April 13, 1943. G. S. WITHAM, JR 2,316,378

APPARATUS FOR DETERMINING THE TENDENCY OF PAPER TO CURL

Filed Oct. 23, 1940

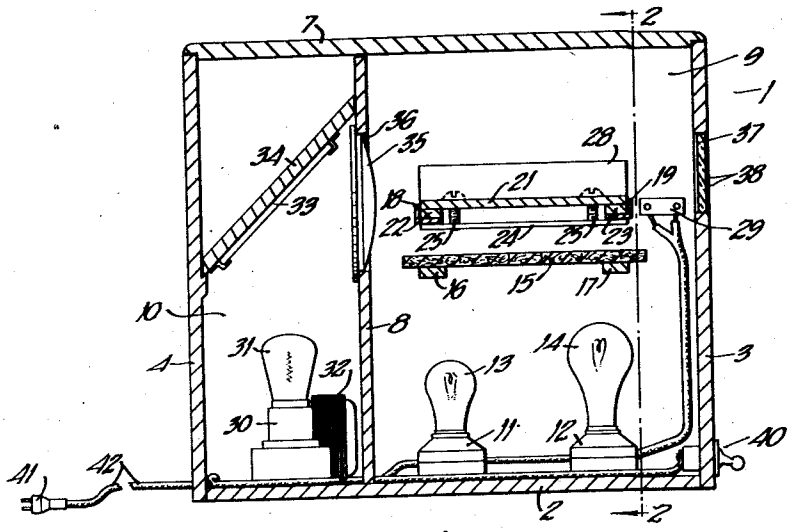


FIG. 1

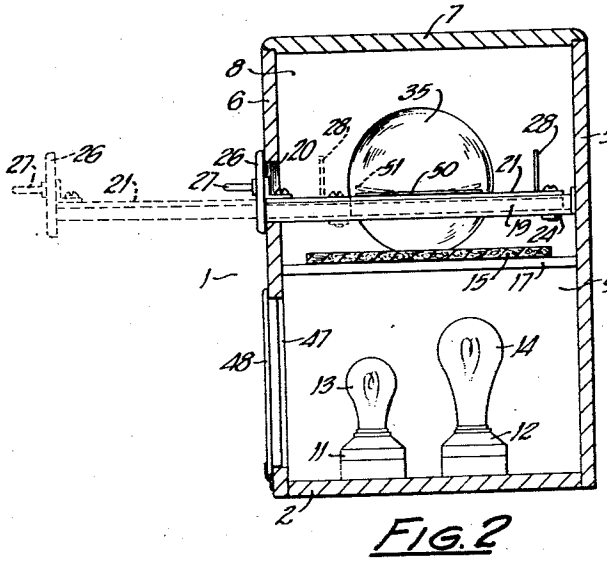


FIG. 2

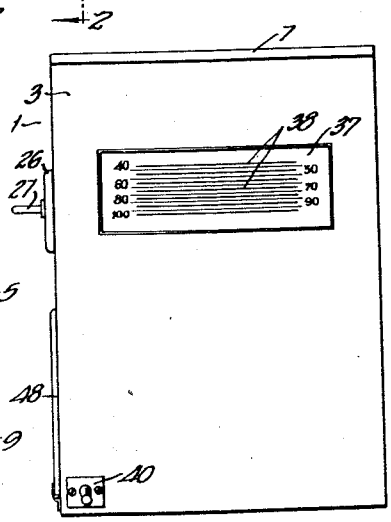


FIG. 3

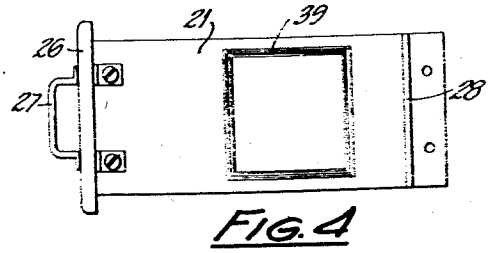


FIG. 4

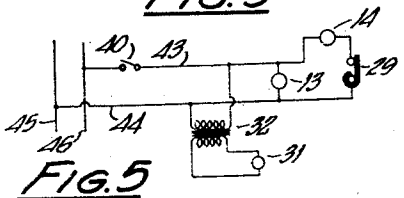


FIG. 5

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APPARATUS FOR DETERMINING THE TENDENCY OF PAPER TO CURL

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10 Claims. (Cl. 73—51)

Curling, or the tendency of paper to curl, materially affects its usefulness to the trade and papers which are manufactured at different times although they may be formed, as nearly as possible, of the same composition and grade may differ greatly in their tendencies to curl.

Paper is ordinarily manufactured for certain purposes. In many cases, the paper should be not only of the proper grade and kind but the tendency thereof to curl must fall within a very low, allowable range or else the paper will not be acceptable or suitable for the purpose intended.

