

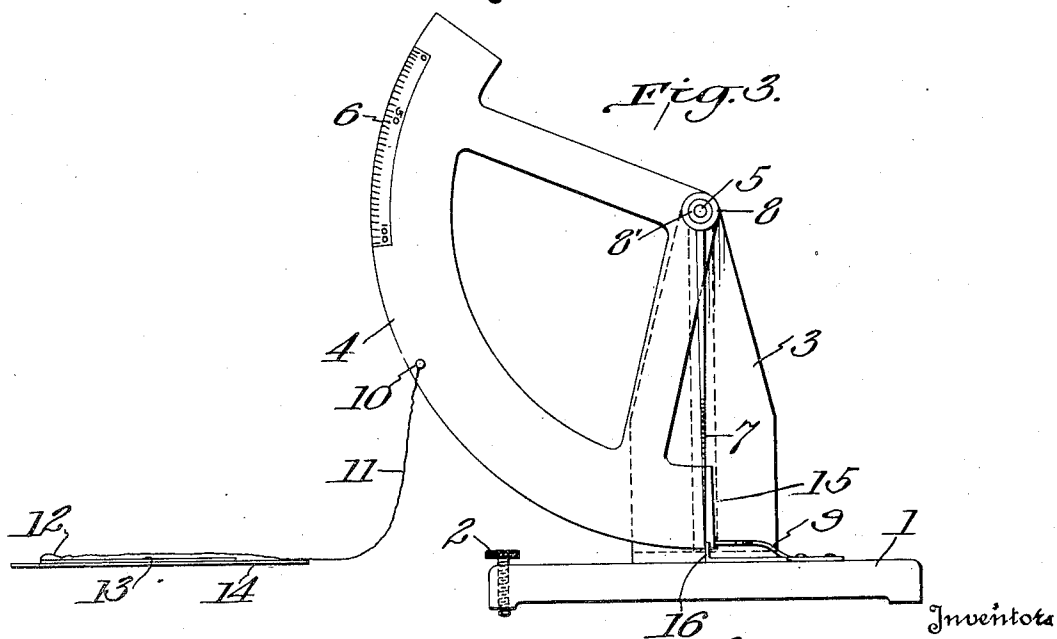
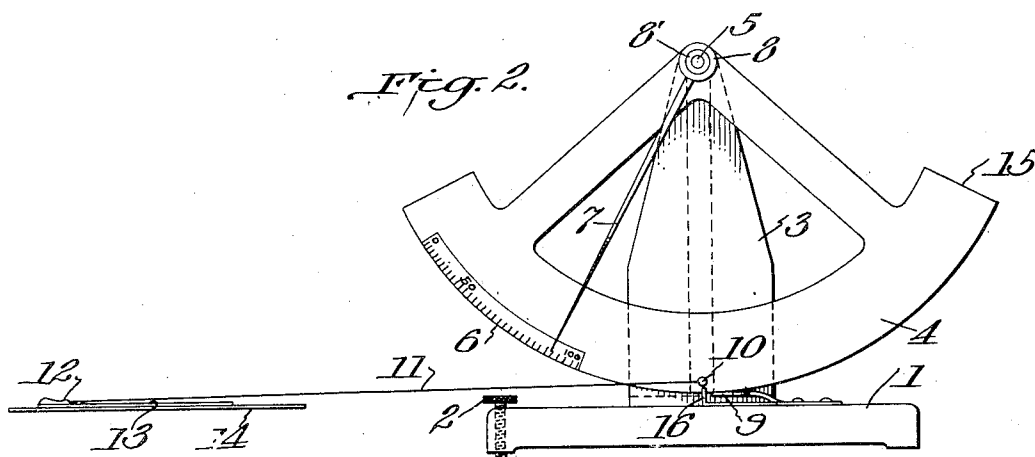
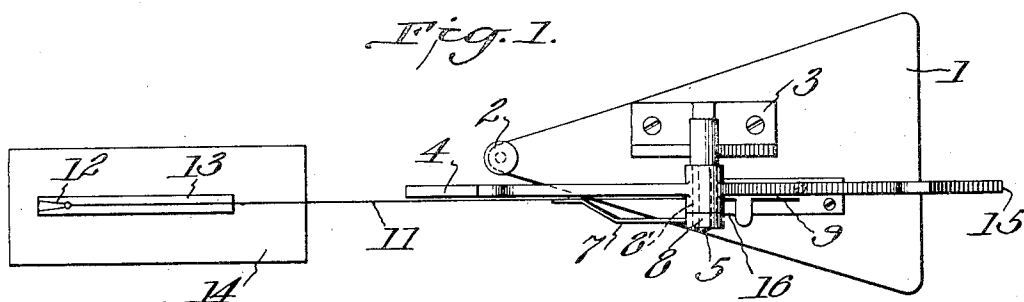
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D. E. BRADNER ET AL

