April 3, 1951 H. BOOTH 2,547,367

METHOD AND APPARATUS FOR TESTING FABRICS

Filed March 13, 1946 2 Sheets-Sheet 1

FIG. I.

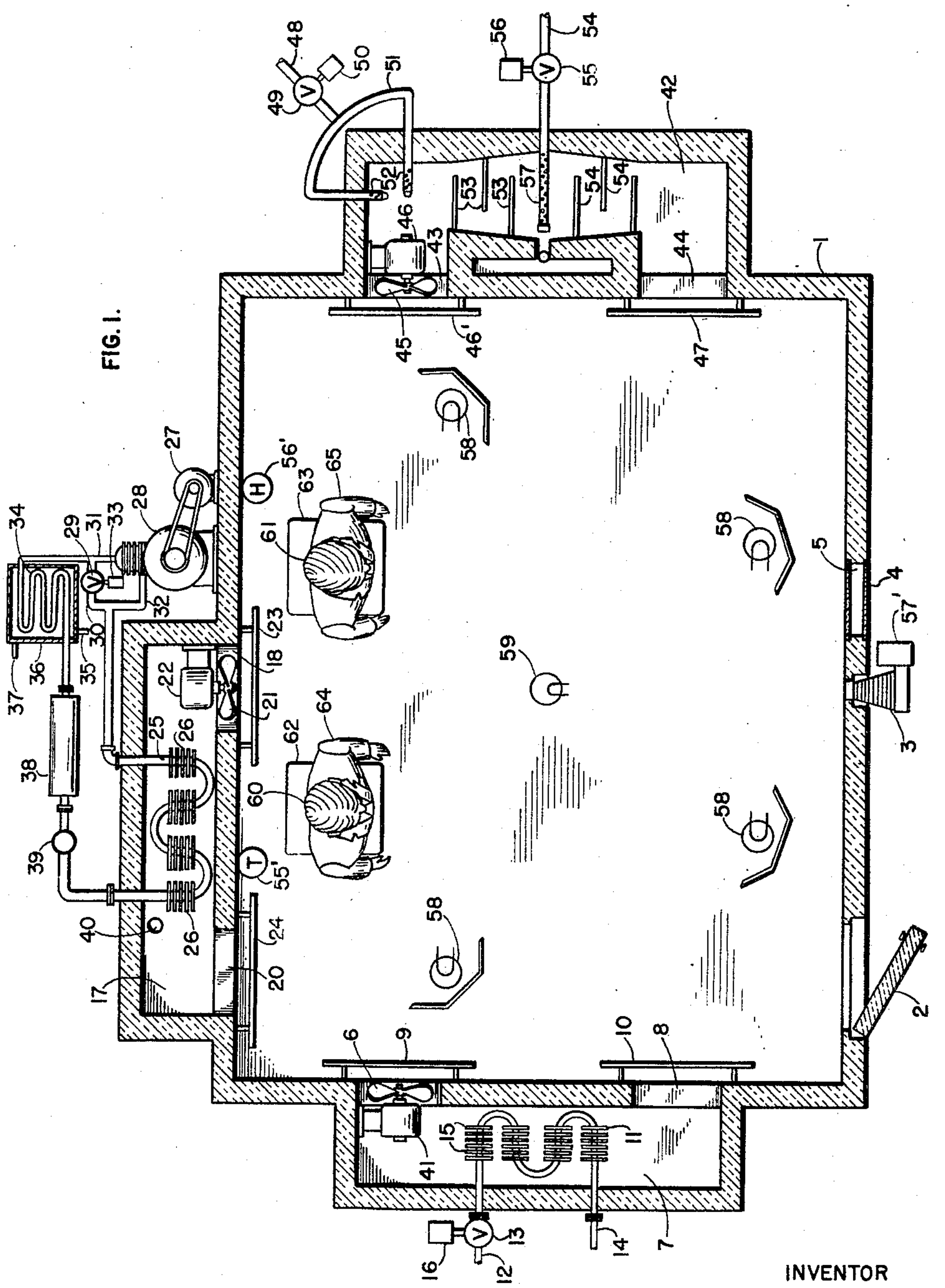

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FIG. 2.

