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**CIGARETTE SMOKING MACHINE**

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14 Claims

**ABSTRACT OF THE DISCLOSURE**

Apparatus comprising a hollow circular specimen heating chamber containing openings circumferentially thereof, a cage at the inner side of each opening, a tunnel at the outer side of each opening for holding a specimen with its head projecting through the opening into the cage, a pressure chamber to which air is supplied under pressure, a valved passage connecting the pressure chamber to the specimen treating chamber through which smoke is transmitted under pressure to the specimen treating chamber, a holder in the pressure chamber in communication with the valved passage, into which the butt end of a burning cigarette is adapted to be placed whereby the products of combustion produced by a burning cigarette fixed in the holder are blown through the cigarette and through the valved passage into the specimen treating chamber and ducts at the bottom of the specimen treating chamber through which the products of combustion may be evacuated following treatment.

**BACKGROUND OF THE INVENTION**

Apparatus for obtaining samples of cigarette smoke and also for testing the burning qualities of cigarettes, cigars, pipes, and the like, is old. Such apparatus generally embodies a holder for one or more cigarettes, a chamber connected to the holder and a vacuum-producing device for lowering the pressure within the chamber so as to draw air through the cigarette or cigarettes at a rate equivalent to normal smoking. An apparatus of the aforesaid kind is shown in the pending application of Thomas F. Kelley and Colin A. Morrissey, Ser. No. 661,937, filed Aug. 21, 1967. The present invention similarly embodies means for holding one or more cigarettes, a chamber for receiving smoke drawn through the cigarette or cigarettes and in addition means for exposing one or more specimens to the smoke in the chamber, the purpose of which is to determine the effect of the smoke on the specimen or specimens.

**SUMMARY**

As herein illustrated, the apparatus comprises a chamber, a holder adapted to receive an end of a cigarette, a valve mounting the holder on the chamber, said valve being operable by depression of the holder to connect the end of the cigarette set into the holder through the valve to the interior of the chamber, means for blowing smoke through the cigarette and valve into the chamber, a cage in a wall of the chamber for accommodating the head of a specimen to expose it to the smoke in the chamber, a tube mounted in the wall of the chamber in registration with the cage at the inner side for receiving and supporting the specimen with its head thrust through the wall into the chamber, and an elastic collar at the junction of the cage and tube through which the neck extends and which prevents flow of smoke from the chamber into the tube. The holder may be provided with an adapter for receiving one or more cigarettes, a filter may be interposed between the valve and the interior of the chamber, and a manifold may be mounted on the chamber for receiving smoke from the cigarette through the

valve and supplying it to the chamber. The chamber has a vent valve which permits displacement of air from the chamber as the smoke enters the chamber, one or more exhaust ports through which the smoke may be withdrawn after the specimens have been exposed for a predetermined length of time, and a plurality of coupling members disposed peripherally of it for receiving a corresponding number of specimen holders, each of which comprises a cage mounted at the inner side of the chamber and a tube mounted at the outer side of the chamber.

The invention will now be described in greater detail with reference to the accompanying drawings wherein:

FIG. 1 is a plan view of the apparatus broken away in part showing a plurality of specimen holders mounted radially with respect to a central chamber;

FIG. 2 is a fragmentary vertical section taken on the line 2-2 of FIG. 1 with parts broken away;

FIG. 3 is an elevation, to larger scale, of a specimen holder partly in section;

FIG. 4 is a fragmentary sectional view of a modification cigarette holder and inlet valve to the chamber in which the manifold is omitted;

FIG. 5 is a fragmentary sectional view of a modification of the holder provided with an adapter for receiving two or more cigarettes.

Referring to the drawings, there is shown a specimen treating chamber 10 of circular horizontal section comprising an annular wall 12 containing at its opposite ends annular recesses 14 in which are seated circular end pieces 16 and 18. The wall and end pieces are preferably comprised of transparent material and closely fitted to each other so as to require no fastening. The treating chamber 10 rests on a base 20 containing at the top a circular opening 22. In the preferred form the top end piece 16 contains a central opening 24 in which is fitted a block 26a. A hollow cap 26b fitted to the upper end of the block 26a provides at the top thereof a manifold chamber 28. The manifold chamber 28 is connected by three conductor tubes 30 with the interior of the treating chamber 10. Preferably the tubes 30 are located symmetrically with respect to the center of the chamber, are connected at their upper ends by elbow pieces 32 to the manifold chamber and at their lower ends by fittings 34 to the treating chamber. The cap 26b is fitted to the upper end of the block onto an annular shoulder 36 so as to be removable and has at its top a circular opening 38 in which there is fitted a sleeve 40 which constitutes one element of a valve assembly. The other element of the valve assembly comprises a spool 42 having a cylindrical body portion 44 slidably supported in the sleeve and heads 46 and 48 at its upper and lower ends. An axial passage 50 extends through the spool from the upper end toward the lower end and intersects adjacent its lower end a diametrical passage 52. Movement of the spool 44 downwardly in the sleeve 40 will displace the diametrical passage 52 below the lower end of the sleeve thus connecting the axial passage 50 with the interior of the manifold chamber 28. Inside the cap 26b concentric with the opening 38 there is an annular recess 54 and a sealing ring 56 is mounted on the body of the spool adjacent the head at the lower end which is adapted, by engagement between the head at the lower end and the lower end of the sleeve 40, to provide a seal.

A holder 58 comprising superposed flat circular plates 60 and 62 is supported at the upper end of the spool by engagement of the upper end 46 with a circular recess 64 formed in the lower of the two plates 60 and 62. A coiled spring 66 is mounted about the spool with one end bearing upon the cap and the other end bearing against the underside of the plate 62 and normally holds the holder elevated with the lower end of the valve spool pressed against the ring 56 and hence in a closed position.

