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ROTOGRAVURE PRINTING OF PAPERBOARD

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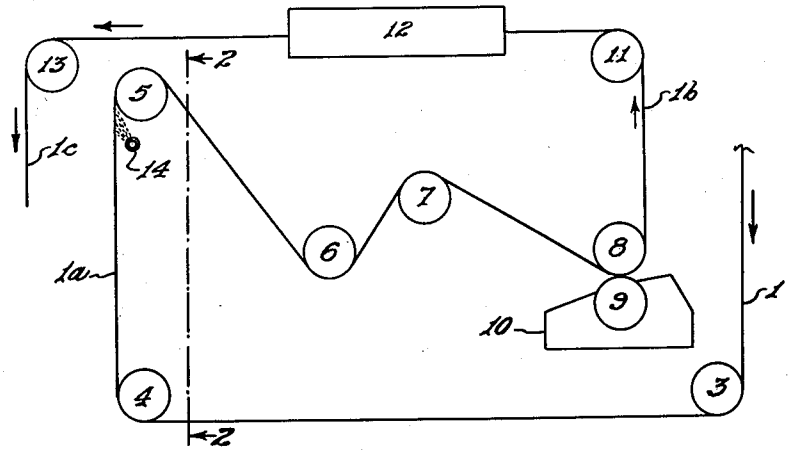


FIG. 1.

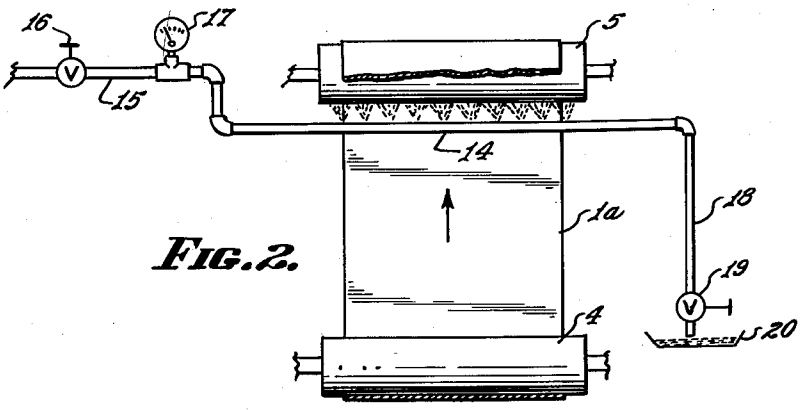


FIG. 2.

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ROTOGRAVURE PRINTING OF PAPERBOARD

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3 Claims. (Cl. 101—170)

The invention has to do with the rotogravure printing of continuous webs, and in particular webs of paperboard such as are used in the manufacture of folding cartons. This application is a continuation-in-part of copending application of the present inventors entitled Improvements in Rotogravure Printing, Serial No. 573,078, filed March 22, 1956.

As is well known, rotogravure printing is accomplished by means of cylinders, usually of steel coated with copper, which are etched to form small depressions or cells differing as to area or depth or both. The ink which is to form the printed impression is contained within the cells or depressions, and when the continuous web is brought against the cylinder under heavy pressure from a rubber-surfaced impression roll the ink is transferred from the cells to the web. The ink is liquid, having for example a viscosity of 17 to 24 seconds at room temperature, 75 to 85° F., by the Number 2 Zahn cup method. The ink is applied to the cylinder so as to enter the cells or depressions, and then is wiped from the outer cylinder surface so that it persists only in the depressions.

The intensity of the printed impression depends on the area and depth of the depressions. In areas where there are no depressions no printing will be done. If the depressions are large, deep and closely spaced, a solid color impression may be made on the surface of the web. Smaller depressions apply interspaced dots of color to the web giving a half-tone effect.

Rotogravure presses are generally large machines designed to apply successive impressions in a plurality of colors. In presses for printing cartons the cylinders may be 20 to 40 inches or more in circumference and more than 42 inches in length; and such presses may operate at lineal speeds up to several hundred feet per minute or more, for example, 600 feet per minute.