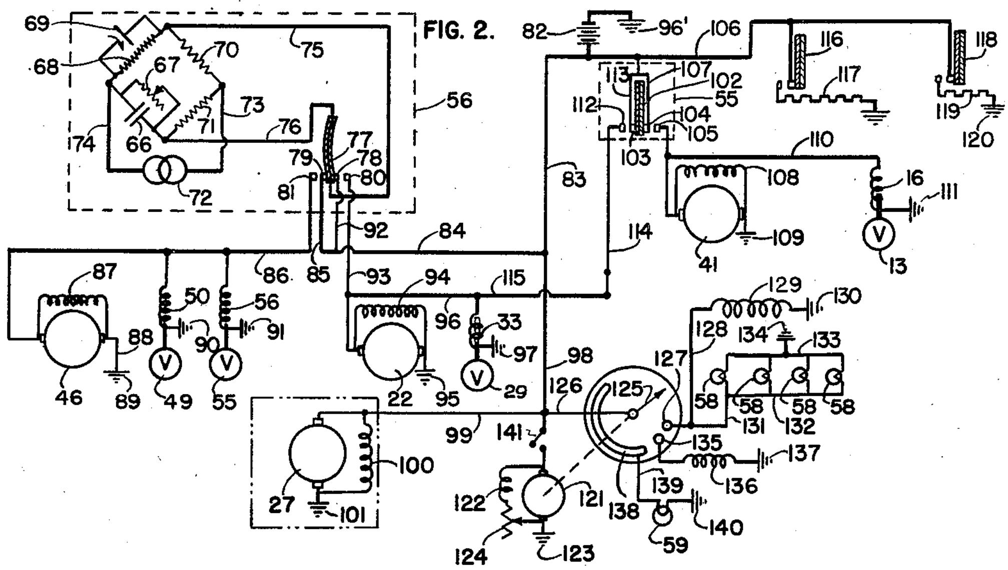
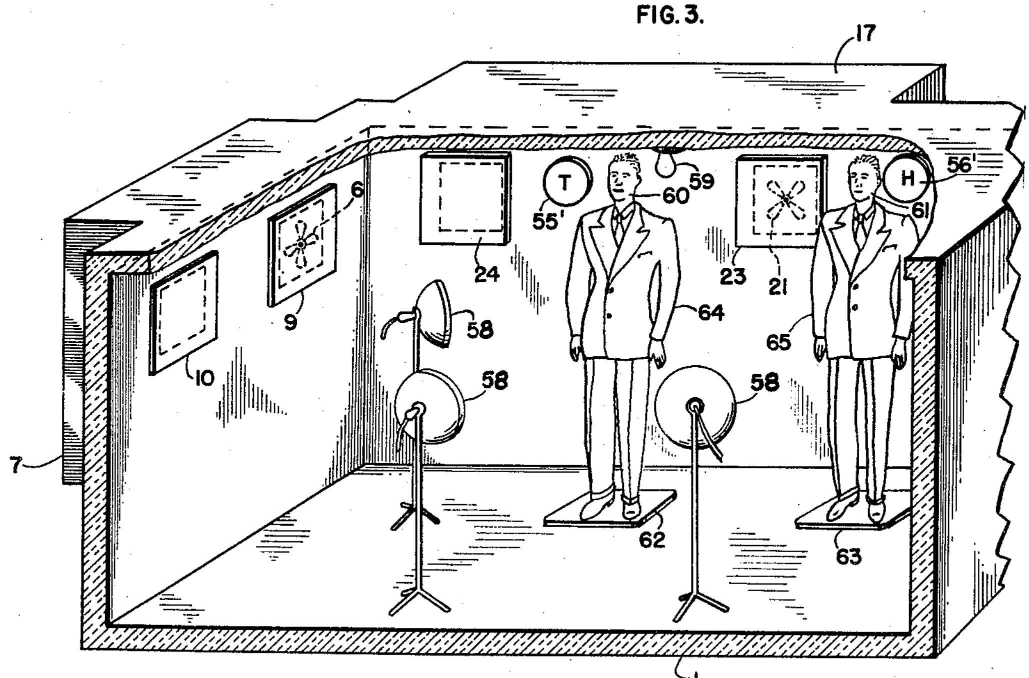


FIG. 3.