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METHOD OF TESTING COATED PAPER

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16 Inventors
Donald B. Bradner
and William J. Montgomery
Byrnes Townsend & Bruckenstein
their Attorneys

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METHOD OF TESTING COATED PAPER

Donald B. Bradner and William J. Montgomery,
Hamilton, Ohio, assignors to The Champion
Paper and Fibre Company, Hamilton, Ohio, a
corporation of Ohio

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This invention relates to an improved method of testing the coatings on coated paper.

Coated paper is commonly manufactured by applying to paper raw stock a coating consisting of mineral pigment and an adhesive substance. The mineral pigment may be clay, satin white, blanc fixe, or the like, and the adhesive substance may be casein, starch, glue, or the like.

In the manufacture of coated paper it is highly desirable to control closely the "size" of the coating. "Size" is a function of the adhesion existing between the coating and the raw stock and the cohesion of the coating for itself. A "soft sized" coated paper is one in which the adhesion existing between the coating and the raw stock and/or the cohesion of the coating for itself is relatively weak. Conversely a coated paper which is "hard sized" is one in which the adhesion existing between the coating and the raw stock and/or the cohesion of the coating for itself is relatively strong. If a coated paper is too "soft sized" the coating will "pick" on a printing press or the coating will "flour off". A coated paper which is too "hard sized" does not print as well and does not finish "high" as readily as a correctly coated paper, and in addition there is an unnecessary consumption of adhesive substance in the production of such coated paper.

Due to the large number of variables in the manufacture of coated paper it is practically impossible to consistently obtain the optimum degree of "sizing" without a reliable method of testing and controlling the "size" of the coated sheet. For example, the casein, starch, glue or similar adhesive substances are complex chemical bodies which vary somewhat in adhesive properties from lot to lot. Furthermore the quantity of adhesive substance required to satisfactorily bind a pigment to the paper varies with the chemical composition and physical state of aggregation of the pigment. Thus, for example, two lots of clay frequently require different quantities of adhesive substance to give coatings of the same adhesive strength.

Heretofore, no satisfactory qualitative or quantitative methods for testing the coatings on coated paper have been devised. It is true that several tests have been proposed and some are in operation in the industry. The most common of these tests is what is known as the thumb test. This test consists in moistening the thumb, pressing it upon the coated paper, removing the thumb and examining it for the quantity of coating adhering to it. If a considerable quantity of coating adheres to the thumb, the paper is said to be "soft

sized"; while if little or no coating adheres to the thumb, the paper is said to be "hard sized". Although widely used, this test is obviously open to a large number of objections due, for example, to variations in the amount of moisture on the thumb, the pressure applied, duration of pressing, the size of the thumb, the speed of removal from the paper, etc. Furthermore, the test tends to show a waterproof coating "harder" than it really is, and a non-waterproof coating "softer" than it really is. It is therefore a common occurrence that two individuals well skilled in the performance of this test fail to agree, and even the same individual does not get consistent results.

