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R. LITTLE ET AL

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APPARATUS FOR TESTING TEXTILE PACKAGES

Filed Sept. 7, 1935

4 Sheets-Sheet 1

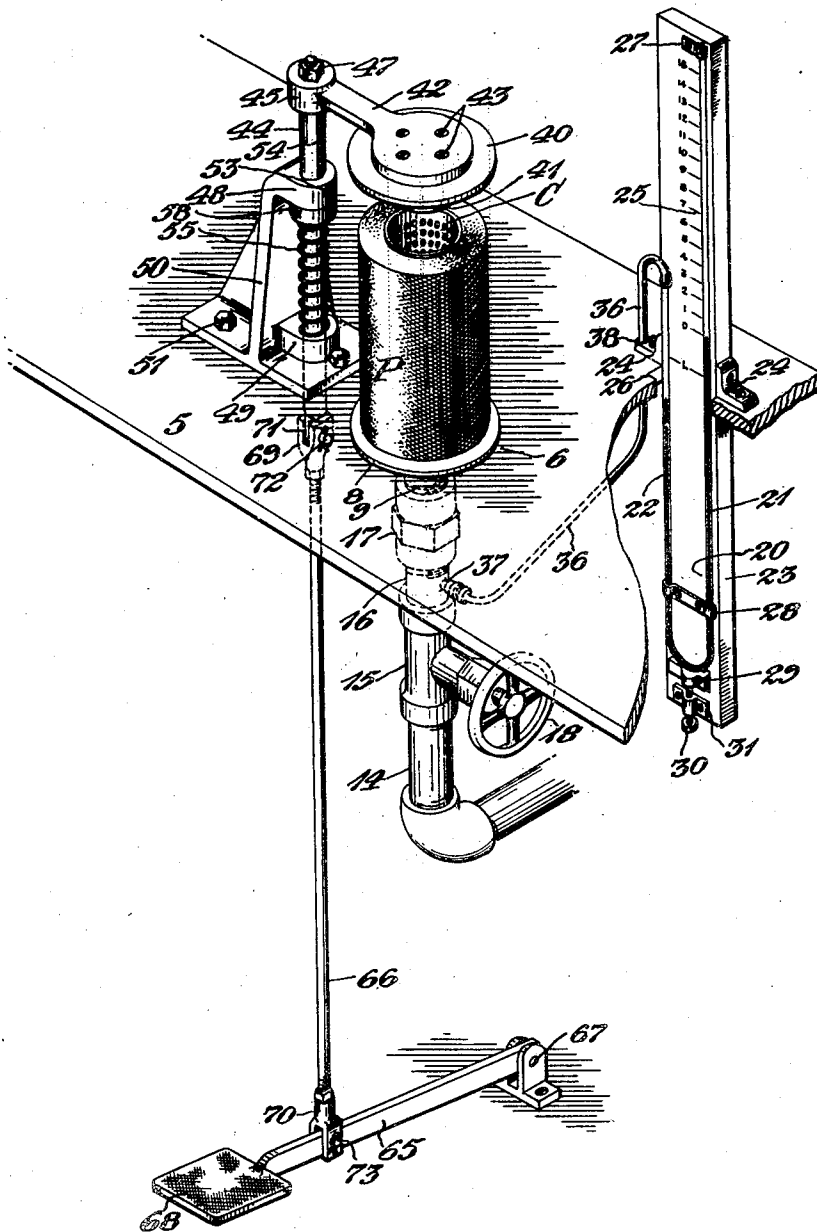


Fig. 1.