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METHOD AND APPARATUS FOR TESTING FABRICS

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6 Claims. (Cl. 73—15)

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My invention relates to a method and apparatus for testing fabrics, and more particularly for testing the tailoring qualities of fabrics in the making of clothes, shirts, coats, and other articles of wearing apparel.

Weavers of fine fabrics have achieved good results in the weaving of excellent cloth which has superior qualities with respect to color, appearance, touch, and handle. It has long been known that certain fabrics when made into clothes retain their shape and appearance over long periods of time and do not develop "bubbles" or wrinkles, but seem to retain their conformity to the wearer. The ability of a fabric when made into clothes to retain its shape and fit, can be generally termed the "tailoring quality" of a fabric.

Just why some fabrics tailor better than others is not generally understood, and it has been largely fortuitous in many cases. One reason for the lack of knowledge of tailoring qualities of fabrics is that there has been no real investigation made of tailoring qualities to ascertain why certain cloths have good tailoring qualities and why others do not.

One object of my invention is to provide a novel method of studying fabrics under various conditions of temperature and humidity in order to investigate the tailoring qualities of fine fabrics.

Another object of my invention is to provide a novel apparatus for observing the tailoring qualities of fabrics for comparative study.

Another object of my invention is to provide a method and apparatus in which the different tailoring of two garments from the same fabric may be observed in a simple, expeditious, and convenient manner.

Another object of my invention is to provide a method and apparatus whereby the behavior of the fabrics under varying conditions of temperature and humidity may be readily observed.

Other and further objects of my invention will appear from the following description.

In general, my invention contemplates the provision of a chamber in which a predetermined temperature and humidity may be maintained and varied in accordance with any desired plan. In this chamber I provide means for displaying fabrics made into garments by different types of tailoring. Means are provided for changing the temperature and humidity of the chamber over wide limits. At predetermined small intervals of time, the fabrics are photographed, preferably on a film which can later be displayed over a

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relatively short period of time so that the changes which occur due to variations in temperature and humidity can be viewed dynamically and thus emphasized and be made readily observable.

In the accompanying drawings, which form part of the instant specification and which are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views,

Fig. 1 is a diagrammatic sectional plan view of apparatus capable of carrying out the process of my invention.

Fig. 2 is a diagrammatic view showing the electrical circuits involved in the apparatus shown in Fig. 1.

Fig. 3 is a perspective view of the apparatus shown in Fig. 1, with parts broken away.