Another test which has been proposed consists in softening a stick of sealing wax by heat, pressing this upon the coated paper and then pulling it vertically from the paper. The end of the stick of sealing wax which has been in contact with the coated paper is then examined. If the wax has "pulled stock", the paper is supposed to be "hard sized"; if it pulls considerable coating, it is supposed to be "soft sized". Although these two tests are the most commonly employed in the industry, neither of them is sensitive or reliable.

The object of this invention is to provide an accurate, reliable, and quick qualitative and quantitative method of testing the coatings on coated paper.

The method consists in contacting over a considerable area of the coated paper a testing agent consisting of a thin flexible body having a relatively strong adhesive surface and then suddenly removing it by a sharp pull or jerk with the hand or by mechanical means in such a manner that the testing agent parts with the coated paper substantially from a line contact as distinguished from an area contact. The testing agent pulls with it more or less coating or coating and paper stock and by examination of the adhesive surface of the testing agent a good qualitative estimate of the adhesion existing between the coating and the paper stock and the cohesion of the coating for itself is obtained. By using mechanical means which is capable of measuring the force or work required to remove the testing agent from the paper, a good quantitative as well as qualitative estimate of the "size" of the coating may be obtained. Thus with a given raw stock the presence of a considerable amount of coating on the testing agent indicates a softer sized coating than does the presence of only a small amount of coating. With a given raw stock the quantity of coating removed is a measure of the sizing of the coating. The testing agent may be a flexible

body consisting of a relatively strong adhesive substance alone or it may consist of a backing composed of cloth, leather, thin metal or any other material of a flexible nature evenly coated or impregnated with a relatively strong adhesive substance. The adhesive substance may be any desired material provided it does not appreciably soften, dissolve or otherwise adversely affect the ingredients of the coating composition. Testing agents impregnated or coated with cured or uncured rubber are particularly suitable. The shape or form of the testing agent is immaterial, although we prefer to use a relatively narrow, elongated strip like a ribbon or tape.

For example, one convenient testing agent for carrying out this invention is ordinary friction tape and the invention will be particularly described in connection therewith. For example, a strip of friction tape about eight to ten inches long and about three quarters of an inch wide is laid firmly and evenly upon the coated paper to be tested. A small seam roller is then pressed back and forth over the tape until it thoroughly adheres to the coated paper except at one end, where a portion large enough to be firmly grasped between the fingers is left extending out of contact with the paper. The paper is held firmly on a smooth surface with the hand or by mechanical means and the free tab or end of the tape is grasped by the other hand and pulled or jerked from the paper in such a way that the tape is pulled back over itself. When it is desired to obtain both a quantitative and qualitative estimate of the "size" of the coating, the tape may be pulled back from the paper by mechanical means which will be described in more detail below. During this removal of the tape from the paper it is essential for consistent results that the tape be pulled back along a line close to the paper and substantially parallel to it. In other words, the tape should separate from the paper at a very acute angle to the surface of the paper, say less than 30°. The tape is then examined. The presence on the tape of no paper stock and only a small amount of coating indicates a "hard sized" coating and a strong stock. The presence on the tape of a considerable amount of coating and no stock indicates a "soft sized" coating and a relatively strong stock. The presence of paper stock usually indicates strong cohesion of the coating for itself and/or a relatively weak stock. Occasionally the paper stock, although not actually pulled off with the tape, will be raised in places forming ripples. This rippling of the paper stock indicates that the adhesion of the coating to the stock is almost as great as the cohesion of the stock for itself. The pulling of stock usually indicates that the paper is at least sufficiently sized for printing purposes.