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4 Sheets-Sheet 2

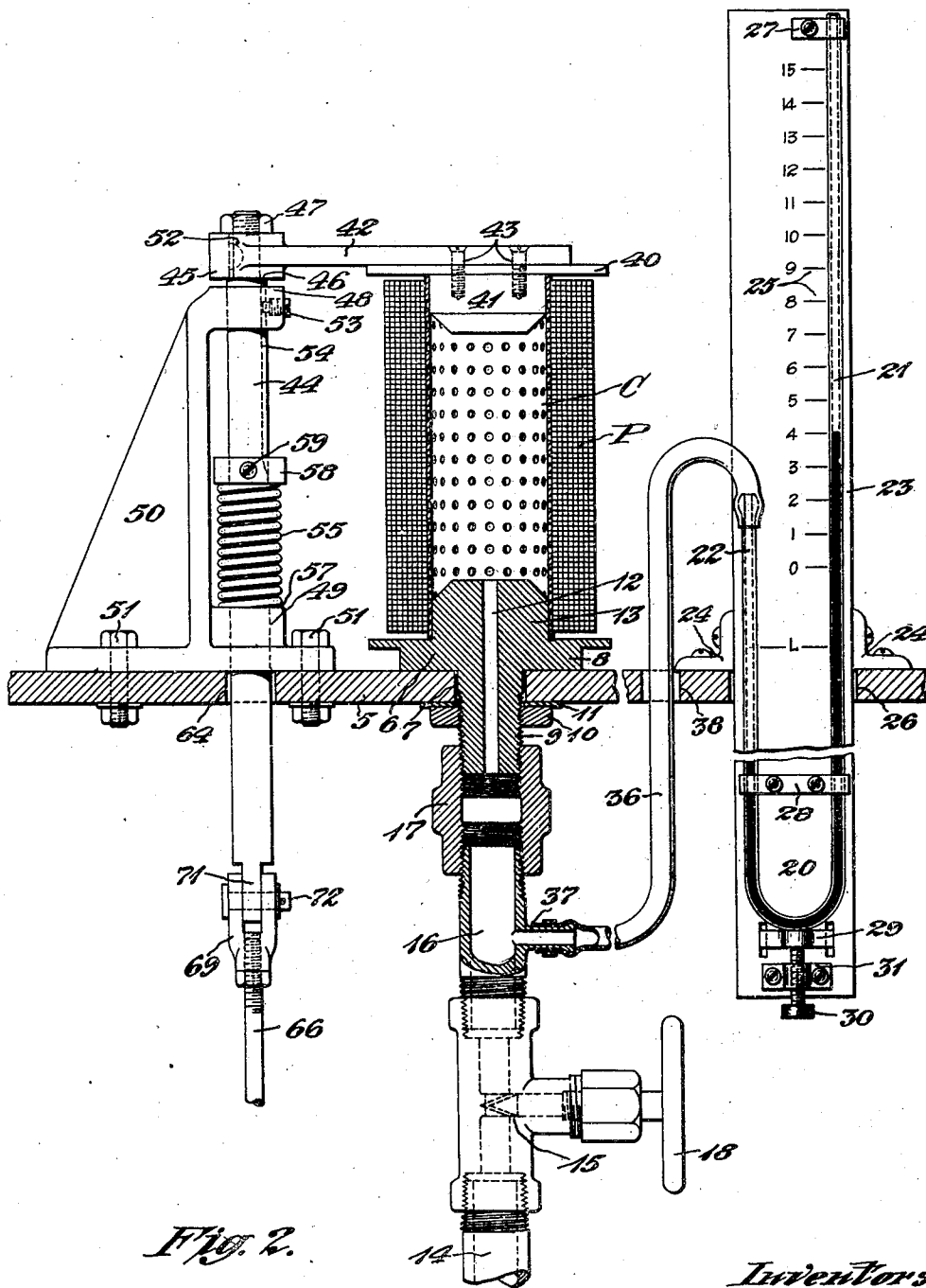


Fig. 2.

