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[54] **APPARATUS AND METHOD FOR INDUCING BLOCKING IN PLASTIC FILMS UNDER KNOWN CONDITIONS**

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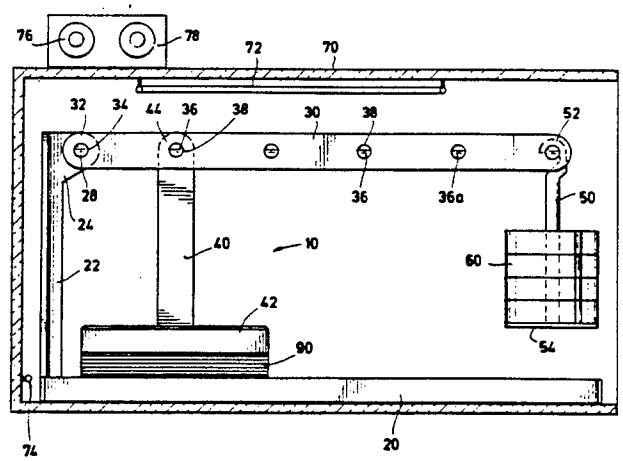
[57] **ABSTRACT**

The present invention is directed to an apparatus and method useful for inducing blocking in plastic film samples under known laboratory conditions. The test device of the present invention comprises a base platen and a movable platen disposed for cooperation to engage and apply a known, preferably multiplied, compressive force to a plurality of plastic samples. The compressive force is transferred to the movable platen through a thrust member from a lever arm pivotable about a pivot, preferably a hinge, above the base platen. Along the lever arm are disposed a plurality of weight receiving locations for engagement by a hanger supporting one or more selected weights. The test device of the present invention permits higher compressive forces to be applied to plastic test samples under laboratory conditions without requiring the use of heavier weights and produces more reproducible compressive forces than prior art methods.