In another method of carrying out this invention we use a strip of friction tape about eight to ten inches long and about three quarters of an inch wide. This strip is only lightly pressed down on the sheet of coated paper so as to avoid wrinkling, and then a gear is firmly rolled over the tape once. The gear may be, for example, of 6 diametral pitch and 4 inches in diameter. One end of the tape is slightly raised from the paper, grasped between the fingers and rapidly pulled or jerked from the paper at a very acute angle to the surface of the paper, in such a way that the tape is pulled back over itself. The tape will be found to have a number of impressions upon it coinciding with the contacting positions of the gear teeth. Examination of each of these

separate impressions indicates the character of the coating at these points. This modification of the test is superior to the modification in which the tape is uniformly rolled with a roller, because in the latter case it occasionally happens that the tape will pull paper stock at one portion of the paper and continue to pull paper stock throughout the rest of the pull by virtue of the additional hold that the adhering paper stock gives. This does not normally occur when the tape is in contact with the paper at spaced intervals because there is no substantial adhesion between the tape and the paper in the intervening spaces.

The preferred method of carrying out this invention consists in separating the testing agent, for example, ordinary friction tape, from the coated paper, after it has been contacted firmly and evenly, by the use of mechanical means capable of measuring the force or work required to effect the separation of the testing agent. In this manner, the coatings may be tested both qualitatively and quantitatively.

The measurement of the force or the work required to remove the testing agent from the coated paper may be accomplished in a variety of ways. For example, the force required to remove an adhering tape at a uniform velocity may be measured by any suitable and well known means, for example, by means of a dynamometer. Or the tape after being firmly contacted with the paper may be attached by means of a loose cord to a falling weight or to a pendulum of known mass which is allowed to pull the tape after attaining a desired velocity. The distance that the weight or the pendulum travels after beginning to pull the tape until it comes to rest can be used as a measure of the adhesion existing between the coating and the paper stock. In this method of testing, the tape should be contacted over a sufficiently large area so that it is not entirely removed from the paper by the pull. In another variation of the test, the tape may be completely removed from the coated paper and the residual energy of the falling weight or pendulum may be measured in any appropriate manner. For example, the residual energy may be measured by allowing the weight or pendulum to fall upon a spring balance or dynamometer at the moment that the tape is completely removed from the paper.

In the accompanying drawing we have shown one form of apparatus which is suitable for carrying out the method of this invention in its preferred form. This apparatus is of the pendulum type.

Figure I is a top view and Figure II is a side elevation of the apparatus in the stable or neutral position.

Figure III shows the apparatus in the position for starting the test.

1 is a base equipped with a levelling screw 2. The pendulum 4 is tightly mounted on the sleeve 8' which is capable of revolving about the axis 5 which is mounted on the frame 3. A graduated scale 6 is inscribed or mounted on the face of a pendulum in about the position shown. A collar 8 carrying the pointer 7 is frictionally fitted to the sleeve 8'. This collar has a constant friction just sufficient to prevent over run of the pointer 7 when the pendulum stops. This constant friction is maintained by a spring in the head of the pointer. 16 is a stop mounted on the frame directly under the center of gravity of the pendulum when the pendulum is in the neu-

tral position. This stop engages the pointer carrying it as far as the pendulum swings to the right. The levelling screw 2, is adjusted so that the pointer stops at zero on the scale at the highest point reached by the free swing of the pendulum. The flat spring 9 exerting an upward pressure is fixed to the base 1 and serves the double purpose of acting as a stop to hold the pendulum in the starting position preparatory to starting a test (see Figure III) and also acts as a brake to prevent the pendulum from oscillating after the test. A hole 10 is drilled in the pendulum directly below its center of gravity when the pendulum is in the stable position. One end of the cord 11 is attached to the pendulum through the hole 10, and the other end to a clip 12. This clip is fastened to the friction tape 13, adhering to the coated paper being tested 14.