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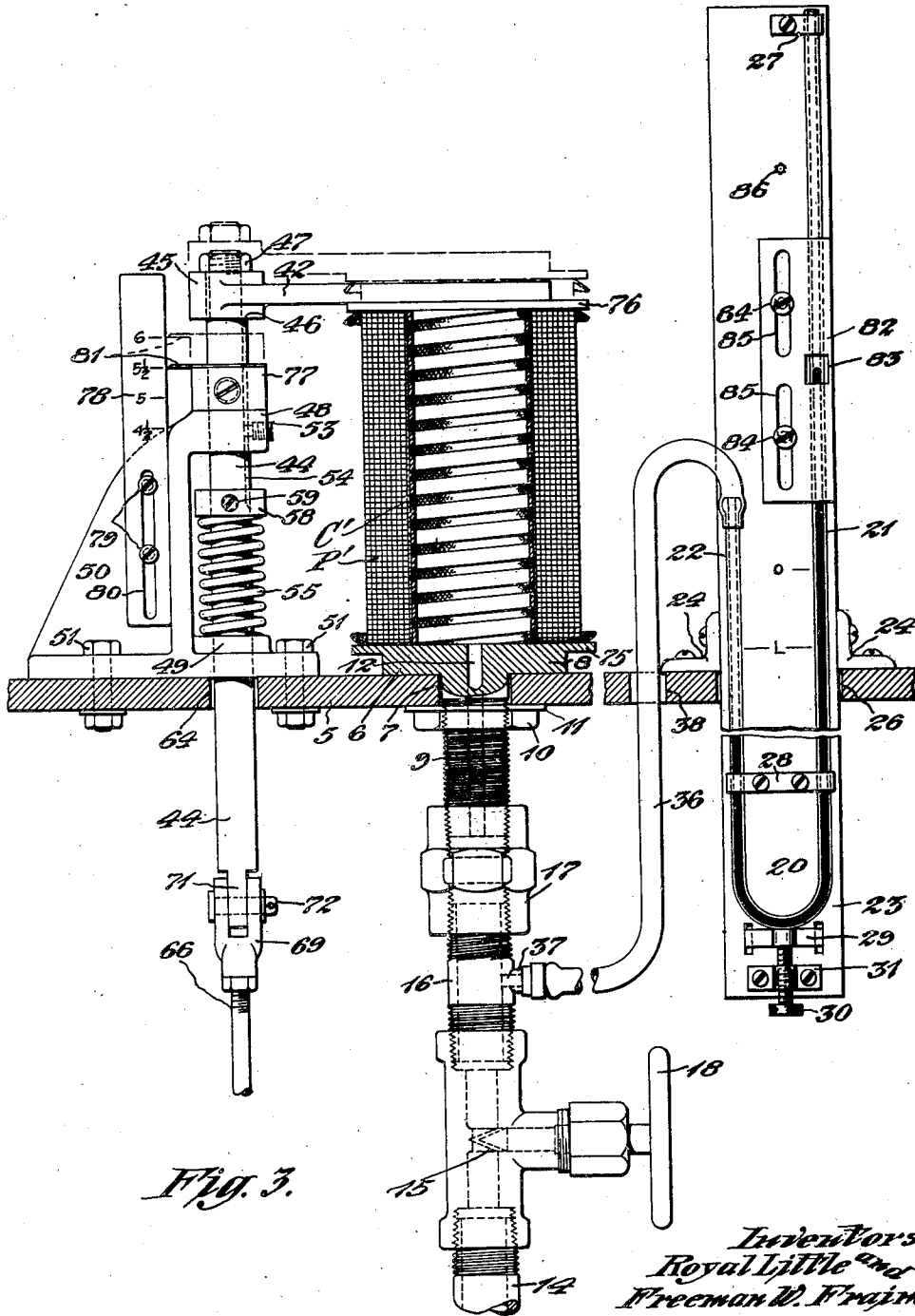
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4 Sheets-Sheet 3



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4 Sheets-Sheet 4

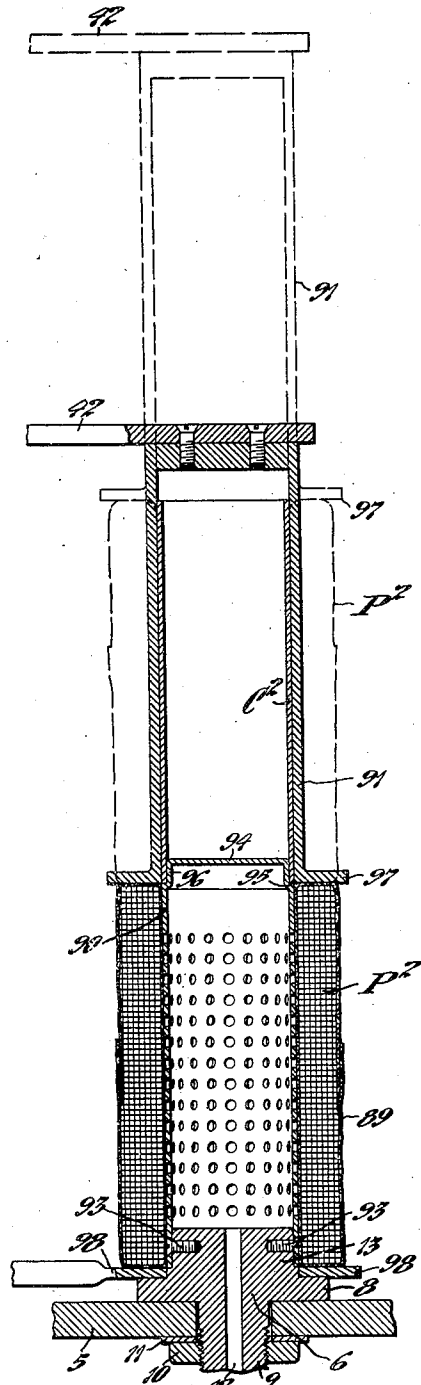


Fig. 4.