After an ink impression has been made, that impression is dried as by passing the freshly printed web through a ventilated hot oven in which the air may be at a temperature of 160 to 180° F., for example; and this is usually repeated after each impression. A final printing unit is sometimes employed to apply a clear, over-print varnish to the entire surface of the web or to selected printed or unprinted areas of the surface.

A number of difficulties have arisen in the past in connection with the continuous rotogravure printing of uncoated and coated paperboard webs, the latter referring to board with the well known coating of mineral matter and adhesive. The defect of "snow flaking" occurs where certain of the cells or depressions of the printing cylinder fail to make a mark on the web by yielding their ink content to the web. Also there are conditions in the printing of solid areas whereby the paper surface absorbs the ink too readily, on the one hand tending undesirably to reproduce individual cells, and on the other hand giving the appearance on the solid printed area called "worming" or "mottling." Worming or mottling is produced when the in flow-out on the paper surface being printed occurs under or near the gravure roll and is so rapid and extensive as to form a film between the paper and gravure roll surfaces which splits as the surfaces separate, thereby producing the pattern inherent in a film-splitting process. With the paper surface too absorbent, the split film of ink on it has insufficient time to flow out into an even layer of liquid ink before it is absorbed; and therefore it reproduces on the paper surface the patterned appearance called worming or mottling. Conversely, if the paper surface too strongly resists ink absorption, a solid color may be obtained by flow-out in an area in which a half-tone effect was desired.

It is an object of the invention to provide means and a method for obviating or ameliorating the specific defects outlined above.

It is an object of the invention to provide means and a method for the substantially automatic control and modification both of the surface compressibility of the web and of its absorptivity.

It is an object of the invention to provide means and a method for producing a marked improvement in the rotogravure printing of continuous webs, particularly of paperboard, which will be cheap, convenient and capable of adequate control.

These and other objects of the invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these specifications, are accomplished by that construction and arrangement of parts and in that procedure of which an exemplary embodiment will now be described. Reference is made to the accompanying drawing, wherein:

Figure 1 is a diagrammatic side elevation of a portion of a rotogravure printing press.

Figure 2 is a diagrammatic sectional view taken along the line 2—2 of Figure 1.

Briefly in the practice of the invention, it has been found that the application of moisture to the web in the way hereinafter set forth will simultaneously affect the surface compressibility of the web and will so unify and modify the absorptivity of the web surface as to eliminate or ameliorate snow-flaking, worming and mottling, and produce a very great improvement in the over-all printed impression.

In our copending application it is taught that a substantial improvement in rotogravure printing can be effected by using one of the printing stations to apply to the web by rotogravure technique a water solution of an organic film forming substance such as polyvinyl alcohol, carboxymethylcellulose, starch, protein, resin and the like. The uniformity of the application of the solution was attributed primarily to the rotogravure printing type of application; but it was also believed that the film forming substance had an effect on uniformity. The bare application of the solution did not normally put the web surface into the best condition for the reception of rotogravure printing; and it was the practice to pass the treated web through one of the drying ovens in order to condition it for printing. The presence of the film-forming substance not only prevented too rapid loss of moisture in the drying oven, but was relied upon thereafter to preserve the moisture content for use in controlling a plurality of printed impressions. The substitution of plain water for the solution of film-forming substance was not found to be satisfactory, for although we recognized that it was possible the moisture itself had a primary effect in controlling the surface characteristics of the web, water alone was not sufficiently persistent in the process to enable any improvement in printing to be noted. Moreover, the use of one of the printing stations for the application of the control solution cut down

the total number of printed impressions which could be produced in any given press.

We have now found that equivalent or superior results may be attained by the application of moisture in the absence of film-forming substances, in the way hereinafter set forth, providing the moisture is applied in the form of steam or vapor at a point so close to the point of formation of the printed impression that the web surface will be adequately conditioned at the latter point. The effect is evanescent, and will not persist through more than one printing stage; but since the application is made by simple apparatus which does not interfere with the use of the stage or unit for printing, the application may be repeated at as many stages as may be desired.

