April 16, 1940. D. B. BRADNER 2,197,463

PAPER MAKING

Filed Sept. 8, 1936 2 Sheets-Sheet 1

Fig. 1.

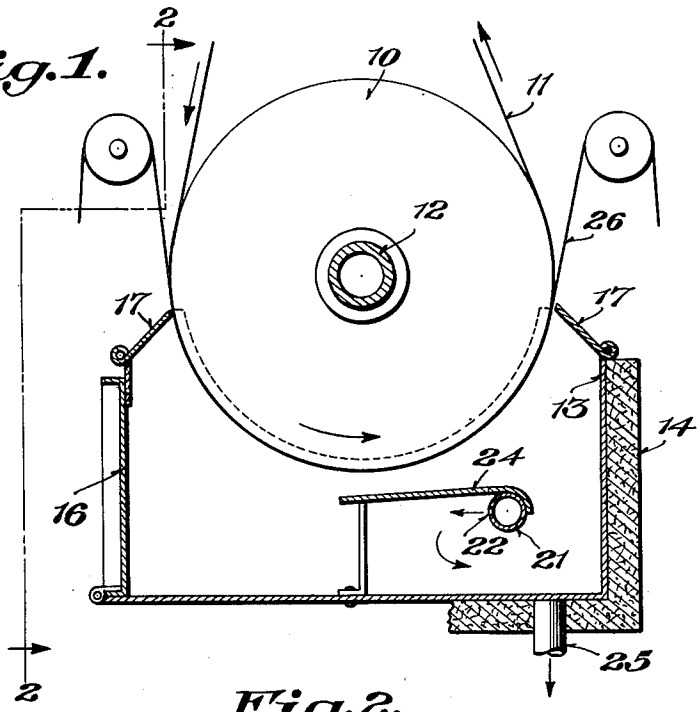
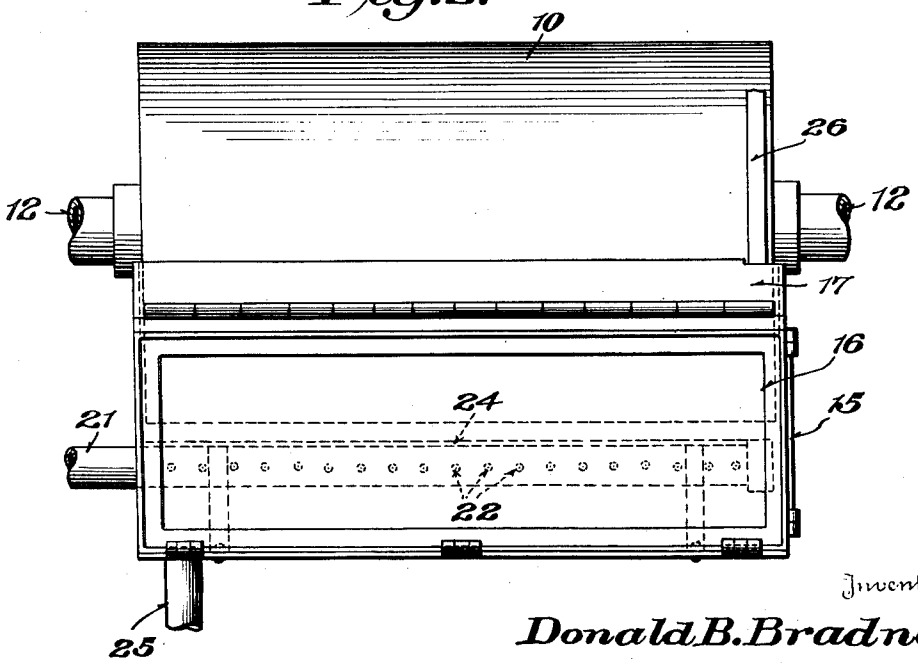


Fig. 2.