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UNITED STATES PATENT OFFICE

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APPARATUS FOR TESTING TEXTILE PACKAGES

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Application September 7, 1935, Serial No. 39,586

2 Claims. (Cl. 73—51)

The present invention relates to an apparatus for testing packages of textile material to determine their relative permeability or resistance to the flow of fluids due to the porosity of the yarn masses in the packages. By the term "package" as employed in the following specification and claims is meant any wound mass of textile material whatever its character or form and whether or not supported either from within or without.

By the usual method of dyeing, bleaching, mordanting or otherwise treating packages of textile material in a kier a treating fluid is surged through a plurality of the packages under pressure. Considerable difficulty has been experienced in passing the same volume of fluid through each package and as a result the material in the different packages is not uniformly treated. For example, when the packages of the material are treated with a dye liquor, and particularly packages of synthetic fibers commonly known as "artificial silk" or "rayon," the several packages do not have a uniform color shade. This difficulty is caused by variations in the density of packages wound on different spindles due to the tension of the yarn when wound, the twist of the yarn and other factors. The varying degrees of density of the packages varies their porosity which, in turn, varies the permeability of the packages to the flow of a treating fluid.

When a series of packages of varying permeability are treated in a kier in the manner explained above a larger proportion of the treating fluid flows through the packages having the greatest permeability and a lesser amount of the fluid passes through the packages having a lesser permeability. As a result the different packages are subjected to the treating fluid in varying degrees. When dyeing the dye liquor is absorbed in varying quantities in the different packages which gives a variation in the color shades. It has been the practice to avoid such inequalities in the packages by testing their density by the feel of the package to the hand; but such a means of determining the permeability of the packages to the flow of fluid is unreliable due to the different sense of touch of different persons and in one person from day to day.

One object of the present invention is to provide an apparatus for accurately testing the relative permeability of a plurality of packages of textile material so that those having the same permeability may be grouped together for subsequent treatment under the same conditions.

Another object of the invention is to provide

an apparatus of the type indicated for holding and closing the ends of a package while the testing fluid is forced therethrough and including means for measuring the pressure of the medium.

Another object of the invention is to provide an apparatus of the type indicated in which the package may be compressed to a degree comparable with its compression when subjected to a subsequent treating operation in a kier.

Further objects of the invention are set forth in the following specification which describes several preferred forms of the apparatus for practicing it, by way of example, as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is a perspective view of the testing apparatus showing a package mounted thereon prior to a testing operation;

Fig. 2 is a longitudinal sectional view of the apparatus illustrated in Fig. 1 showing the relationship of the elements while a testing operation is being performed;

Fig. 3 is a longitudinal sectional view of a modified form of testing apparatus for determining the permeability of a compressible package; and

Fig. 4 is a longitudinal sectional view of another modified form of apparatus for transferring packages from imperforate cores on which they are mounted to a perforated standpipe for testing.

The present invention provides for forcing a stream of fluid testing medium through a package of textile material at a constant rate, and measuring the pressure of the medium necessary to cause the flow. As the resistance of the package to the flow of the medium is inversely proportional to its permeability the variation in pressure necessary to force a stream of the testing medium through the different packages will indicate their relative permeability.

The packages are preferably wound on hollow porous cores which may be either rigid or compressible but the invention in its broadest aspect includes the testing of packages in any form such as cops, cones, cheeses, cakes, jack-spools, beams and the like. Air is usually used as the testing medium because of the ease and convenience with which it may be supplied and controlled, but it is to be understood that any other fluid whether a gas or liquid may be used to test the permeability of textile packages by the present apparatus. Preferably, a stream of the testing medium is passed through a measuring

orifice from a chamber containing the medium at a predetermined constant pressure so that the fluid will be fed at a constant rate. The stream of fluid is then confined within the package so that it can escape only through the porous core and the mass of material forming the package. The pressure will then indicate a value of permeability of the package to the flow of the medium.

It has been found by experiment that the value of permeability of a package to any particular testing medium, such as air, may be converted by constants to the permeability of the package to other fluids such as dyeing or bleaching compounds or any fluid for treating textiles. It has further been determined by experiment that the present apparatus for testing packages accurately measures their relative permeability so that groups of the packages having substantially the same permeability by test will pass the same amount of treating fluid. For example, when a group of such packages are subjected to a dye liquor at a predetermined pressure they will all take the same color shade, other variables being constant. Further, it has been found that when groups of packages having a permeability greater or lesser than a standard are subjected to a treating fluid at a pressure proportional to their permeability as tested, the same amount of fluid will pass through each package of the different groups to uniformly treat all the packages.