14 Claims, 1 Drawing Sheet



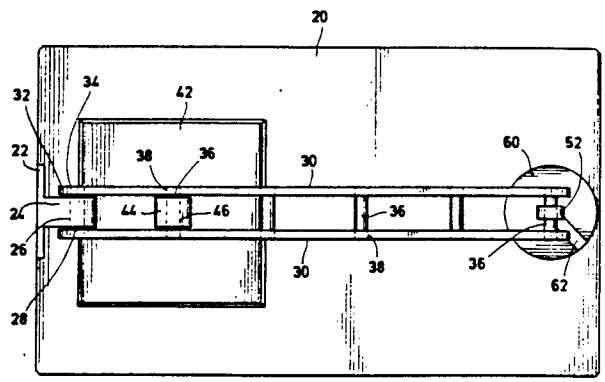


FIG. 1

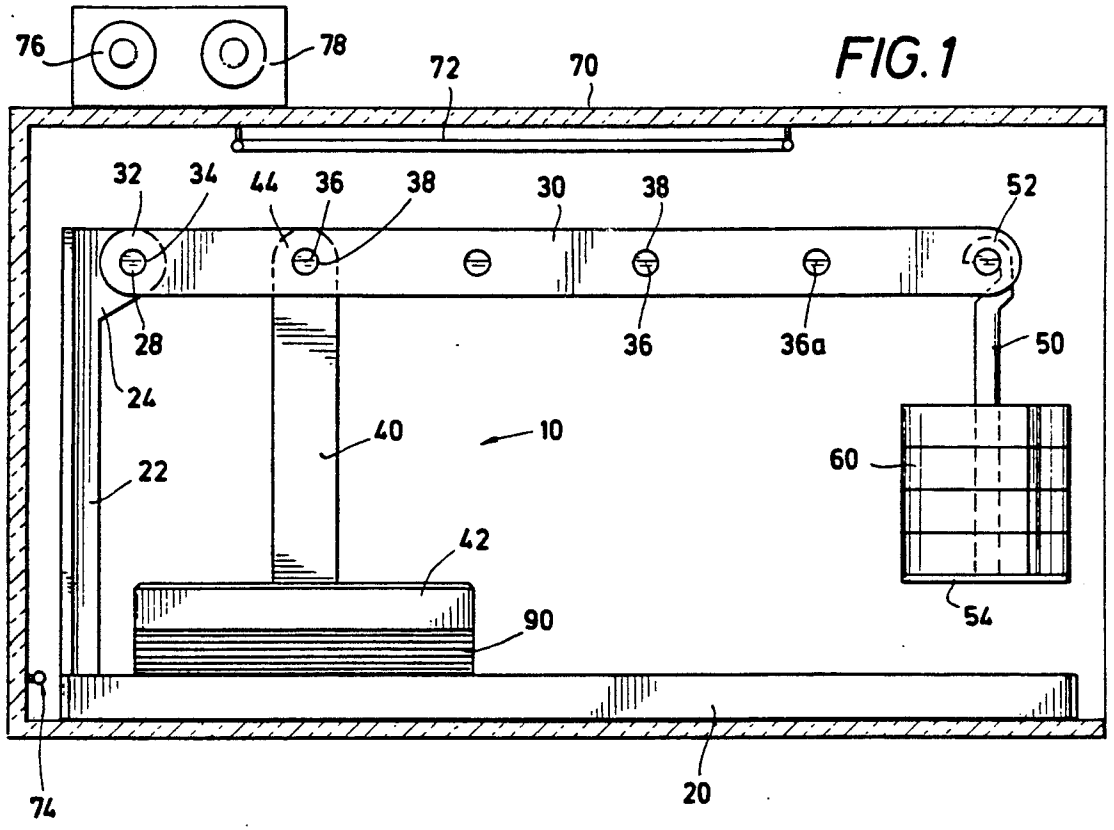

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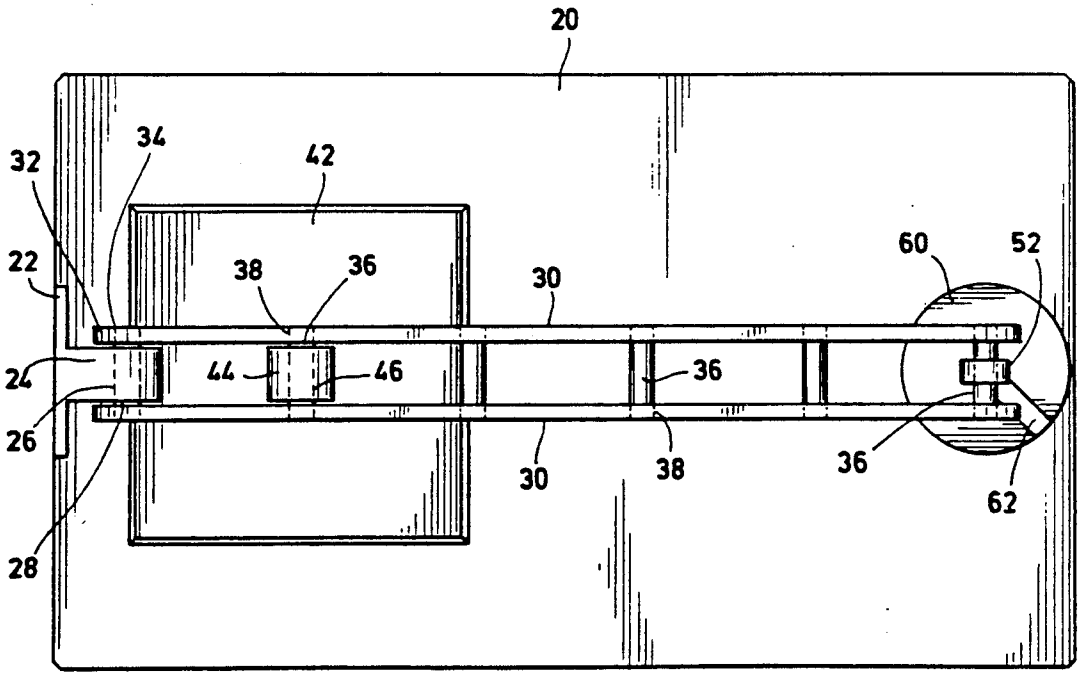
FIG. 2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APPARATUS AND METHOD FOR INDUCING BLOCKING IN PLASTIC FILMS UNDER KNOWN CONDITIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to an apparatus and method useful for inducing blocking in plastic films under known conditions. More specifically, the present invention is directed to an apparatus and method for applying a known force to a plurality of plastic film samples maintained at a predetermined temperature for a predetermined time to study induced blocking in plastic film samples under known laboratory conditions.

2. Description of the Background

Blocking is essentially a sticking together of the surfaces of thermoplastic films or coatings. Accordingly, blocking is an undesirable characteristic. The tendency of thermoplastic films and coatings to suffer blocking increases with elevated temperatures and with increasing contact pressure between adjacent films or coatings.