For example, in mimeograph work and high speed flat bed printing presses with automatic feeds, the paper which is supplied for use therein must have an extremely low tendency to curl since, otherwise, the automatic feeders will not operate properly and inefficiency results. Furthermore, paper of low curling tendencies is quite desirable even where used as forms, for example, in composition books, sales books and the like.

However, if during the process of manufacturing paper, the tendency to curl of the ultimate paper product can be determined, steps may be taken, for example, to modify the stock during the paper making process whereby materially to reduce and substantially to eliminate such tendency in the paper.

It is, therefore, a first object of my invention to provide an apparatus for determining the tendency of paper to curl. More specifically, an object of my invention resides in providing an apparatus in which the tendency to curl of paper may be determined under standard temperature conditions and such tendency measured according to a standardized scale.

More specifically, it is an object of my invention to provide an apparatus wherein a sample sheet of paper may be subjected to a standard or substantially constant, predetermined temperature and the actual curling of the paper measured on a scale. Still more specifically, an object of my invention resides in providing an apparatus comprising an enclosure within which a specimen sheet may be subjected to heat of substantially a standard temperature, the temperature being thermostatically controlled and the curling of the paper under these conditions being measurable directly on a scale.

I accomplish the foregoing objects by means of the novel constructions and arrangement of elements described below and illustrated in the accompanying drawing, in which—

Fig. 1 is a sectional elevation view of a preferred form of my invention;

Fig. 2 is a sectional elevation view thereof taken in about the plane 2—2 of Fig. 1;

Fig. 3 is an elevation view of the front of the device;

Fig. 4 is a plan view of the support for the paper specimen; and

Fig. 5 is a wiring diagram for the electrical parts of the device.

Referring to the drawing in which I have illustrated a preferred embodiment of my invention, 1 indicates generally a receptacle or housing within which a sample of paper is adapted to be placed and subjected to heat of substantially a standard or constant, predetermined temperature. The receptacle comprises a base 2, upstanding end walls 3 and 4, side walls 5 and 6 and a cover 7 which is preferably removable and may be hinged or otherwise suitably fastened to the walls. The interior of the receptacle is provided with a partition 8 extending transversely thereof and subdividing the receptacle into two compartments 9 and 10. The compartment 9 is designed to be heated to a suitable, standard temperature to which the sample of paper is subjected for testing purposes; and the compartment 10 is designed to house a light source which, in the present embodiment of my invention, is employed in determining the tendency of the paper sample to curl.

Since it is desirable to maintain a substantially constant or standard temperature in the compartment 9, the walls including the top and base of the receptacle are preferably formed of material having fairly good thermal insulating properties. On the base 2 of the receptacle and in compartment 9 are mounted sockets 11 and 12 for incandescent lamps 13 and 14. The lamp 13 may, for example, be of a 40 watt rating and lamp 14 may be of a 100 watt rating. Above these lamps which are primarily employed for heating purposes, I preferably provide a baffle 15 of asbestos or a material of like heat resisting properties which is supported by means of transversely extending bars 16 and 17. These bars may be fastened to opposite side walls 5 and 6 of the receptacle and the baffle 15 is preferably spaced on all sides thereof from the side walls of the chamber 9.

Above the baffle 15 are fastened two angle members 18 and 19 which extend transversely of the compartment and are secured at one end to the side wall 5 and terminate at the other end in an opening 20 (see Fig. 2) in the side wall 6. The angle members 18 and 19 are adapted slidably to support and guide a substantially flat plate ele-

ment, preferably of fairly good heat conducting material, which is adapted to support the sample of paper for test purposes. The plate 21 may be provided with runners 22 and 23 on the under surface thereof to engage the guides 18 and 19 and a strip 24 may be fastened beneath and in spaced relation to the plate 21, as by means of screws 25, to engage the bottoms of the guides 18 and 19 whereby slidably to hold the plate 21 in position thereon.

To one end of the plate 21 is fastened a cover plate 26 which is adapted to close the opening 20 in the side wall 6 of the receptacle when the plate 21 is substantially wholly inserted within the receptacle. To the plate 26 is fastened a handle 27 for operating the plate 21. Adjacent the other end of the plate 21 is provided an upstanding plate-like element 28 which is adapted, when the plate 21 is practically wholly withdrawn through the opening 20, to engage the side wall 6 about said opening 20 and effect a substantial closure thereof. The plate 28 is preferably provided in order to prevent the escape of heat from the compartment 9 and a resulting drop in temperature therein when the plate 21 is withdrawn for purposes of placing a specimen or sample of paper thereon.