The present drawings illustrate three different forms of apparatus for testing textile packages. The apparatus shown in Figs. 1 and 2 includes a supporting bench or table 5 on which a nozzle 6 is mounted for dispensing a stream of the testing fluid at a constant rate. The nozzle 6 is mounted in an aperture 7 in the table 5 and has a radial flange 8 which seats against the table top. The end of the nozzle 6 extending downwardly through the aperture 7 is formed as a threaded pipe-nipple 9 and a nut 10 screwed up on the nipple against a washer 11 abutting the bottom of the table secures the nozzle fixedly in place. The nozzle 6 has an axially-extending measuring orifice 12 through which the testing fluid passes and a cylindrical extension 13 projecting upwardly from the flange 8 to form a closure plug for a purpose to be later described. The testing fluid, preferably air, is constantly supplied to the nozzle from a suitable source, not herein shown, through a conduit 14. Between the conduit 14 and nozzle 6 a needle-valve 15 and pressure-measuring chamber 16 are provided. The chamber 16 as herein illustrated is constituted as a short pipe-nipple having one of its threaded ends connected to the nipple 9 on the nozzle 6 by a union 17. The needle-valve 15 has a suitable operating handle 18 and opposite female pipe threads for connecting it to the pipe-nipple forming the pressure chamber 16 and the conduit 14.

A pressure-indicating device is mounted in any convenient position as on the table 5 and preferably takes the form of a manometer tube 20 having a long arm 21 and short arm 22; but it is to be understood that other forms of pressure-indicating instruments may be substituted for that herein illustrated. The manometer tube 20 is mounted on an indicating board 23 which, in turn, is mounted on the table 5 by means of brackets 24. The board 23 is suitably marked with indicia to provide a scale 25 at its upper end while its lower end extends through an aperture 26 in the table 5 to position the scale to be readily observed by an operator. The manometer tube 20 is slidably supported on the board 23 by

brackets 27 and 28 with its lower end resting on a vertically adjustable seat 29. The brackets 27 and 28 loosely embrace the manometer tube 20 so that it may be adjusted vertically by moving the seat 29 with an adjusting screw 30 extending through a screw-threaded support 31 fixed to the board 23 and engaging the seat 29. In this manner the tube 20 may be adjusted on the board 23 so that the level of the fluid in the opposite arms 21 and 22 of the tube 20 may be brought into register at a point indicated on the scale at L when no pressure is applied.

The pressure in the chamber 16 is transmitted to the short arm 22 of the manometer tube 20 by means of a flexible tube or conduit 36 having one end connected to a nipple 37 projecting laterally from the chamber 16 and its opposite end connected to the short arm 22 of the tube. As herein illustrated, the conduit 36 extends through an aperture 38 in the table, but it will be understood that any other arrangement of the parts may be made whereby to transmit the pressure in the chamber 16 to the manometer tube 20. The needle-valve 15 is adjusted by means of the handle 18 to permit a flow of the testing medium from the conduit 14 into the pressure chamber 16 at a constant rate. The medium will then flow from the pressure chamber 16 through the measuring orifice 12 of the nozzle 6 at a constant rate to maintain a constant pressure in the chamber. The needle-valve 15 is set to maintain a normal level of the liquid in the long arm 21 of the manometer tube 20 in register with the O graduation on the scale 25 when the testing medium is freely escaping through the nozzle 6.

The apparatus illustrated in Figs. 1 and 2 is particularly adapted for testing packages, such as indicated by the character P, wound on rigid, hollow, cylindrical cores C which are provided with a series of rows of perforations for passing a treating fluid such as a dye liquor during subsequent treatment. A package to be tested is mounted on the apparatus with its lower end abutting the upper face of the flange 8 surrounding the cylindrical plug 13 which is of such diameter as to provide a close fit with the interior of the core C. The plug 13 is of such length as to block the lowermost row of perforations in the core C and together with the seating of the core on the flange 8 seals the lower end of the package.