Referring now to Fig. 1, the chamber is formed in any suitable manner and of any desired shape of insulated walls 1 adapted to prevent ready heat exchange between the interior and the exterior of the chamber. A suitable door 2 is provided for permitting ingress and egress from the chamber. A camera 3 of any suitable construction is mounted in one of the walls of the chamber. An observation window 4, preferably a double window having an insulating dead air space 5, is provided. A fan 6 driven by motor 41 is adapted to take suction from within the chamber and pass air through the housing 7 whence it is returned through the opening 8 into the chamber. A baffle 9 prevents excessive air currents from being created in the chamber. A similar baffle 10 diffuses the air leaving the housing 7. Within the housing 7 I provide a heat-exchanger 11, through which steam may pass, entering through pipe 12 controlled by valve 13, and leaving through pipe 14. The heat-exchanger 11 is fitted with heat-exchange fins 15 to increase the heat-exchange surface. The valve 13 is controlled by a solenoid 16 and is normally in a closed position. A similar housing 17 is provided with an intake opening 18 and a discharge opening 20. A fan 21 rotated by a motor 22 is adapted to take suction from the atmosphere within the chamber and pass air through the housing 17 for discharge through the opening 20 back into the chamber. A baffle 23 diffuses the air flowing to the fan 21 and a baffle 24 causes diffusion of the air being returned to the chamber. A heat-exchange coil 25 provided with heat-exchange fins 26 is positioned within the housing 17. A motor 27 drives a compressor 28 of a refrigerating system. A valve 29 controls the pipe 30, which normally connects the discharge pipe 31 of the compressor and its suction pipe 32. The valve 29 is controlled by a solenoid 33. When the valve 29 is closed, the compressed refrigerant fluid will flow through pipe 31, through a condenser coil 34. The hot compressed refrigerant fluid will be cooled in condenser coil 34 by a cooling medium supplied through pipe 35 to the condenser housing 36, leaving through pipe 37. The cooled compressed refrigerant fluid passes into a receiver 38 and is adapted to pass from the receiver through an expansion valve 39, and thence into the refrigerating coil 25. The air passing through the housing 17 is thus adapted to be cooled by heat exchange with the refrigerating coil 25. The cooling not only lowers the temperature of the atmosphere passing through the housing 17, but also chills the air below its dew point, precipitating moisture. The precipitated moisture may be drained from the housing 17 through drain opening 40. A third housing 42 is provided with communication with the interior of the chamber through openings 43 and 44. A fan 45 driven by a motor 46 is adapted to take suction from the air within the chamber and deliver it through the housing 42 for exit through opening 44 back into the chamber. A baffle 46′ diffuses the air passing into the housing 42 and a baffle 47 serves a similar purpose for air leaving the housing 42. A pipe 48 is connected to a steam supply and is controlled by a valve 49 adapted to be operated by a solenoid 50. The pipe 48 communicates with a manifold 51, to which are connected steam jets 52. The interior of chamber 42 is provided with a plurality of baffles 53. A pipe 54 communicates with a supply of water under pressure such as the city water main. It is controlled by a valve 55 which is operated by a solenoid 56. When the valve 55 is open, water is adapted to be sprayed from a spray pipe 57 within the housing. The water spray precipitates uncondensed steam which has been theretofore injected into the air passing through the housing 42 to humidify it. Large particles of moisture in suspension are removed from the air passing through the housing 42 by the baffles 54 so that the air being returned into the chamber through opening 44 has been substantially increased in humidity.

I provide a thermostat 55′ connected in a circuit so that when the temperature within the chamber is lower than that desired, the solenoid 16 will be actuated to permit steam to pass through the heat-exchange coil 11 and the motor 41 of the fan 6 will be energized. When the temperature is higher than that desired, the thermostat is connected in circuit to close bypass valve 29 of the compressor and to energize motor 22. In this manner, the air in the chamber will be cooled, as will be hereinafter more fully described. I also provide a hygrostat 56′. The hygrostat is connected in a circuit so that when the relative humidity within the chamber is lower than that desired, it will energize a circuit to open both valves 49 and 55 and energize the motor 46. The hygrostat further is connected in a circuit so that when the humidity is too high it will energize the motor 22 and operate to cause the closing of valve 29, all of which will be hereinafter more fully described.

The camera 3 is provided with magnetic means designated generally in Fig. 1 by the reference numeral 57 adapted to operate the shutter of the camera at periodic intervals and also to transport the film or photographic medium on which the picture is being made. Within the chamber I position a plurality of photographic flood lights 58 operated in synchronism with the camera, as will be hereinafter described. The chamber is normally illuminated by an incandescent lamp 59. Within the chamber I provide a plurality of tailor's dummies 60 and 61 mounted on suitable pedestals 62 and 63. Clothes 64 and 65 are fitted on the tailor's dummies. One of the tailor's dummies may have apparel 64 of known qualities with which the apparel 65 on the tailor's dummy 61 is to be compared. Similarly, two suits of clothes to be tested, tailored in different manners, may be fitted about the tailor's dummies 60 and 61.