Within the comaprtment 9 and preferably at about the elevation of the plate 21 is disposed a thermostat 29 which, as hereinafter more fully explained, is connected in circuit with the lamp 14. The lamp 13 is preferably so arranged as to be continuously energized while the apparatus is in operation while the lamp 14 is thermostatically controlled whereby to maintain a substantially constant and standard temperature within the compartment 9.

In compartment 10 is mounted a lamp socket 30 which is adapted to receive an incandescent lamp 31 of the type which will provide substantially a point source of light. Since incandescent lamps of this character are ordinarily of a six volt rating, a transformer 32 is provided for transformation purposes. In the embodiment illustrated, a mirror 33, mounted on a removable support 34, is arranged to reflect the light cast thereupon from the light source or lamp 31 through a plano-convex lens 35 which is mounted in an aperture 36 in the partition 8. The lens 35 is a collimating lens which casts light from the light source in parallel rays across the compartment 9. The lens and plate-like element 21 which support the specimen of paper are so arranged that the light rays from the lens will be substantially parallel with the element 21 or the specimen paper supported thereon and will be intercepted by the specimen.

In the end wall 3 of the compartment 9 of the receptacle is disposed preferably a ground glass target 37. The target is so arranged with respect to the lens 35 and supporting plate 21 that a specimen of paper on the plate 21 will intercept the light rays and the shadow thereof will be cast upon the target. The target is provided with a scale 38. Preferably, the lowest calibration of the scale, marked "100" in Fig. 3, is so positioned that the shadow of a sample sheet of paper lying upon the supporting plate 21 will coincide therewith. However, if the paper should curl, its shadow will correspondingly move upwardly on the scale 38 and the degree to which the paper curls may be determined from the scale. Preferably, the scale is calibrated in terms of degree of flatness of the paper as indicated. In other words, if the paper should not curl, its shadow will remain coincident with the calibration marked "100" and it will have 100% flatness. If, however, the side edges thereof should curl sufficiently to cause the shadow thereof on the target to coincide with the calibration 70, for example, it would have a flatness of only 70%.

The plate-like element 21 for supporting the paper samples, which is illustrated in plan in Fig. 4, is preferably provided on its upper surface with a zone marking 39 which designates the proper location of the sample for testing purposes.

A toggle switch 40 may be located at the front of the receptacle and a plug connector 41 connected with a lead 42 which connects with the electrical devices within the receptacle may also be provided. The electrical devices are preferably connected as shown in the wiring diagram in Fig. 5. Assuming that conductors 43 and 44 of the lead 42 are connected with the service mains 45 and 46 by means of the plug connector 41, a circuit will be established, if the switch 40 is closed, to the transformer 32 and lamp 13, transformer 32 and lamp 13 being connected across the conductors 43 and 44. Lamp 14 and thermostat 29 are connected in series between conductors 43 and 44 and, hence, thermostat 29 serves to control the energization of lamp 14. The lamp 31 is connected across the transformer 32 from which it receives its energy.

An opening 47 may be provided in side wall 6 of the compartment 9 to provide access to the interior thereof, and a door 48 associated therewith.

To determine the tendency of paper to curl, the apparatus is electrically connected with the supply mains and the compartment 9 thereof heated to the desired temperature which is maintained substantially constant by the thermostat 29. I prefer to maintain the temperature at about 120° F. During the process of manufacturing the paper, a sample may be taken which is preferably of standard dimensions, for example, it may be 4" x 4" square and placed upon the zone designated on the supporting plate 21. For this purpose, the plate 21 is withdrawn through the opening 20, the paper placed thereupon in correct position, and the plate 21 reinserted to position the sample substantially in proper position, as indicated at 50 in Fig. 2, with respect to the lens and target. While the plate 21 is withdrawn, the plate 28 closes the opening 20 to maintain the desired temperature within the compartment and when the plate 21 is again positioned within the compartment with the paper sample thereon, the plate 26 effects a closure of opening 20. As hereinbefore stated, when the paper sample is first placed within the compartment 9, the shadow thereof should appear substantially in alignment with one of the calibrations of the scale 38. If curling thereof occurs, as indicated in dotted lines at 51 in Fig. 2, the degree to which such curling takes place will be indicated by the shadow thereof on the scale and its tendency to curl thereby determined.

Preferably, paper samples of the same dimensions are used and, by determining the tendency to curl of such samples in the foregoing manner, ratings thereof may be standardized for comparison purposes and, of course, if the sample indicates a tendency to curl which is of such a high magnitude that it will be commercially unacceptable, corrections may be made in the manufacturing process whereby the forthcoming paper will have a practically eliminated tend-

ency to curl or, at the most, a tendency which is well within the permissible range.

It will be understood that although I have described my invention in connection with its use in determining the tendency of paper to curl, it may likewise be employed for determining like tendencies in other materials.