In order to explain the practice of the invention, reference is made to Figure 1 which illustrates one stage or printing unit of a typical rotogravure press. The continuous web 1 passes beneath the unit under a pair of turning rolls 3 and 4, then travels upwardly, as at 1*a*, to a turning roll 5. Thence it passes downwardly in a generally diagonal direction, interrupted by its passage over turning rolls 6 and 7, to the printing means, which comprises a rubber coated pressure roll 8 and a rotogravure printing cylinder 9. The elements 8 and 9 coact to form the printed impression on the web, the roll 8 serving to bring the web into contact with the cylinder 9. Means for inking the cylinder 9 and for wiping excess ink from its outer surface are diagrammatically indicated at 10 and require no description here.

Leaving the pressure roll 8, the web moves upwardly as at 1*b* passing over a turning roll 11, through a drying oven 12 and downwardly over a turning roll 13. The web may be thought of as coming either from a supply roll or from a preceding similar unit of the press. After passing through the illustrated unit, the web may travel downwardly as at 1*c* either to a succeeding press unit or to a point at which it may be wound into a roll, cut into sheets, or passed through cutting and scoring presses, if cartons are to be made.

In the practice of the invention steam may be applied to the surface of the web by means of a steam pipe 14, extending transversely of the web and perforated at intervals with relatively small holes, closely spaced, which holes provide steam jets across that surface of the web which is to receive the printed impression.

Referring to Figure 2, the pipe 14 is connected to a source of steam through a conduit 15 which will contain a control valve 16 and may advantageously be provided with a pressure gauge 17. The opposite end of the pipe 14 may be closed if desired; but it is preferable to provide it with a depending condensate leg 18 having a valve 19 located above a condensate sump 20. Such an arrangement permits the formation of dry jets of steam without the spraying of condensed water. The valve 19 is opened fully at the beginning of an operation so that any water in the pipe 14 will be carried into the condensate leg and drained from the system. After the spray pipe has been heated up to the point where too little condensation occurs within the pipe to affect the dryness of the steam jets, the valve 19 may be adjusted to a small opening such as will permit the removal of condensate only.

It will be understood that the pipe 14 acts to treat the surface of the web uniformly with jets of live steam devoid of water drops or droplets, so that the surface is treated with moisture of the form of vapor and hence is uniformly treated. The application of the moisture of the form of vapor should occur ahead of the printing station by a distance which, taking into account the speed of travel of the web and the moisture applied to it, will result in a suitably conditioned surface on the web at the printing line.

It has been found preferable to form the steam jets adjacent or into the nip of the roll 5. The steam jets may be applied elsewhere, however, as to some freely traveling portion of the web or into the nip of the roll 7. Where the jets are formed into the nip of a roll such as 5 or 7, they being of metal, corrosion may be obviated by chrome-plating the roll. The roll should not be so low in temperature as to produce condensation of the steam in droplets, which in turn transfers an uneven amount of moisture to the web surface. However, there is condensation of a thin film of moisture on the roll surface which prints onto the web surface evenly and which is advantageous to preserve, even to the extent of chilling the roll, as by cooling water. Moreover such roll chilling prevents undue heating of the web by the steam, as the process continues and heat from the steam accumulates.

It is impossible to state just how much moisture is added to the surface of the web, since the condition is so evanescent that measurements cannot be made. However, the factors involved are readily controllable in the light of an examination of the printing being accomplished. By way of a specific example, in a continuous multiple rotogravure press of the roll dimensions set forth above, the pipe 14 was a standard ¾ inch pipe having 1/16 inch holes drilled along one side thereof at one inch spacings. Actual nozzle elements may be employed if desired. The pipe was located 3 inches from the surface of the web with the jets directed into the nip of the roll 5. The pipe fittings in this instance were left loose enough so that the angle of steam application could be adjusted by slightly rotating the pipe 14 by means of the condensate leg 19, with the press operating at normal speed (600 feet per minute).

In the particular press unit, the distance (tangential) between rolls 5 and 6 was 15 inches; the distance between rolls 6 and 7 was 3 inches; the distance between rolls 7 and 8 was 20 inches. A simple calculation using these values will show that the total distance traveled by the web at the specified normal operating speed is such that the elapsed time between the application of the steam and the subsequent contact with the rotogravure cylinder is only about one third of one second. This distance was found sufficient at the speed of operation to condition the board for printing with a readily controllable steam feed; and a marked improvement in printing results was noted when the steam pressure in the pipe 14 was adjusted to approximately 5 p.s.i.g. Adjustment may also be made in the position of the steam application, i.e. in its specific distance from the printing line, if desired. If the steam application is too far from the printing line, the desired effect may be lost, just as, if the application is too close there may not be time enough for the effect to take place. However, the specific distance is not critical, and can usually be determined, as indicated, with reference to the construction of the printing unit.