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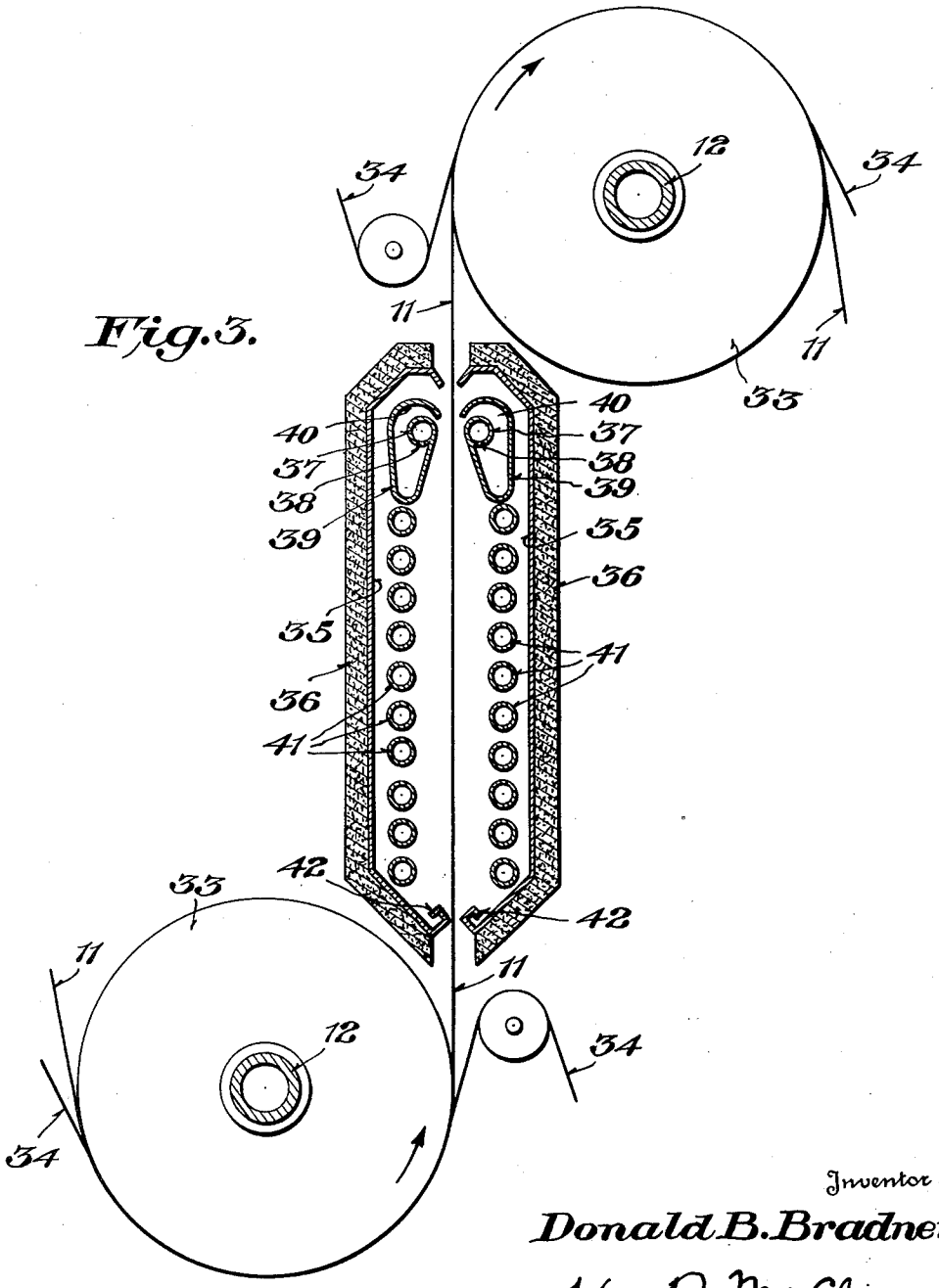
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Fig. 3.



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UNITED STATES PATENT OFFICE

2,197,463

PAPER MAKING

Donald B. Bradner, Hamilton, Ohio, assignor to The Champion Paper and Fibre Company, Hamilton, Ohio, a corporation of Ohio

Application September 8, 1936, Serial No. 99,824

1 Claim. (Cl. 92—21)

This invention relates to paper making; and it comprises, in a method of making paper from a pulp mixture including raw starch wherein the beaten pulp is converted into a web and heated and dried, the improvement which comprises passing the web while still containing a large amount of water through a zone of heat and high humidity wherein evaporation is restrained to permit the temperature of the web to rise high enough to cook the starch, the web being thereafter dried and otherwise treated in the usual manner; and it further comprises the combination in a paper making organization of apparatus including paper stock mixing means, web forming means and web heating and drying means, of means adapted to restrain evaporation and permit a rise of temperature of the web to the starch cooking temperature; all as more fully hereinafter set forth and as claimed.

The incorporation of starch into paper-making fibers during the beating operation as a sizing agent to increase the strength and "rattle," etc., is well known. Starch has been added to the beater furnish, that is the mixture of pulp fibers, filler, etc., to be made into paper, either as a dry powder or aqueous suspension or as a cooked solution, the last being the most common procedure. The results obtained by use of pre-cooked starch are for many purposes not so satisfactory as those obtainable with starch added to the beater raw and afterwards cooked in situ in the web formed from the beater mixture. But to cook and to gelatinize raw starch in the traveling web is difficult and the action is apt to be incomplete.

Only the portion of the starch which is cooked or gelatinized during the drying operation becomes effective as a sizing agent. The rest of the starch, the uncooked granular raw starch, acts merely as a filler. The reason for the difficulty is that while heat is applied to the traveling web the very rapid evaporation in drying tends to keep the web relatively cool. Temporarily the web is apt to be well below the temperature of the dryer drums. As the amount of water in the web diminishes this self-cooling effect lessens and the temperature of the web rises. Unfortunately the rise in temperature often does not occur until most of the water is evaporated; when there is not enough to give good and complete gelatinization of the starch.

One object achieved in the present invention is to provide a method by which the sizing properties of starch may be more completely and consistently developed and utilized than by previously known methods. Another object achieved is to provide a simple and effective apparatus for this purpose.