The opposite end of the rigid core C is sealed by a closure-plate 40 carrying a plug 41 for insertion into the interior of the core with a close fit in a manner similar to the plug 13. The closure-plate 40 and its depending plug 41 are adapted for movement toward and away from the end of the package and to this end are rigidly fixed to one end of an arm 42 by means of screws 43. The arm 42 is mounted on the upper end of a reciprocable rod 44 by means of a hub 45 which is held against a shoulder 46 on the rod by a nut 47 screwed down on its threaded end. The rod 44 is supported in suitable bearings 48 and 49 carried by a bracket 50 which is fastened to the table 5 by means of bolts 51. The plate 40 and plug 41 are held from turning about the rod 44 by a key 52, see Fig. 2, and maintained in proper alignment with the nozzle 6 and plug 13 by a set-screw 53 extending through the bearing 48 and engaging a longitudinal slot 54 in the rod. The closure-plate 40 is normally held in spaced relation with respect to the end of the core C, as illustrated in Fig. 1, by a coil-spring 55 tensioned between an abutment 57 on the bracket 50 and a

collar 58 fixed to the rod 44 by a set-screw 59. With the closure-plate 40 in its normal raised position packages of the textile material may be conveniently applied to the apparatus for a testing operation and thereafter removed therefrom.

The rod 44 extends through an aperture 64 in the table 5 and may be drawn downwardly against the action of the spring 55 to lower the closure-plate 40 into engagement with the open end of the core C by means of a foot-treadle 65 and connecting rod 66. The treadle 65 is of usual construction having one end pivoted as at 67 and a pedal 68 at its opposite end. The connecting rod 66 has bifurcated end members 69 and 70 screwed onto its threaded ends to provide for adjusting its length. The member 69 is pivotally connected to a tongue 71 at the lower end of the rod 44 by means of a clevis-pin 72 while the member 70 is similarly connected to the treadle 65 intermediate its ends by a clevis-pin 73. Having now described one form of the testing apparatus its mode of operation will next be explained.

The operator initially adjusts the apparatus for a testing operation by first moving the manometer tube 20 with respect to the scale-board 23 by means of the adjusting screw 30 until the level of the liquid in the two arms 21 and 22 register with the normal level point indicated at L on the scale 25. The needle-valve 18 is then opened by turning the handle 19 to permit the testing fluid to enter the chamber 16 and escape through the measuring orifice 12 in the nozzle 6. Due to the throttling effect of the measuring orifice 12 a pressure will be built up in the chamber 16 which is constant for a particular setting of the needle-valve 15. To provide a predetermined normal pressure in the chamber 16 the operator adjusts the needle-valve 15 until the liquid level in the long arm 21 of the manometer tube 20 registers with the graduation marked O on the scale 25. A package P is next mounted in position on the apparatus as shown in Fig. 1 with the lower end of its core C engaging the flange 8 and with the plug 13 extending into the lower end of the core.

The apparatus is then ready for a testing operation and the operator depresses the treadle 65 which acts through the connecting rod 66 and sliding rod 44 to lower the closure-plate 40 into sealing engagement with the upper end of the core C. The stream of testing fluid passing through the measuring orifice 12 is then confined within the core C and can only escape through the perforations therein and the interstices in the mass of yarn forming the package P. The position of the plugs 13 and 41 allows the escape of the testing fluid through that portion only of the package where the resistance to flow is uniform per unit of area. Due to the resistance of the package to the flow of the testing medium a pressure builds up in the package which causes an increase in the pressure in the measuring chamber 16 that is directly proportional thereto. Further, as the pressure necessary to force the testing fluid through the package is inversely proportional to the rate of flow of fluid through the package the degree of pressure in the chamber 16 is a measure of the permeability of the package. The pressure in the chamber 16 is transmitted through the conduit 36 to the short arm 22 of the manometer tube 20 and its degree is indicated on the scale 25 when it attains a constant value. After a particular package P has been tested the operator releases the treadle 65

and the spring 55 actuates the rod 44 to raise the closure-plate 40 to release the package. The package is then removed and another package applied and this package tested and the pressure observed in the same manner as above indicated.

The operator continues to test a plurality of packages and groups them in accordance with their degree of permeability as indicated by the pressure readings. Each group of the packages can then be subsequently treated under the same conditions and a uniform result obtained. For example, when packages are to be dyed a group having the same permeability within reasonable limits are placed in a kier and the dye liquor pumped through the packages at a predetermined pressure. Equal quantities of dye liquor will then pass through all the packages of the group and be uniformly absorbed to give a uniform color shade. Those groups of packages which are less permeable are subjected to the dye liquor at a greater pressure and those groups which are more permeable subjected to the dye liquor at a lesser pressure in proportion to their permeability to produce uniform absorption.

