocity air therefrom. Baffles 32 then redirect this air to the outlet ports 11a and 11b. Thus, according to the invention, the high velocity of the air traveling through the hood is utilized to facilitate exhaust, whereas in conventional drying apparatus, the high velocity of such air makes exhaust difficult. The baffles 32 are spaced from the end seals 34 of the hood in order that air from the outdoor atmosphere may continue to be drawn into the hood by the pressure differential between supply and exhaust, thus providing double assurance against escape of gases and fumes from the hood into the surrounding atmosphere.

Since many modifications may be made in the invention without departing from the scope thereof, it is intended that the foregoing description and the accompanying drawing be regarded as illustrative only and not in a limiting sense, applicant limiting himself only as indicated in the accompanying claims.

I claim:

1. In an apparatus of the character described, a drying hood including means for supplying air to an object to be dried, an exhaust port, an air passage providing communication between the supply means and the exhaust port, whereby air may be circulated through said air passage adjacent the object to be dried, adjustable baffles disposed within said air passage for causing turbulence and eddying of air circulating through said passage, means for moving said object relative to said hood, and means for adjusting the position of the baffles in accordance with the speed at which said object is moved.

2. In an apparatus of the character described, an air passage, means for circulating air through said passage adjacent material to be dried, baffles spaced from a wall of said passage for removing air from near the surface of said material and other baffles for impinging said removed air against said material.

3. In an apparatus of the character described, means including a confining wall for forming an air passageway between said confining wall and web material which is to be subjected to the drying action of air circulated through said passageway, means for circulating air through said passageway adjacent said web material, and a plurality of baffles disposed in said passageway and spaced from said confining wall and from said material.

4. In a drying hood of the character described, an air passage, means for passing through said passage material to be dried, means for supplying air to said passage, means including an outlet port for withdrawing air from said passage, whereby air may be circulated through said passage in contact with said material to be dried, and baffle means spaced from a wall of said passage in juxtaposition with said outlet port and positioned relatively close to said material, said baffle means being adapted to remove air from proximate material moving past said baffle means and to redirect said removed air to said outlet port.

5. In a drying apparatus having an air passageway through which air is circulated adjacent the material to be dried, and means for moving said material through the drying apparatus; adjustable baffles within said air passageway for causing turbulence and eddying of air circulating through said passageway, speed-responsive control means, means for adjusting said control means in accordance with the speed at which said material is moved through said apparatus, and means under the control of said speed-responsive control means for controlling the position of said baffles.

6. In a drying apparatus having an air passageway through which air is circulated adjacent the material to be dried, and means for moving said material through the drying apparatus; adjustable baffles within said air passageway for causing turbulence and eddying of air circulating through said passageway, speed-responsive control means, means for operating said control means in accordance with the speed at which said material is moved through said apparatus, and means controlled by said speed-responsive control means for moving end portions of said baffles closer to said material as the speed at which said material is moved increases, and for moving said end portions of said baffles away from said material as the speed at which said material is moved decreases.

7. In an apparatus of the character described, means forming an air passage, means for circulating air through said passage adjacent material to be dried, baffle means spaced from a wall of said passage and positioned proximate the surface of said material for removing air from near the surface of said material and means within said passage for rerouting said removed air to impinge against said material.

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