The interiors of the tailor's dummies may be made hollow and fitted with thermostatically controlled heating elements set to keep the dummies at about 98° Fahrenheit, which is substantially the temperature of the human body.

Referring now to Fig. 2, which shows the electrical connections of my apparatus, the hygrostat is shown generally by the reference numeral 56′. A bridge network comprising a capacitor 66 by-passed by a variable resistance 67 is adapted to be opposed by a resistance 68 by-passing a variable condenser 69. Resistances 70 and 71 complete the bridge. A suitable source of alternating potential, such as an alternator 72, is connected across the bridge by conductors 73 and 74. Conductors 75 and 76 are connected to the opposite terminals of the bridge in a circuit containing a bimetallic thermostatic element 77. The bimetallic element carries a pair of contact points 78 and 79 adapted to contact contact points 80 and 81 respectively. The dielectric for the condenser 66 comprises the air within the chamber 1. As the humidity of the air within the chamber increases, the dielectric value of the air will decrease, and the condenser 66 will present a lower capacitive impedance to the flow of the alternating current from alternating current source 72. As the humidity within the chamber decreases, the dielectric strength of the air which forms the dielectric of the air capacitor 66 will increase, thus increasing the capacitive impedance to the flow of the alternating current from alternating current source 72. The bridge network is normally unbalanced so that a predetermined current will flow through the bimetallic element 77 which is in the circuit and connected across conductors 75 and 76. At the predetermined current value, the bimetallic element assumes a position such that neither contact point 79 nor contact point 78 is in contact with the respective contact elements 81 or 80. Should, however, the humidity within the chamber decrease, the current flowing through the bimetallic element 77 will decrease, thus heating it less strongly, that is, the value of I^2R, in which I is the current flowing through the bimetallic element, and R is its resistance, will be less. The lower temperature of the bimetallic element, which is normally curved due to the heating effect of the predetermined current, will permit it to assume a straighter position, thus causing contact point 79 to make contact with contact point 81. When this occurs, current will flow from the battery 82, through conductor 83, through conductor 84, through conductor 85, through contact point 79, through contact point 81, through conductor 86, through the field 87 of motor 46, and through its armature, through conductor 88, to ground 89. At the same time, current will flow from conductor 86, through winding 50, to ground 90, thus opening valve 49. Likewise, current will flow through the winding of solenoid 56 to ground 91, thus opening valve 55.

When the humidity of the atmosphere within the chamber 1, the testing chamber, increases, more current will flow through the bimetalic element 77, thus curving it further. When this occurs, contact point 78 will make contact with contact point 80, permitting current to flow from the battery 82, through conductors 83 and 84, through conductor 92, through contact point 78, through contact point 80, through conductor 93, through the field winding 94 and armature of motor 22, to the ground 95. It will be noted that the other side of the battery 82 is grounded at 96′ so that the circuit through the battery is always completed through ground. At the same time, current will flow through conductor 96, through the winding of solenoid 33, to ground 97, thus closing the valve 29. The motor 27 which drives the compressor 28 is supplied electrical potential through conductor 98 and conductor 99, current flowing through the armature of motor 27 and its field winding 100 to the ground 101. The thermostat 55 may be of any suitable type and is shown as a bimetallic element 102 carrying contact point 103 and contact point 104. When the temperature is too low, the bimetallic element 102 will curve to bring contact point 104 into contact with contact point 105. When this occurs, current wil flow from the battery through conductor 106, through conductor 107, through contact point 104, through contact point 105, energizing the field winding 108 and the armature of motor 41, the circuit being completed through ground 109. At the same time, current will flow through conductor 110, through the winding of solenoid 16, to ground 111, thus opening valve 13.