It is important to be able the blocking tendency of thermoplastic films and coatings under various conditions. Accordingly, methods and procedures have been developed to study blocking in the laboratory. ASTM Standard D-3354 defines blocking as essentially a sticking together of the surfaces of adjacent thermoplastic films or coatings under the exclusion of air. Various ASTM Standards set forth test methods to measure the blocking force, i.e., the force required to separate blocked film surfaces.

The preparation of blocked film samples for testing, however, has traditionally been performed mainly using various non-standardized methods. In a commonly used method weights are merely placed upon film samples in an oven to produce the desired contact stresses in an environment of elevated temperatures. Because these methods are non-standardized, the researcher is often unable to reproduce prior results. Further, the researcher is often unable to correlate his results with those of other workers who have used other testing methods. Reproducibility and correlation of results are poor due to the inability to precisely duplicate placement of the weight on the samples to assure uniform contact stress. In addition to poor reproducibility and correlation, these methods suffer from a variety of other shortcomings. For example, the attainable stress levels are limited by the weights which may be safely handled in a hot environment, by the weight which the oven can support and by the size of the oven.

Accordingly, there has been a long felt but unfulfilled need in the testing industry for apparatus and methods for obtaining high and reproducible levels of compressive force to block samples in a hot oven while requiring only moderate weights and moderate oven space.

SUMMARY OF THE INVENTION

The present invention is directed to an apparatus and method for inducing blocking in plastic films under a wide range of laboratory pressures and temperatures. The apparatus and method of the present invention permit reproducible results to be achieved using moderate weights and requiring only moderate oven space. Using the apparatus and method of the present invention the blocking tendencies of thermoplastic films and coatings may be studied under any desired conditions, including the most extreme conditions which those films and coatings may be expected to encounter. Study under these extreme conditions is a significant improvement over the traditional methods allowing study only under relatively mild conditions and with poor reproducibility of results.

The test apparatus of the present invention includes a test device for applying a known, but variable compressive force to a plurality of stacked, plastic film samples. The test device comprises a base platen and a movable platen disposed for cooperation therewith. A rigid, fixed support extends above the base platen. Pivoted, preferably hinged, to the fixed support is a lever arm characterized by a plurality of weight receiving locations disposed thereon. Affixed to the movable platen and in contact with, preferably hinged to, the lever arm is a thrust member for transmitting a force from the lever arm to the movable platen for compressing the plastic samples between the movable platen and the base platen. In the presently preferred embodiment the thrust member contacts the lever arm at a point between its pivot with the fixed support and the weight receiving locations. In the presently preferred embodiment the device further includes a hanger for hanging a weight from one of the weight receiving locations, together with a plurality of weights from which a desired weight may be chosen. The test device of the present invention is configured to fit within a conventional oven.

In the method of the present invention a plurality of plastic film samples are disposed between the base platen and the movable platen of the test device. A desired weight is selected from the plurality of weights and applied to the lever arm at a weight receiving location to exert a compressive force of the plastic samples through the movable platen. In the presently preferred method selection and position of the weight along the lever arm permit a wide variety of forces to be applied to the samples. In the presently method the applied force is multiplied by the mechanical advantage of the lever arm, permitting testing under more severe conditions without requiring the use of heavier weights. Finally, the samples are heated to a desired temperature and maintained at that temperature for a predetermined time while being subjected to the compressive force. In this manner, severe, yet precise and reproducible testing conditions are produced.

The apparatus and method of the present invention have solved the long felt, but unfulfilled need for an apparatus and method for studying blocking of thermoplastic films and coatings under severe, but reproducibile laboratory conditions, in confined spaces with safely handled equipment. These and other meritorious features and advantages of the present invention will be more fully appreciated from the following detailed description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and intended advantages of the present invention will be more readily apparent to the references to the following detailed description in connection with the accompanying drawings, wherein:

FIG. 1 is a side elevation of a test device in accord with the present invention disposed within an oven illustrated in partial cross-section; and

FIG. 2 is a top elevation of a test device in accord with the present invention.

While the invention will be described in connection with the presently preferred embodiment, it will be understood that it is not intended to limit the invention to this embodiment. On the contrary, it is intended to cover all alternatives, modifications and equivalents as may be included in the spirit of the invention as defined in the appended claims.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides an method useful for inducing blocking in a plurality of plastic film samples under controlled laboratory conditions. The apparatus and method of the present invention provide means for reproducibly applying a known force to plastic samples at elevated temperatures wherein the force is reproducibly multiplied and applied using a lever arm.

