

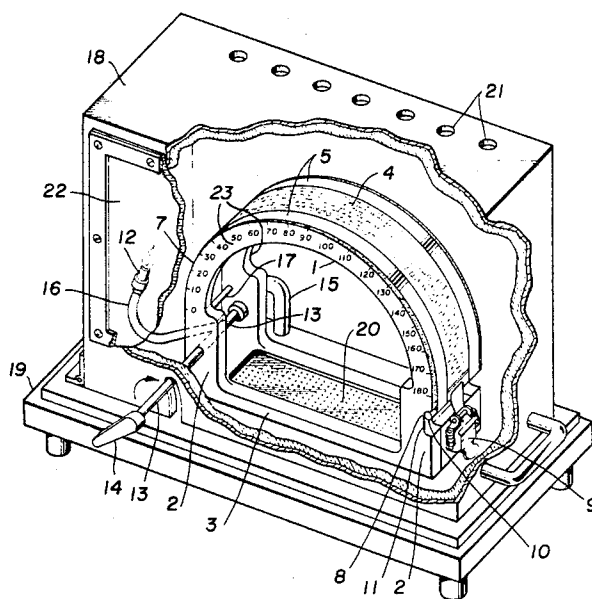
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[56] References Cited
UNITED STATES PATENTS
2,391,161 12/1945 Hubert 73/15
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[54] **METHOD OF TESTING FLAMMABILITY OF FIBERS**
9 Claims, 1 Drawing Fig.

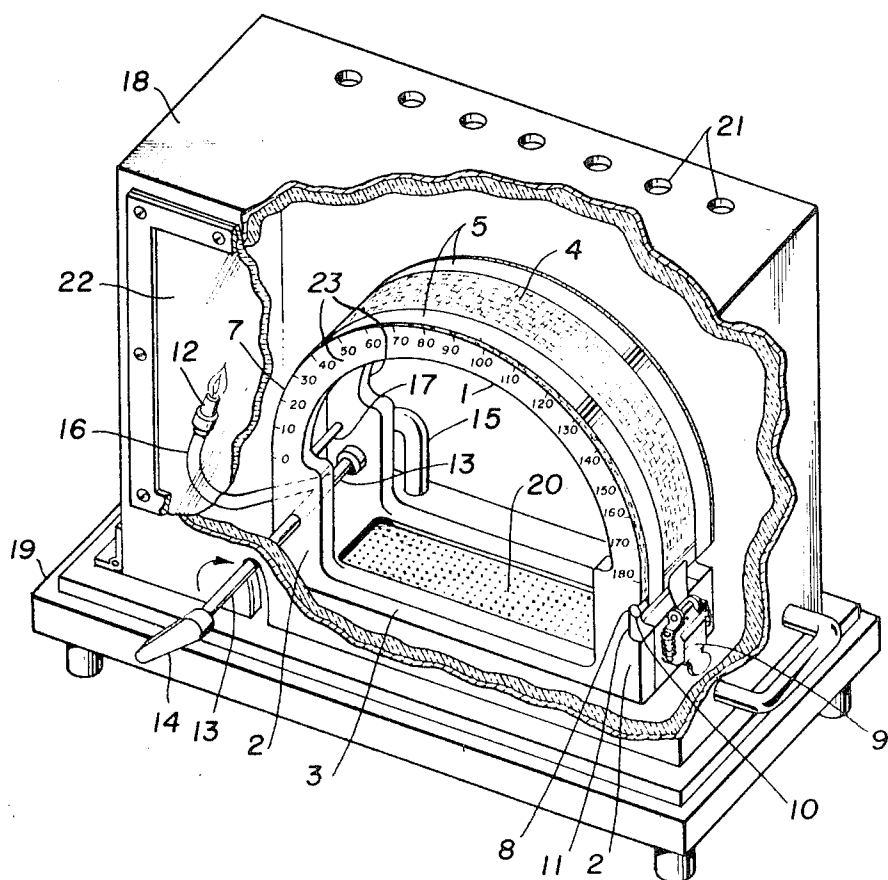
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160

ABSTRACT: Flammable fibers are blended and/or twisted with fibers which are substantially less flammable and of relatively high melting point, and subsequently knit or woven into a fabric. The fabric is stretched across and along a semicircular bifurcated nonflammable frame, and ignited on one end. Burning characteristics of the fibers being tested can then be observed without the adverse burn—irregularity otherwise caused by melting or shrinkage of the fibers away from heat and flame.



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METHOD OF TESTING FLAMMABILITY OF FIBERS

BACKGROUND OF THE INVENTION

This invention relates to a method of testing the flammability characteristics of fibers, filaments, and the like.