When the temperature in the testing chamber is too high, the bimetallic element 102 will curve to bring contact point 103 into contact with contact point 112. When this occurs, current will flow from the battery through conductor 106, through conductor 113, through contact point 103, through contact point 112, through conductor 114, through conductor 115, thus energizing the motor 22 and the solenoid 33. A bimetallic element 116 is positioned within the dummy 60. When the temperature is too low, it is adapted to complete a circuit through the heating resistance 117 to raise the temperature to the desired point. A similar bimetallic element 118 is positioned within the dummy 61 and is adapted to complete a circuit through heating resistance 119, to ground 120, when the temperature within the dummy 61 is too low. Potential is supplied to a timing motor 121 having a field winding 122, the circuit being completed from conductor 98 to ground 123, through switch 141. The speed of the motor 121 may be controlled by variable resistance 124. The motor 121 is adapted to drive a revolving conducting arm 125, to which potential is supplied from conductor 98 through conductor 126, the arm 125 being assumed to rotate in a clockwise direction, as viewed in Fig. 2. When the arm makes contact with contact point 127, current will flow from the battery through conductors 83, 98, and 126, through revolving arm 125, through contact point 127, through conductor 128, through the winding 129 of a solenoid adapted to actuate the shutter of camera 3, the circuit being completed through ground 130. At the same time current will flow through conductor 131, through conductor 132, thence through the filaments of the incandescent lamps 58 to conductor 133, and thence to ground 134. Further movement of the arm 125 will make contact with contact point 135, permitting current to flow through the winding 136 of a solenoid adapted to operate the film-transporting mechanism of the camera 3, the circuit being completed through ground 137. Thereafter, the contact arm 125 will make contact with conducting segment 138, completing a circuit through conductor 139, through the filament of the incandescent lamp 59 to ground 140.

The humidity at which the hygrostat 56 is to operate may be readily adjusted by mounting contact points 81 and 80 on an adjustable member so that relative position with respect to the bimetallic element 77 may be readily controlled. The humidity may be further adjusted by varying the capacity of condenser 69. The temperature at which the thermostat 55′ is to operate may be readily adjusted by mounting the contact points 112 and 105 on a common support and moving them relative to the bimetallic element 102, as is well known in the art. It is to be understood that any suitable adjustable hygrostat and any suitable adjustable thermostat may be employed. In practice I contemplate the constant variation of humidity or of temperature or of both by any suitable time mechanism such as clockwork or a timing motor similar to the motor 121. If desired, the thermostat and the hygrostat may be adjusted by hand at predetermined intervals.

In operation, let us assume that it is desired to test a fabric. Suits are tailored of the fabric to be tested by two different methods of tailoring. These suits are fitted upon the dummies 60 and 61 and placed within the testing chamber in the position shown in Fig. 1 or in any other suitable position so that they may be photographed by the camera 3. Let us assume that the test is to be made at a temperature of 60° Fahrenheit through relative humidities from 10 to 90. The thermostat is set at the temperature of 60 degrees and the hygrostat is set either at 90 percent and the humidity lowered, or preferably at 10 per cent and the humidity increased. In either case, the test may be made to increase the humidity from a predetermined point to a predetermined point and returned back to the first point.

Let us assume further that the temperature within the chamber is below 60 degrees. When this occurs, the thermostat operates to open valve 13 and start the motor 41. The fan 6 will take suction of the cool air and pass it through the housing 7 in contact with the heat-exchanger coil 11, thus heating the air. The cool air being circulated from the room through a heat-exchanger back through the room will rapidly raise the temperature to 60 degrees. At this point the thermostat operates to de-energize the motor and close the valve 13. If the temperature were too high, the thermostat would operate to close valve 29, thus permitting the refrigerant cycle to operate, and to energize the motor 22. The warm air will be withdrawn from the testing chamber by the fan 21 and passed into contact with the refrigerating coil 25 to chill the air and the cooled air returned to the chamber. In this manner the temperature is rapidly lowered to the desired temperature.