According to the invention, a newly formed wet web of paper containing raw starch is subjected to heat under such conditions as to insure complete and uniform cooking of the starch. This is accomplished advantageously on one of the dryer drums sufficiently near the wet end of the dryer section of the machine so that the amount of water in the web of paper is still ample to allow cooking or gelatinization of the starch in the paper in a manner to secure the maximum improvement in its properties. Ordinarily the web in this zone consists of 25–50 per cent solids and 75–50 per cent water. The term "near the wet end" as used in this specification is to be understood as referring to this zone. According to the invention the temperature of the wet paper is raised above the cooking temperature of the starch. Wet bodies subject to evaporation tend to assume the wet bulb temperature of the surrounding atmosphere. Accordingly, at the location selected, I maintain, in the atmosphere surrounding the web, a wet bulb temperature higher than the cooking temperature of the starch. This is conveniently accomplished by adding steam and excluding air as far as practicable. It serves to prevent evaporation below this temperature with its resulting tendency to keep the web cool. Consequently when heat is added to the web, by any suitable method such as contacting it with a heated drum, the web is quickly raised to the required temperature. It is thus only necessary to pass the web a short distance through this atmosphere in order to give time for the heat transfer necessary to completely cook the starch.

In the accompanying drawings are shown, more or less diagrammatically, two examples of specific embodiments of apparatus within the purview of the invention. In the showings:

Fig. 1 is a side view partly in vertical section of one form of apparatus;

Fig. 2 is a view in elevation corresponding to Fig. 1 and taken in the direction of arrows 2—2 of Fig. 1; and

Fig. 3 is a side view partly in vertical section of a modified form of apparatus arranged for cooking the starch elsewhere than directly on the dryer rolls.

Referring to Figs. 1 and 2, the invention is shown in conjunction with a roll 10 forming part of a dryer stack in the usual way, the remaining rolls not being shown. The roll is adapted to

carry a web of paper 11 coming from a paper making machine (not shown). The roll is provided with a hollow shaft 12 for circulation of heating steam. The roll is similar in construction to an ordinary dryer roll, but in the present invention its function is primarily one of heating rather than drying. I omit the customary dryer felt from the roll 10. A housing 13 is provided, advantageously heat insulated as at 14 and provided with hinged doors 15 and 16, for removing broken paper, etc., which might accumulate therein. The insulation is shown largely broken away for the sake of clarity. A pair of hinged gates 17 provide a close clearance where the paper enters and leaves the housing. Steam is introduced through a shower pipe 21 provided with a plurality of holes 22 for distributing it across the width of the machine. A guard 24 is provided to prevent drops of entrained water from being blown against the paper and to keep broken paper from stopping holes 22. A drain pipe 25 is provided for removing condensate. A threader belt 26 is provided for threading paper around the drum through the housing 13, in the absence of the dryer felt.

In operation enough steam is introduced into housing 13 to keep the wet bulb temperature of the atmosphere surrounding the paper well above the cooking temperature of the starch used, in spite of the air unavoidably carried in with the paper. This practically eliminates evaporation and its attendant heat absorbing effects and permits the paper to be brought to and maintained at the required temperature so that substantially all the starch is cooked and becomes effective as a sizing material.

Optionally, heat for cooking the starch may be supplied by steam in direct contact with the paper, or by direct radiation, or a combination of the two, instead of or in addition to heating by steam inside a dryer drum. An alternative form of apparatus, providing direct heating, is illustrated more or less diagrammatically in Fig. 3 in which 11 represents a wet paper web traveling between rolls or dryer drums 33 which may be provided with the customary dryer felts 34. The paper passes through a two-part housing 35 advantageously insulated as at 36 and arranged to be filled with steam by two shower pipes 37 through a plurality of holes 38, which are directed downward into troughs 39 arranged to catch any entrained water. The steam then passes through channels 40 which direct it on to the paper. A plurality of steam pipes 41 may be provided to prevent condensation within the housing and to provide radiant heat for helping to raise the paper temperature. Any condensate which may accumulate is collected at troughs 42 and removed by drain pipes, not shown. Although the starch may be completely cooked by this method, the heat is provided so largely by steam condensing on the paper, thus adding moisture which must later be removed by evaporation, that I regard the method first described as being simpler and more efficient.

The apparatus used is illustrated more or less diagrammatically and any other form may be used without departing from the present invention as defined in the appended claim.

What I claim is:

A method of making starch sized paper which comprises the steps of incorporating raw starch in paper pulp, continuously forming a web of paper therefrom, heating the moving web throughout its thickness, in an enclosed space, at a stage where the web still contains enough water to permit complete gelatinization of the starch, to a temperature above the gelatinizing temperature of the starch, while supplying steam to said space and excluding air from said space to a degree sufficient to maintain the wet bulb temperature adjacent the web above the cooking temperature of the starch and restrain evaporation, whereby the starch is uniformly gelatinized throughout the thickness of the web.

DONALD B. BRADNER.