The testing device **10** of the present invention comprises a base platen **20**. Base platen **20** must be of sufficient size and shape to hold a plurality of standard samples **90** and to provide a stable foot for supporting test device **10**. In the presently preferred embodiment, support is provided by support arm **22** vertically disposed at one end of base platen **20** provides a rigid, fixed support. Support arm **22** terminates at its end away from base platen **20** in flange **24** having therein bore **26**. Test device **10** further includes lever arm **30**. In the presently preferred embodiment lever arm **30** is comprised two, identical, interconnected arms **30**. Lever arm **30** and support **22** pivot with respect to one another. In the presently preferred embodiment, lever arm **30** is hingedly connected at a first end **32** with the flange **24** of support **22** by hinge pin **28** passing through bore **26** in flange **24** and being fixed within bores **34** in lever arms **30**. Lever arm **30** is further characterized by a plurality of bores **38** disposed along its length, preferably spaced equidistantly. Fixed within each bore **38** and connecting the two identical arms of lever arm **30** are a plurality of connecting pins **36**. Pins **36** also provide weight receiving locations from which weight hanger **50** may be hung. Further, pins **36** provide points at known locations for contacting thrust member **40** with lever arm **30**. In the presently preferred embodiment, thrust member **40** includes bore **46** through end **44** to permit hinged engagement with one of pins **36** of lever arm **30**. In the illustrated and presently preferred embodiment, thrust member **40** is hingedly suspended from pin **36** nearest the pivot or hinge between lever arm **30** and support **22**. In an alternative embodiment, thrust member **40** may be capable of being moved to be engaged by any of pins **36**. For example, pins **36** may be removable to permit placement of thrust member **40** at any pin **36**. In a further alternative, thrust member **40** simply may terminate with a thrust receiving top surface for contact with the bottom of pin **36**. Thrust member **40** is affixed at its opposite end to movable platen **42** for connecting and applying a compressive force to a plurality of plastic film samples **90** disposed between movable platen **42** and base platen **20**. Hanger **50** includes hook **52** on a first end for engaging connecting pins **36** of lever arm **30**. Opposite hook **52** of hanger **50** is weight support plate **54** upon which one or more weights **60** may be disposed. Weights **60** are preferably circular, flat disks each having a slot **62** to permit easy loading and stacking on plate **54** of hanger **50**.

Test device **10** may be constructed of any material which will withstand the elevated temperatures and environment of oven **70**. Although the device **10** is often constructed of steel, particularly preferred materials are low density materials, including aluminum, magnesium, other lightweight alloys and even plastics capable of withstanding the highest temperatures to which the device **10** will be subjected. Further, the overall dimensions of the test device must conform to the interior dimension of conventional laboratory test ovens in which it will be disposed. Weights **10** are constructed of an appropriate high density material, e.g., brass, bronze, steel or the like.

The apparatus of the present invention useful for inducing blocking in a plurality of plastic film samples comprises in addition to test device **10** a conventional oven **70** equipped with electric or other conventional heater **72**. Oven **70** includes conventional temperature control **78** and thermostat **74** for controlling the temperature in the interior of oven **70**. Optionally oven **70** may include timer **76** for controlling the length of the heating cycle.

The method of the present invention comprises disposing samples **90** between base platen **20** and movable platen **42** of test device **10**. The compressive force applied by platen **42** at samples **90** is comprised of the weights of platen **42** and thrust member **40** plus the force applied through thrust member **40** from the weights of arm **30**, hanger **50** and weights **60** and the locations on lever arm **30** of hanger **50**, of the contact point between lever arm **30** and thrust member **40** and of the pivot between lever arm **30** and support **22**. The force applied by platen **42** may be greater or lesser than the weights **60** employed, depending upon the foregoing locations. Those skilled in the art can readily determine the force from the mechanical advantage of the lever and the weights of platen **42**, thrust member **40**, arm **30**, hanger **50** and weights **60**. Finally, the force is easily verified by applying it to a suitable weighting device disposed on base platen **20** under movable plate **42**.