Let us assume now that the starting humidity is too high. The hygrostat operates to close valve 29, permitting the refrigeration cycle to take place and to energize the motor 22. The humid air from the testing chamber is withdrawn by fan 21 and passed into contact with the refrigerating coil 25. This chills the air below its dew point and precipitates moisture from the air which is withdrawn through the drain 40. The dry air is returned to the testing chamber. The cooling action which must necessarily take place in the dehydration is compensated for by heat furnished by the heat-exchanger 11. As soon as the humidity is restored to its predetermined value, the motor 22 will be stopped and the valve 29 will be opened. The opening of valve 29 connects the discharge side of the compressor with the suction side and removes the refrigerating load from the motor 27, which may run continuously. It is to be understood, of course, that the motor 27 may be stopped and started instead of using the by-pass valve 29. If the humidity is too low, the hygrostat will operate to open valves 49 and 55 and to energize the motor 46. Dry air will be drawn from the testing chamber, saturated with steam and moisture, and returned to the chamber. As soon as the humidity builds up to the desired value, valves 49 and 56 are closed and the motor 46 stops.

It will be seen that the refrigeration cycle acts to correct both a too high temperature and a too high humidity. The correction of the humidity will lower the temperature, while the correction of the temperature will lower the humidity. The deficiencies introduced are balanced by the humidifying system and the heating system. All three elements work in unison controlled by the hygrostat and the thermostat. In this manner, the humidity may be controlled within narrow limits in a rapid, simple, and expeditious manner, and further, the humidity may be varied. It will be noted that the thermostat and the hygrostat are within the range of the camera so that each picture will show both the temperature and the humidity at the moment the photograph is taken, the instruments being of the indicating type.

As soon as the testing chamber has reached the initial conditions of temperature and humidity, a switch 141 (shown in Fig. 2) is operated to energize the timing motor 121. The shutter is first actuated and the photographic flood lamps 58 energized to take the picture. When the shutter is closed and the flood lights are extinguished, the photo-sensitive medium in the camera, such as a film, is transported to present the next frame, and the action takes place automatically and continuously. In the meantime, the humidity is being changed from the assumed value of a relative humidity of 10 to a relative humidity of 90. Any changes in the garments on the dummies which take place will be recorded photographically. After the particular test being conducted is completed, the photographic medium such as a film is removed from the camera, developed, and prepared for projecting as a moving picture. Let us assume that the photographs were taken every minute, and let us assume further that the cycle of humidity change was performed during a period of twenty-four hours. We then have 1440 frames taken over a period of twenty-four hours. This film can then be projected at the rate of sixteen frames per second and it will produce in a period of a minute and a half, or ninety seconds, the changes which took place over twenty-four hours. Any changes in attitude, hang, or fit will immediately become apparent to one who views the film. At the same time, for example, a shoulder will develop a wrinkle, which will appear and disappear as the humidity changes from one value to another and back again. Separate frames at various extreme conditions may be enlarged and compared in detail, and the changes will thus become apparent. Furthermore, a plurality of tests of various types may be readily and expeditiously conducted. One test may involve merely a temperature change. Another test may involve a humidity change. One test may comprise the changing of both the temperature and the humidity. In one test both the temperature and the humidity may be increasing, and in one test the temperature may be increasing while the humidity may be decreasing.

It will be seen that I have accomplished the objects of my invention. I have provided an apparatus and method of studying the tailoring qualities of fabrics and the effect of different types of tailoring on fabrics. I am thus enabled to produce a positive and perfect account of what transpires in a garment made of a certain fabric or tailored in a certain manner. I am enabled to achieve accurate answers to the following problems:

1. The degree to which different tailoring of two garments in the same fabric has affected the appearance of a suit through various cycles.

2. The degree of improvement of the new hairline over the original hairline, and the effect of different tailoring on each.

3. Whether difficulties in tailoring are due to the fabric or to the method of tailoring.

4. An accurate record of a suit at its best and worst condition, together with data concerning the amount of shrinkage and residual shrinkage, and various other factors which would constitute a permanent record to which reference may be had in experiments and development having for their aim the improvement of tailoring qualities.