Although I have illustrated and described the use of incandescent lamps as heating means, it will be understood that any suitable heating means may be employed such as heating coils. Coils may be employed which are adapted to be threaded in sockets of the character illustrated. Furthermore, it will be understood that one or a plurality of heating means may be used and that one or any number, or all, of such heating means may be thermostatically controlled.

While I have described my invention in its preferred embodiments, it is to be understood that the words which I have used are words of description rather than of limitation. Hence, changes within the purview of the appended claims may be made without departing from the true scope and spirit of my invention in its broader aspects.

What I claim is:

1. In a device for determining the curling properties of paper and the like, means forming an enclosure provided therewithin with means adapted freely to support thereon a sample sheet of paper in substantially horizontal, flat condition and means for providing and maintaining within said enclosure-forming means heat of substantially a standard temperature, said enclosure-forming means being provided in a side thereof with a translucent target provided with a scale for measuring the flatness of said sample sheet and means for casting light rays upon said target; said paper-supporting means being arranged to support said paper in the path of said light rays whereby the shadow of said paper will appear on said target.

2. In a device for determining the curling properties of paper and the like, a translucent target provided with a scale, means including a light source disposed in spaced relation to said scale and arranged to cast light rays thereupon, means for collimating the rays of light from said light source and means for so supporting a sample sheet of paper substantially parallel to and in light-intercepting relation to said light rays when so collimated whereby to provide the edgewise shadow of said paper on said scale, and means for providing heat of substantially a standard temperature to said sample sheet.

3. In a device for determining the curling properties of paper and the like, means forming an enclosure provided therewithin with means adapted freely to support thereon a sample sheet of paper in substantially horizontal, flat condition, a translucent target mounted in a wall of said enclosure and provided with a scale, a light source disposed in spaced relation to said target and arranged to cast light rays thereupon, means for collimating the rays of light from said light source, said sheet-supporting means being arranged to support a sample sheet of paper substantially parallel to and in light-intercepting relation to said light rays when so collimated whereby to provide the edgewise shadow of said paper on said scale, and means disposed within said enclosure-forming means for providing heat of substantially a standard temperature to said sample sheet.

4. In a device for determining the curling properties of paper and the like, a scale, means disposed in spaced relation to said scale for casting light rays thereupon, means for supporting a sample sheet of paper in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample sheet upon said scale, and means for providing heat of substantially a standard temperature for heating said sample sheet.

5. In a device for determining the curling properties of paper and the like, a scale, means disposed in spaced relation to said scale for casting light rays thereupon, means for freely supporting a sample sheet of paper in substantially initially flat, horizontal position in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample sheet edgewise upon said scale, and means for providing heat of substantially a standard temperature for heating said sample sheet.

6. In a device for determining the curling properties of paper and the like, a scale, means disposed in spaced relation to said scale for casting light rays thereupon, means for supporting a sample sheet of paper in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample sheet upon said scale, means forming an enclosure for said sample sheet and supporting means therefor through which said light rays may pass to said scale, and means for providing substantially standard temperature conditions within said enclosure.

7. In a device for determining the curling properties of paper and the like, a translucent target provided with a scale for observing and measuring the curl of a sample sheet of paper, a light source disposed in spaced relation to said target and arranged to cast light rays thereupon, means for freely supporting a sample sheet of paper in substantially flat condition in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample sheet edgewise upon said scale and in alignment with one of the calibrations of said scale, and means for providing heat of substantially a standard temperature for heating said sample sheet.

8. In a device for determining the curling properties of paper and the like, means forming an enclosure provided therewithin with means adapted freely to support thereon a sample sheet of paper in substantially horizontal, flat condition, a scale and means disposed in spaced relation to said scale for casting light rays thereupon; said scale, sheet-supporting means and last mentioned means being so constructed, correlated and arranged as to cast the edgewise shadow of said sample sheet upon said scale, and means for providing heat of substantially a standard temperature to the sample sheet.

9. In a device for determining the curling properties of paper and the like, means forming an enclosure having an opening therein, a scale, means disposed in spaced relation to said scale for casting light rays thereupon, movable means for supporting a sample sheet of paper in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample on said scale, said supporting means being movable into and out of said enclosure through said opening therein, means for closing said opening when said supporting means is substantially wholly inserted in said enclosure,

and means for providing substantially standard temperature conditions within said enclosure.

10. In a device for determining the curling properties of paper and the like, means forming an enclosure having an opening therein, a scale, means disposed in spaced relation to said scale for casting light rays thereupon, means slidably mounted within said enclosure for supporting a sample sheet of paper in free, flat condition thereupon and in the path of said light rays and in substantially parallel relation thereto whereby to cast the shadow of said sample on said scale, said supporting means being slidable into and out of said enclosure through said opening therein, means for closing said opening when said supporting means is substantially wholly inserted in said enclosure, and means for providing substantially standard temperature conditions within said enclosure.

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