Thus, after the system had attained equilibrium and condensate was removed therefrom, the amount of moisture applied to the web in vapor form could be accurately adjusted by means of the control valve 16. This adjustment was found easy of accomplishment by observing the quality of the printing being done; moreover it was found readily possible to demonstrate the effect of the application of moisture by turning the valve 16 off at intervals and noting the change of the quality in the printing. After each such discontinuance of steaming, it was found that a few minutes had to be allowed for the system to reach equilibrium.

The effect of the steaming is uniform and constant, and in normal operation does not require readjustment during the course of a long run. The improvement in printing no only involves substantial elimination of snowflaking, worming and mottling, but also a general improvement in the printed result which, it is believed, can only be due to a control of the effective absorptivity of the surface of the board. Thus the procedure not only permits the production of a more perfect impression by

increasing the surface compressibility and plasticity of the board at the printing line so that more perfect conformity of the board surface to the surface of the etched cylinder is obtained, but also improves the over-all result by appearing to render the specific absorptivity of the board surface more uniform and dependable. It is believed that these results are obtained by a very light and superficial layer of moisture which, upon the elapse of a very brief interval of time is capable momentarily of controlling the surface compressibility of the web as well as its specific absorptivity to give optimum printing. In many instances it has been found that the procedure permits acceptable printing by rotogravure on board surfaces which otherwise could not be acceptably printed, thus rendering unnecessary the upgrading of the board. It has been found further that the practice of the process on coated boards provides a distinct and noticeable improvement in printing.

The effect of any one application of moisture in conditioning the web surface is temporary and will not persist beyond a single printing stage. However, the apparatus used is so simple, and the control so easy, that it may be duplicated for several or all of the printing stages operated in the press. If the process is operated for less than all of the printing stages it is usually readily possible by eye to distinguish those impressions which have been formed under the conditions outlined in this application from those formed without the application of moisture, even though these impressions be superposed one on the other.

The apparatus has been illustrated and described herein in a simplified form and refinements are both possible and desirable. For example, each steam system may be provided with an automatic inlet valve arranged to interrupt the flow of steam when the press is stopped. Manual opening of the inlet valve, however, permits the pressman to start the press before the steam is applied. Steam traps may be substitued for the condensation legs of the steam systems. The steam pipes are preferably insulated to diminish condensation and to guard against the burning of operating personnel. The steam can be limited to the zone of application by installing suitable baffles, which may also serve to carry condensate to the side of the press. Provision may be made, if desired, for changing the width of the jet application with changes in the widths of webs being printed.

Other modifications may be made in the apparatus and procedure without departing from the spirit of the invention. The invention having been described in an exemplary embodiment, what is claimed as new and desired to be secured by Letters Patent is:

1. In a rotogravure printing process wherein a continuous paperboard web is advanced at high speed into printing contact with an inked rotogravure cylinder along a printing line, the improvement comprising the steps of applying a thin, uniform superficial layer of hot moisture to the surface to be printed of the advancing web at a position ahead of and so spaced from the printing line that only a fraction of one second elapses between the application of the moisture and the subsequent contact with the rotogravure cylinder, said layer of moisture being limited to said surface of the web and having the effect of momentarily increasing the surface absorptivity and compressibility of the web for said fraction of one second, and controlling the application of said moisture in relation to the speed of the advancing web to maintain said momentary effect.

2. The process defined by claim 1 wherein the layer of hot moisture is applied by jetting dry live steam uniformly across the advancing web.

3. The process defined by claim 2 wherein the elapsed time between the application of the hot moisture derived from the steam and the subsequent contact with the rotogravure cylinder is sufficiently long to achieve the effect of momentarily increasing the surface absorptivity and the compressibility of the web, but said elapsed time is not longer than about one third of one second.

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