Shirtings and other fabrics, as well as suitings, can be tested, not only for different methods of tailoring, but also against shirtings and suitings of known shrinkage qualities.

By my method and apparatus I am enabled to determine the effect of the variations and types of thread and types of canvas used for the manufacture of clothes. Not only am I enabled to measure the changes which take place, but I can actually see the movement of the garment, such as the effect on the shoulders and the front, the effect on the sleeves and other parts of the garment, due to the changes in temperature and humidity.

I have thus provided a method and apparatus of solving the sole remaining problem of the clothing industry today, namely, the problem of getting all types of different cloth to come through manufacturing processes true to size. It is known that wool fibers respond very quickly to changes in atmospheric conditions, but it is not known how a particular cloth will react to temperature and humidity changes. Even if weavers are unable to manufacture cloth free of changes due to temperature and humidity, I am enabled by my method to predetermine what changes will take place in order that proper allowances can be made so that clothing will come from the manufacturing process true to size and will remain true to size under average atmospheric conditions to be encountered.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and described.

Having thus described my invention, I claim:

1. An apparatus for testing fabrics, including in combination a chamber, a dummy within said chamber upon which apparel made of the fabric to be tested is adapted to be displayed, means for controlling the temperature within said dummy, means for controlling the atmospheric conditions within said chamber, a camera, and means for controlling said camera to photograph said apparel at frequent intervals.

2. An apparatus for testing fabrics, including in combination a chamber, means for heating said chamber, means for humidifying said chamber, means for controlling said heating means, means for controlling said humidifying means, refrigerative means responsive to both said controlling means for lowering the humidity and for lowering the temperature within said chamber, means for displaying the fabric to be tested within said chamber, a camera, and means for controlling said camera to make exposures of said fabric at frequent intervals.

3. An apparatus for testing fabrics, including in combination a chamber, a dummy within said chamber upon which the fabric to be tested is adapted to be displayed, means for heating said chamber, means for humidifying said chamber, means for cooling said chamber, thermostatic means for controlling said heating means when the temperature in said chamber drops below a predetermined point, and for controlling said cooling means when the temperature within said chamber rises above a predetermined point, a hygrostat for controlling said humidifying means when the relative humidity within said chamber drops below a predetermined point, and for controlling said cooling means when the relative humidity within said chamber rises above said predetermined point, a camera, and means for controlling said camera to make exposures at predetermined frequent intervals.

4. Apparatus for testing fabrics including in combination a chamber, means for heating the chamber, means for humidifying the chamber, means for controlling the heating means, means for controlling the humidifying means, refrigerative means responsive to both said controlling means for lowering the humidity and for lowering the temperature within said chamber and means for displaying the fabric to be tested within the chamber.

5. A method of observing the tailoring qualities of a fabric including the steps of displaying the apparel made of the fabric to be tested upon a dummy in a confined space, maintaining the interior of the dummy at substantially the temperature of the human body, varying the atmospheric conditions in the confined space at a predetermined rate and photographing the displayed apparel at frequent intervals while the atmospheric conditions are being varied.

6. Apparatus for testing fabrics including in combination a chamber, means for displaying the fabric to be tested within the chamber, means for heating the chamber, means for humidifying the chamber, means for cooling the chamber, thermostatic means for controlling the heating means when the temperature in the chamber drops below a predetermined point and for controlling the cooling means when the temperature within the chamber rises above a predetermined point, a hygrostat for controlling the humidifying means when the relative humidity within the chamber drops below a predetermined point and for controlling the cooling means when the relative humidity within the chamber rises above a predetermined point, a camera, means for controlling the camera to make exposures of the fabric being tested at predetermined frequent intervals.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,602,213	Robbins	Oct. 5, 1926
1,743,619	Pfeiffer	Jan. 14, 1930
1,969,606	Hall	Aug. 7, 1934
2,326,088	Witham	Aug. 3, 1943
2,347,661	Butland	May 2, 1944
2,377,590	Talalay	June 5, 1945
2,404,584	Liska et al.	July 23, 1946