In the illustrated embodiment, the compressive force applied to samples **90** by platen **42** would equal five times the weight of hanger **50** and weights **60** plus the force applied by the weights of platen **42**, thrust member **40** and arm **30**. The force applied to platen **42** is easily changed by removing or adding weights **60** or relocating hanger **50**. For example, when relocated to connecting pin **36***a*, the compressive force applied is diminished to four times the weight of hanger **50** and weights **60** plus the force developed by the weights of platen **42**, thrust member **40** and lever arm **30**. In an alternative embodiment, lever arm **30** may extend beyond hinge pin **28** and include an appropriate, variable means to counterbalance the weights of arm **30**, platen **42**, thrust member **40** and hanger **50**, so that the force applied to platen **42** may be determined solely from the weight of weights **60** and the mechanical advantage of the chosen lever configuration. In any event, those skilled in the art can readily determine the compressive force applied by platen **42** from the mechanical advantage of the particular lever compression chosen and the weights of platen **42**, thrust member **40**, arm **30**, hanger **50** and weights **60**.

Finally, blocking is induced by heating the samples **90** in oven **70** to a desired temperature conveniently set with control **78**. That temperature is maintained for a predetermined time, conveniently using timer **76**. Accordingly, a wide range of desired compressive forces, temperatures and times may reproducibly be developed

to improve the laboratory study of blocking in thermoplastic films and coatings.

The foregoing description of the invention has been directed in primary part to a particular, preferred embodiment in accordance with the requirements of the patent statutes and for purposes of explanation and illustration. It will be apparent, however, to those skilled in the art that many modifications and changes in the specifically described apparatus and method may be made without departing from the scope and spirit of the invention. For example, lever arm **30** alternatively may be constructed with a single arm member **30** having notches on the top from which hanger **50** may be hung and notches on the bottom for engaging end **44** of thrust member **40**. Therefore, the invention is not restricted to the preferred embodiment illustrated but covers all modifications which may fall within the scope of the following claims.

What is claimed is:

1. An apparatus useful for inducing blocking between a plurality of plastic samples comprising:

an oven;

means for controlling the temperature within said oven; and

a sample testing device for applying a known, but variable, compressive force to a plurality of plastic samples, said testing device disposed with said oven and comprising,

a base platen;

a movable platen disposed for cooperation with said base platen;

a rigid, fixed support extending above said base platen;

a lever arm, said lever arm pivotable about a pivot with respect to said support;

a plurality of weight receiving locations disposed along said lever arm; and

a thrust member for transmitting a force from said lever arm to said movable platen.

2. The apparatus for claim **1** wherein said temperature control means comprises:

a heater disposed in said oven;

a variable control for setting a desired temperature in said oven; and

a thermostat for controlling said heater to maintain said set temperature.

3. An apparatus useful for applying a known, but variable compressive force to a plurality of plastic samples, comprising:

a base platen;

a movable platen disposed for cooperation with said base platen;

a rigid, fixed support extending above said base platen;

a lever arm, said lever arm pivotable about a pivot with respect to said support;

a plurality of weight receiving locations disposed along said lever arm; and

a thrust member for transmitting a force from said lever arm to said movable platen.

4. The apparatus of claim **3** wherein said thrust member is hingedly affixed to said lever arm and rigidly affixed to said movable platen.

5. The apparatus of claim **3** wherein said support and said lever arm are hinged at said pivot.

6. The apparatus of claim **5** wherein said thrust member is hingedly suspended from said lever arm.

7. The apparatus of claim **3** wherein said thrust member contacts said lever arm between said pivot and said plurality of weight receiving stations.

8. The apparatus of claim **3** further comprising a hanger for suspending a weight from at least one of said weight receiving locations.

9. The apparatus of claim **8** further comprising a weight for cooperation with said hanger.

10. A method of inducing blocking in a plurality of plastic samples, comprising:

disposing said samples between a base platen and a movable platen, said movable platen in contact through a thrust member with a lever arm pivotable about a pivot above said base platen;

selecting from a plurality of weights a desired weight;

applying said selected weight at a point disposed along said lever arm to produce a compressive force on said samples through said movable platen;

heating said samples to a desired temperature; and

maintaining said samples at said temperature for a predetermined time while applying said compressive force.

11. The method of claim **10** wherein said weight is applied at one of a plurality of weight receiving locations disposed along said lever arm.

12. The method of claim **10** wherein said movable platen is hinged to said lever arm between said pivot and said point at which said weight is applied.

13. The method of claim **10** wherein said lever arm and said base platen are maintained substantially parallel while applying said weight.

14. The method of claim **10** wherein said weight is applied by hanging said weight from said lever arm.

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