A modified form of apparatus is illustrated in Fig. 3 of the drawings for testing compressible packages under conditions corresponding to those to which the packages are subjected in a kier. In Fig. 3 the package P' is illustrated as wound on a compressible core C' of well known construction comprising a helical spring covered by a fabric sleeve. It is to be understood, however, that other forms of compressible cores may be used or that packages wound on rigid cores may be compressed for the testing by sliding the yarn mass longitudinally of the core. In the form of construction of the apparatus as illustrated in Fig. 3, the stationary and movable closure-plates 75 and 76 have flat faces for engaging the open ends of the package P' and the range of movement of the movable plate 76 is limited by the collar 58 and a collar 77 mounted on the actuating rod 44 to engage with opposite sides of the bearing 48 which serves as an abutment. A scale 78 is adjustably mounted on the bracket 50 by means of screws 79 extending through a slot 80 in the scale and engaging tapped holes in the bracket. The scale 78 is marked with suitable indicia for indicating regular decrements effected in the length of the package under compression. A pointer 81 carried by the collar 77 fixed to the rod 44 cooperates with the scale 78 to indicate the degree of compression of the package.

In this form of the invention a shutter 82 is shown as cooperating with the manometer tube 20 for permitting the observation of the degree of permeability of packages within certain defined limits. The shutter 82 takes the form of a plate having a window 83, being mounted on the scale-board 23 with the window positioned over the long arm 21 of the manometer tube 20. The shutter 82 is adjustably mounted on the scale-board 23 by means of screws 84 extending through elongated slots 85 in the shutter and engaging tapped holes 86 in the scale-board. To set the shutter 82 for a particular range of values the screws 84 are loosened and the shutter moved vertically of the board 23 until the upper and lower limits of the window 83 expose the pressure range desired.

The operation of this latter modified form of apparatus is generally similar to that previously described. However, with this form of apparatus

the limits of movement of the closure-plate 76 is first adjusted by setting the collars 58 and 77 on the rod 44 with respect to the bearing 48 on the bracket 50. For example, if it is desired to compress each package by a decrement equal to one-half of a unit indicated on the scale 78 the operator sets the collar 77 on the rod 44 so that when the closure-plate 76 engages the open end of the package the pointer 81 will be in the position shown in dot and dash lines in Fig. 3. With this setting the collar 77 will engage the bearing 48 to limit the downward movement of the closure-plate 76 when the package has been compressed to the desired degree. The collar 58 is set to limit the upward movement of the rod 44 to a normal position such as to permit the application and removal of the packages to and from the apparatus.

The shutter 82 is adjusted on the scale-board 23 so that the window 83 will indicate the level of the fluid in the long arm 21 of the manometer tube 20 within a permissible range of permeability of the package. The operator then applies a package to the apparatus, noting from time to time that the closure-plate 76 just engages the open end of the package when the pointer 81 indicates 6 on the scale 78. The treadle 65 is then depressed until the collar 77 engages the abutment formed by the bearing 48 to compress the package P' to the desired extent. The pressure existing in the chamber 16 will then be indicated by the level of the liquid in the long arm 21 of the manometer tube 20. The operator observes the reading and if within the range of the upper and lower limits of the window 83 the permeability of the package is permissible, but if either below or above the limits of the window the package is to be rejected. It will be understood that the form of shutter shown in this last-described embodiment of the invention may be applied to the manometer tube 20 disclosed in the first-described modification to produce the same results.

A third modified form of apparatus is illustrated in Fig. 4 of the drawings as adapted for transferring and testing compressible packages mounted on relatively rigid and imperforate cores C². In order to reserve the compressible cores C' of the type illustrated in Fig. 3 for winding and dyeing operations it is a common practice to employ imperforate cores C² when the packages are wound to support them from collapsing. The individual packages P² are enclosed and protected by porous stockinets 89 folded back over the opposite ends and peripheries of the package as illustrated in Fig. 4.

The apparatus illustrated for testing the permeability of this form of package is generally similar to that previously described but has a perforated standpipe 90 for receiving the package P² and a longitudinally-movable cap 91 for transferring the packages from the rigid core C² to the standpipe. The perforated standpipe 90 is preferably made of metal and rigidly fixed at its lower end to the projecting plug 13 of the nozzle 6 by screws 93 or any other suitable means. The standpipe 90 has a top wall 94 closing its upper end and adjacent thereto the standpipe is offset inwardly to form an annular seat 95 and a projecting plug 96 for supporting the lower end of the core C².