Various devices and procedures are known for measuring the flammability of sheeted material including plastics, fabrics, carpets, and the like. Devices include mechanical and electrical means and combinations thereof to provide in a series of samples, relative measurements of burning speed, heat of combustion, etc. by varying the application of heat, even by providing for testing at various slopes of the film from the vertical.

It is well known that a sheeted material will burn most rapidly in the direction of a draft and that the draft caused by burning will, unless diverted, direct itself vertically. Samples of sheeted material may be tested for flammability while stretched in a vertical position or at any angle from the vertical; and variances as between different types of materials will be noted.

Prior art procedures and devices for testing flammable fibers and filaments or fabrics comprised essentially of flammable fibers or filaments have proved unsatisfactory not only because the burning positions and position ranges of samples failed to reflect subtle differences between samples, but also because many of the fibers have a tendency to shrink away from the heat of the flame, and therefore do not ignite or burn evenly or reproducibly; and known testing devices have been designed for relatively nonflammable fabrics or for those that burn rapidly.

There is thus a need for a testing method which will permit the observation of the full range of flammability characteristics of fibers without the "shrinking away" effect, which, by its very nature, precludes uniformity of testing results among identical samples.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a method of testing the flammability characteristics of fibers without the detrimental effects of the shrinking characteristics of the fibers.

It is another object of this invention to provide a test fabric which can be used for evaluating the flammability characteristics of flammable fibers included in the test fabric.

Briefly, the objects of this invention are accomplished by blending fibers to be tested with less flammable fibers of high melting point and knitting or weaving the fibers into a test fabric. The test fabric can then be ignited, and the speed of burning, and the propensity to burn under various conditions can be observed in a testing device which holds the test fabric strip in an arclike position.

Other objects and advantages of this invention will become apparent from the following detailed description read in conjunction with the appended drawing in which:

The FIGURE is a perspective view of one device in which the test fabric of this invention may be ignited and observed in accordance with the method of this invention.

The term "fiber" as used herein includes filaments, threadlines and the like.

Fibers and filaments suitable for testing in accordance with the instant invention include those made from thermoplastic fiber-forming polymers which are formed by known techniques including melt extrusion, wet spinning processes and dry spinning processes. As examples of fiber-forming synthetic polymers which are included may be mentioned polyethylene; polypropylene; polyurethane; copolymers of vinyl acetate and vinyl chloride; the copolymers of vinylidene chloride and a minor proportion of mono-olefinic compounds copolymerizable therewith, such as for example, vinyl chloride; homopolymers of acrylonitrile, copolymers of acrylonitrile and a minor proportion of at least one mono-olefinic compound copolymerizable therewith and polymer blends containing combined acrylonitrile in a major proportion; copolymers of vinyl chloride and acrylonitrile; linear

polyesters of aromatic dicarboxylic acids and dihydric compounds, such as polyethylene terephthalate; linear polycarbonamides, such as for example, polyhexamethylene adipamide, polyhexamethylene sebacamide; polymeric monoamino monocarboxylic acids or their amide-forming derivatives, such as polymeric 6-aminocaproic acid; and other fiber-forming polymers. Also contemplated are mixtures of such fiber-forming synthetic polymers.

Included among the less flammable fibers suitable for supporting fibers in the practice of this invention are the preferred glass fibers and asbestos fibers. Glass fibers are most practical in terms of versatility and economy. Although there is some shrinkage of glass fibers from flame, the fibers are stable enough to hold the test fibers during the course of burning. Any fiber which is substantially less flammable and with a higher melting point than fiber being tested will serve as a satisfactory matrix for the fiber being tested.

In the preparation of these test fabrics, there are no critical proportions as between the test fibers and the supporting fibers. We have found that test fabrics made up with as little as 10 percent of the supporting fibers suffice to accomplish the purpose of the blending. The manner of blending or incorporation of the supporting fibers into the fabric is immaterial. Conventional blending techniques may be used; or the supporting fibers may be twisted with the test fibers. Combinations of twisting and conventional blending may also be used. The structural features of the test fabric are unimportant, and any conventional method of making a fabric, including knitting or weaving, can be used. It is important, of course, that all test samples be prepared in the same manner. Any variation in the blend or structure as between test samples will lead to variations in testing results not attributable to the characteristics of the test fibers.

A strip of the test fabric is held in a semicircular position, preferably by stretching along a semicircular frame. The ends of the semicircle should be at a position where the radius is horizontal. When one end of the test fabric is ignited, the direction of flame is at first vertical. As the flame proceeds upward, the direction approaches the horizontal. As it descends, it approaches the vertical again. The speed of the flame and the distance it progresses is measured as against other samples.