In using this apparatus for carrying out the invention a strip of friction tape about eight to ten inches long and about three quarters of an inch wide is laid evenly upon the paper. The tape is then firmly contacted to the paper by means of a press. The paper is next removed from the press and the end of the tape furthest from the pendulum is slightly raised from the paper and attached by means of the clip to the cord on the pendulum. During this operation the pendulum is in the stable or neutral position. The coated paper to which the tape is attached and the cord are then aligned with the pendulum so that the pull on the tape will be directly along its length without any appreciable side pull. The distance of the paper from the pendulum should be such that the cord is taut when the pendulum is in the neutral position. The pendulum is then put in the starting position as shown in Figure III with the edge 15 resting against the edge of the spring 9. The pointer is adjusted to point directly downward. The paper is held firmly with the hand or by mechanical means while the spring 9 is pressed down, thus releasing the pendulum and permitting it to swing down by its own weight. As the pendulum passes the neutral point it pulls the tape back over itself from the paper. The resistance due to the adhesion of the tape to the coated paper retards the pendulum in its upward course bringing it to a stop. The highest point the pendulum reaches before dropping back is indicated by the pointer on the scale. As the pendulum begins to drop back, the spring 9 is again allowed to engage the pendulum, thus acting as a brake and preventing further motion of the pendulum.

The test is not limited to having the cord attached at the hole 10. It may be attached to any part of the pendulum; for example, we have obtained good results by attaching the cord at a point near the zero end of the scale.

The method is accurately quantitative only when the testing agent does not pull paper stock or ripple. When paper stock is pulled or rippled the reading is unreliable. The method is adaptable to the condition when paper stock is pulled or rippled by contacting the tape to the coated paper over regularly spaced areas instead of over a continuous area. For example, a thin sheet of paper perforated with a number of holes may be placed between the coated paper to be tested and the friction tape, and the tape firmly contacted with the coated paper at the perforated spaces by means of a press. The test is then carried out as described above. Due to the smaller area of contact between the tape and the coated paper this method gives a lower read-

ing than that obtained when the whole area of the tape is contacted with the coated paper. Obviously this modification of the method is not limited to use on those coated papers whose coating is such that paper stock is pulled or rippled, but may also be used with coated paper whose coating is such that the testing agent does not pull paper stock.

In any method of carrying out this invention it is usually advisable that the adhesive tape be jerked or rapidly pulled from the paper. When the tape is jerked or rapidly pulled from the paper, it tends to pull coating or coating and stock with it; whereas, if the tape is very slowly removed from the paper, the rubber or other plastic adhesive substance of the tape tends to separate from the backing leaving a layer of adhesive substance on the coated paper and failing to give a test.

The tests are sharply differentiated from the sealing wax test in a number of important respects. In the sealing wax test the piece of wax must be lifted from the paper at substantially right angles to the paper. Slight deviations in the angle of withdrawal cause great inconsistencies in the results. Slight variations in the angle of withdrawal do not affect results in our tests. When the sealing wax is pulled away from the coated paper it breaks away from the whole contacting area simultaneously. On this account the sealing wax test fails to differentiate between two coated papers which vary only slightly in "size". In our tests the tape breaks away from the sheet continuously substantially along a line instead of from an area. This makes it possible to test coatings having a much wider range of "size" than can be obtained with the sealing wax test.

The tests may be conducted with the testing agent laid either with or across the grain of the paper, and obviously either side of the paper may be tested before or after calendering. The tests can be performed very quickly and the conditions of pressure, contacting, etc., can be readily controlled. They are accurate regardless of the waterproofness of the coating and regardless of the character of the adhesive substance used in the coating. Furthermore, the tests do not depend upon the thermo-plastic properties of the adhesive substance. All of these points are among the advantages that our tests have over the usual thumb test and sealing wax test.

It is understood that this invention is not limited to the use of any particular testing agent such as friction tape nor to any particular means of contacting it with the coated paper or of removing it from the coated paper, nor to any particular means for measuring the force or work required to remove the testing agent from the coated paper except as required by the scope of the appended claims.