The cap 91 is constructed in the form of an inverted cup of a length greater than the length of the core C², the annular wall of the cap being adapted to surround the upper end of the stand-

pipe 90 with a close sliding fit. At the lower open end of the cap 91 is an outwardly flaring rim 97 for engagement with the end of the package P² to slide it from the core C² onto the perforated standpipe 90 and compress it during a testing operation. The cap 91 is carried by the movable arm 42 to be actuated by the treadle 65 as in the previously described embodiments of the invention; but in this form the arm is adapted for a considerably greater range of movement to transfer the package and apply a predetermined mechanical pressure at its end.

Suitable means are preferably provided for sliding the package P² from the standpipe 90 back onto any suitable core after a testing operation. As illustrated this latter means may take the form of an annular ring 98 between the lower end of the package and the flange 8 on the nozzle 6. The ring 98 may be lifted manually or by suitable treadle mechanism after a testing operation to transfer the package P² back onto any suitable core, the latter being axially held against the annular seat 95 on the standpipe 90 during the transfer.

With this last-described form of apparatus the package P² is mounted on the upper end of the standpipe 90 with the lower end of the core C² surrounding the reduced end 96 of the standpipe and supported on the seat 95. The treadle 65 is then actuated to lower the arm 42 and the depending cap 91. The flaring rim 97 of the cap 91 engages the upper end of the package P² and as the cap continues to be lowered the package is slid from the core C² onto the standpipe 90 axially aligned therewith. The lower end of the package P² seats against the annular lifting ring 98 and the package may be compressed between the ring and the flaring rim 97 to a predetermined extent. The testing fluid is then supplied to the interior of the standpipe 90 by opening the needle-valve 15 in the manner previously explained and the fluid escapes through the perforations in the standpipe and the mass of textile material forming the package. As in the previously-described embodiment the pressure necessary to force the fluid through the package at a constant rate is measured on the manometer tube 20 or other pressure indicating gauge to determine the permeability of the package. After the test has been made the treadle 65 is released and the arm 42 and cap 91 moved to their normal raised position. The package P² enclosed by the stockinet 89 is then bodily slid from the standpipe 90 back onto any suitable core by the lifting ring 98. In this manner the packages of a batch are individually tested and those having the same permeability grouped together for subsequent treatment.

From the foregoing description of the invention it will be observed that a novel apparatus is provided for accurately measuring the relative permeability of packages of textile material to the flow of a fluid as indicated by the pressure necessary to force a testing fluid through the package at a constant rate. It will also be observed that by testing the relative permeability of a plurality of packages a subsequent uniform treatment may be given to the various packages of a group in dyeing, bleaching, mordanting or other treating processes. It will still further be observed that the present invention provides for testing the packages with great facility by a series of simple operations that may be performed by an unskilled person with unerring accuracy.

Various modifications may be made in the 75

herein described arrangement and form of the parts of the apparatus without departing from the spirit or scope of the invention. Therefore, without limiting ourselves to the exact embodiment shown and described, we claim:

5 1. In an apparatus for testing the permeability of a mass of textile material wound on a hollow longitudinally compressible core, a nozzle having a support for one end of the core with a bore
10 extending therethrough, an imperforate closure for engaging the opposite end of the core and movable toward the support, means for moving the imperforate closure toward the support to cause the package to be compressed therebetween,
15 means for indicating the degree of compression of the package, means for supplying a testing medium to the interior of the core through the bore in the support, and means for measuring the pressure of the testing medium caused by the
20 resistance of the textile material to the flow of the medium radially therethrough.

2. In an apparatus for testing the permeability

of a mass of textile material wound on a hollow foraminous core in the form of a package, the combination of a support, a nozzle fixedly mounted on the support, said nozzle having a measuring orifice extending longitudinally throughout its
5 length and an annular flange overlying the support and forming a seat surrounding the orifice, an imperforate closure plate overlying the annular flange on the nozzle in spaced relation thereto to adapt a package to be placed therebetween,
10 means for mounting the imperforate closure plate for movement toward the annular flange on the nozzle to clamp the package therebetween and seal the upper and lower ends thereof, means for forcing a testing medium through the nozzle at
15 a constant rate, and means connected to the nozzle for measuring the pressure of the testing medium caused by the resistance of the textile material in the package to the flow of the medium radially therethrough.

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