Referring now in detail to the drawing, there is shown bifurcated semicircular frame 1 with mounting frame 2 on base 3. The bifurcations 23 of frame 1 are graduated in terms of degrees along the arc. Sheeted material Sample 4 is held in place between and along the bifurcations 23 of frame 1 by nonflammable flexible straps 5 which are permanently affixed at the juncture 8 of frame 1 and frame-mounting means 2 by a spring latch 9. The relative positions of straps 5 are maintained, when the straps are removed by bar 10, which is permanently affixed to the removable ends of straps 5, and for which is provided recess 11 in frame-mounting means 2. Gas jet nozzle 12 is affixed to the end of tubing 16 which is mounted on rotatable control rod 13 equipped with handle 14. The gas jet is provided with a flexible gas supply hose 15 which feeds tubing 16 through a hollowed portion of rod 13. Tubing 16 is provided with a stop 17 which is affixed to frame-mounting means 2 and furnishes a finite stopping point for the jet when it approaches the sample ignition position. The testing frame is mounted in a cabinet having a hinged top 18 and a cabinet base 19. Cabinet base 19 is provided with gas ingress perforations 20. Top 18 is provided with gas exhaust vents 21 and transparent observation plate 22.

In the operation of this device, spring catch 9 is released and straps 5 are pulled away from frame 1 whereupon the remains of a burnt sample are removed and a fresh sample of a woven or knitted blend of test fibers and supporting fibers is placed across and along frame 1. Hooks are provided at juncture 7 (not shown) to hold one end of the sample in place, while straps 5 are again fastened. The gas supply is turned on and gas jet 12 is ignited. Cabinet top 18 closed. Handle 14 is rotated rapidly in a clockwise direction until jet support 16

rests against stop 17. The jet is now in position to ignite the sample. Stopwatch timing is commenced when gas jet support 16 hits stop 17. Depending upon the nature of the sample being tested, readings are taken at uniform graduations along the degree scale on frame 1. The point at which burning stops is also recorded.

EXAMPLE

Continuous filament poly(ethylene terephthalate) of about 100 denier was simultaneously plied and twisted about 4 or 5 twists per inch with glass fiber of approximately the same diameter as the polyester continuous filament. The plied and twisted filament was knitted on a circular knitting machine at about 34 inches per course into 3-inch diameter tubing. The knitted tubing was scoured to remove any oil deposited during the knitting operation, rinsed, and dried in an oven at about 100° C. The dried tubing was slit and cut into 18-inch by 3-inch sections and returned to the oven for 2 hours prior to testing. Cut sections were removed from the oven one at a time, mounted in the semicircular tester and the rate of burning was determined. A 5/8-inch long gas flame was impinged on the fabric for 3 seconds at the 0° angle of the tester. Timing of the burning was begun when the flame first touched the fabric. As burning of the fabric continued, times were recorded at which the flame front passed 90°, 120°, 150°, and 180° angles of the tester. Results obtained on five observations with this knit fabric were found to be very reproducible as shown from the following:

TABLE I.—3 SECOND IMPINGEMENT—MODERATE TIGHTNESS

[Burning Time, (Seconds) for each of 5 Repeat Samples]						
	1	2	3	4	5	Average
Angle:						
0°	0	0	0	0	0	0
90°	7	6	6	6	7	6.4±0.6
120°	15	16	17	17	18	16.6±1.6
150°	31	29	30	31	33	30.8±2.2
180°	44	43	46	46	47	45.2±2.2

It is understood that the example given in the specification is not meant to be limitive; the test device shown is only one which may be used in accordance with the method of this invention; and that the invention itself may be modified in many details.

What we claim is:

1. A method for testing the relative flammability of test fibers comprising:
 1. blending said test fibers in a uniform and predetermined manner with supporting fibers which are substantially less flammable than said test fibers and which have a substantially higher melting point than said test fibers;
 2. fabricating in a uniform and predetermined manner test samples of said blended fibers;
 3. igniting said test samples; and
 4. timing the burning rate of said test samples, thereby determining the relative flammability of said test fibers.
2. The method of claim 1 wherein said test sample is held in a semicircular position so that burning may proceed along an arc.
3. The method of claim 1 in which the test sample contains at least about 10 percent of supporting fibers which are substantially less flammable.
4. The method of claim 1 wherein said supporting fibers are glass fibers.
5. The method of claim 1 wherein said supporting fibers are asbestos fibers.
6. The method of claim 1 wherein said tested fibers are thermoplastic fibers.
7. The method of claim 1 in which said test sample is stretched along and across a bifurcated nonflammable frame.
8. The method of claim 7 wherein said bifurcated frame is semicircular and wherein the radii of said frame at the ends thereof are substantially horizontal.
9. The method of claim 7 wherein oxidization is controlled by performing the test within a cabinet having means for regulating ingress and egress of gas supporting the oxidization.