In the appended claims by "line contact" we mean the line of intersection of the plane of the loose end of the tape with the surface of the paper being tested.

We claim:

1. The method of testing the coatings on coated paper comprising adhesively contacting a flexible body having a strongly adhesive surface with a considerable area of the coated paper, suddenly separating it from the paper and then examining the surface of said flexible body.
2. The method of testing the coatings on coated paper comprising adhesively contacting a

flexible body having a strongly adhesive surface with a considerable area of the coated paper, suddenly separating it from the paper by pulling a loose end of said flexible body so that the plane of said loose end and the plane of the paper intersect at an angle less than 30° and then examining the surface of said flexible body.

3. The method of testing the coatings on coated paper comprising adhesively contacting with the coated paper a strip of flexible material having a strongly adhesive surface, suddenly separating said strip from the paper by pulling it back over itself so that it parts with the paper substantially along a line contact and then examining the surface of said flexible material.

4. The method of testing the coatings on coated paper comprising adhesively contacting with the coated paper at spaced intervals, a flexible strip of tape having a strongly adhesive surface, suddenly separating the strip from the paper and then examining the surface of said strip of tape.

5. The method of testing the coatings on coated paper comprising adhesively contacting a strip of adhesive tape with the paper at spaced rectangular areas transversely of the tape, suddenly pulling the tape back over itself from the paper and then examining the surface of said strip of tape.

6. The method of testing the coatings on coated paper comprising adhesively contacting with the paper a strip of rubber-impregnated adhesive tape, suddenly separating said tape from the paper by pulling it back over itself so that it parts with the paper substantially along a line contact and then examining the surface of said strip of tape.

7. The method of testing the coatings on coated paper comprising adhesively contacting to a considerable area of the coated paper a flexible body having a strongly adhesive surface and measuring the work required to remove the flexible body from the paper.

8. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape and measuring the work required to remove the tape from the paper when the tape is suddenly pulled back over itself.

9. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, at spaced intervals, suddenly applying a known amount of energy tending to pull the tape back over itself, and measuring the distance the tape is pulled from the paper.

10. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, connecting the tape to a pendulum, allowing the pendulum after it has swung through a portion of its arc, to pull the adhesive tape back over itself away from the paper, and measuring the work done by the pendulum in partially removing the tape from the paper.

11. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape at

spaced intervals, connecting the tape to a pendulum, allowing the pendulum after it has swung through a portion of its arc, to pull the adhesive tape back over itself away from the paper, and measuring the work done by the pendulum in partially removing the tape from the paper.

12. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape and measuring the force required to remove the tape from the paper.

13. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape and measuring the energy required to remove the tape from the paper.

14. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, suddenly applying a known amount of energy tending to pull the tape back over itself, and measuring the distance the tape is pulled from the paper.

15. Method of testing coating materials which comprises adhesively contacting thereto a flexible body having an adhesive surface, suddenly applying a known amount of energy tending to detach said flexible body from the material being tested along a line contact and measuring the distance said flexible body is pulled from the material tested.

16. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, connecting the tape to a pendulum, allowing the pendulum after it has swung through a portion of its arc, to partially pull the adhesive tape back over itself away from the paper, and measuring the distance the tape is pulled from the paper.

17. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape and measuring the force required to remove the tape from the paper at a uniform velocity.

18. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, allowing a falling body of known weight after it has attained a desired velocity to partially pull the tape from the paper until said body comes to rest and measuring the distance travelled by said body after beginning to pull the tape.

19. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, allowing a falling body of known weight to remove the tape from the paper and measuring the residual energy of said body.

20. The method of testing the coatings on coated paper comprising adhesively contacting to the coated paper a strip of adhesive tape, connecting the tape to a swinging body, allowing said body after it has swung through a predetermined arc to partially pull the tape from the paper and measuring the work done by the body.

DONALD B. BRADNER.
WILLIAM J. MONTGOMERY.