The holder 58 contains centrally of the plates 60 and 62 an opening 68 for receiving the lower end of a cigarette *c* and holding it aligned with the axial passage 50 in the valve spool. By depressing the holder 58 so as to force the valve spool downwardly into the manifold chamber far enough to clear the diametrical passage 52 of the sleeve 40, smoke forced or drawn through the cigarette will be permitted to enter the manifold chamber.

In accordance with the invention, it is desirable to blow the smoke through the cigarette from its burning upper end into the chamber rather than to effect burning by a vacuum in the chamber itself, as this enables filling the chamber with smoke without leakage of the ambient atmosphere into the chamber. By blowing smoke into the chamber if there is any leakage it is leakage of smoke outwardly of the chamber and so without contamination of the smoke in the chamber.

A pressure chamber is provided to blow smoke through the cigarette comprising an enclosure 70 mounted on the support 58 above and around the cigarette. A fitting 72 connects the pressure chamber to a source of air under pressure and a regulator valve R and timer T are provided for controlling the flow of air from the source to the pressure chamber.

To permit air in the treating chamber 10 to be displaced as the smoke is forced into it there is provided a vent 74 having a relatively small orifice 76.

The side wall 12 of the treating chamber 10 contains peripherally thereof equally spaced circular openings 78 in each of which is mounted a hollow fitting 80 comprising portion 82 at one end of which there is a portion 84 of larger diameter and at the other end a portion 86 of smaller diameter. The portions 84 and 86 provide in conjunction with the portion 82 annular shoulders 88a and 88b. The cylindrical portion 82 fits snugly into the opening 78 and provides a mount for the specimen holder which comprises a cage 90 at the inner side and a tube 92 at the outer side. The cage is cylindrical, being made up of small diameter wire 94 fastened to form a lattice with one end closed and the other end open and adapted to fit snugly over the cylindrical portion 86 of the fitting. The tube 92 is a piece of aluminum tubing and the cylindrical portion 84 is provided with an annular recess 96 for receiving one end of the tube. The tube has an interior diameter sufficiently large to receive the body of a specimen placed therein with its head extending through the fitting into the cage and to keep the specimen in the tube a stopper 98 of circular shape provided with a handle 100 is fitted into the open end of the tube. To assist in placing the specimen in the tube and also of removing it after the test is completed, the upper side of the tube 92 contains an axially extending slot 102 through which the tail of the specimen may project, as shown in FIG. 2.

To prevent exposure of the body of the specimen to the smoke, that is to confine the smoke to the lungs of the specimen, in so far as possible, an elastic collar 104 FIG. 3 is interposed between the inner end of the tube 92 and the fitting 80 which contains a relatively small central hole 106 through which the specimen can thrust its head and which will form a close enough seal around the neck to prevent flow of smoke into the tube. The collar is comprised of a relatively elastic sheet of plastic material and the diameter of the tube is large enough relative to the opening 96 so that when thrust into it against the marginal edge of the collar the latter will provide a seal about the end of the tube which is sufficiently tight to hold the tube in place. There are as shown eight (8) specimen holders mounted peripherally of the chamber.

At the bottom of the treating chamber 10 there is a centrally located circular recess 105 in which there is mounted a paddle 107 of cylindrical shape, the purpose of which is to agitate and stir the smoke forced into the chamber to obtain a uniform distribution so that all of the specimens will be exposed to the same concentration.

To effect rotation of the paddle 107 without a mechanical connection a magnet 108 is mounted below the chamber on the shaft 110 of a motor M and by rotation will produce a corresponding rotation of the paddle 107.

At the bottom of the chamber there are provided ports 112 to which are connected ducts 114, these in turn being connected to a low pressure chamber or vacuum pump V by means of which smoke may be removed from the chamber when the specimen or specimens have been exposed for a sufficient length of time.

Optionally, as shown in FIG. 4, the manifold chamber 28 may be omitted and the valve assembly mounted directly on the end piece 16 at the top of the treating chamber 10. In this instance the hole in the top piece 16 is made small enough to receive the valve sleeve. In other respects the modified apparatus is the same as that shown in FIG. 2.

If it is desirable to have more than one cigarette the holder 58 may be replaced by a holder 58a, as shown in FIG. 5, containing a circular opening 116 in which there is an adapter 118 containing two or more holes 120 for receiving cigarettes. By providing a number of the adapters with different numbers of holes it is possible to control the volume of smoke.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents falling within the scope of the appended claims.

I claim:

1. A test apparatus comprising walls defining a treating chamber, a specimen holder mounted in a wall of the treating chamber, said holder comprising a cage inside the treating chamber, a tube externally of the treating chamber, an elastic collar adjacent the junction of the cage and tube, and a stopper adapted to be thrust into the tube behind the specimen to retain it herein, means for generating and blowing a predetermined quantity of smoke into the treating chamber and means operable to evacuate smoke from the treating chamber.

2. A test apparatus according to claim 1, comprising a manifold chamber mounted on the treating chamber from which said smoke is supplied to the treating chamber, said smoke generating means comprising a holder into which an end of the cigarette is adapted to be inserted, said holder embodying a passage from it into the manifold chamber, a valve closing said passage at its entrance into the manifold chamber, said valve being displaceable to open said passage, an enclosure adapted to be applied to the holder over the cigarette, said enclosure providing in conjunction with the holder a pressure chamber to which air under pressure is adapted to be supplied and means for supplying air under pressure to said pressure chamber, said pressure chamber and holder being movable in unison simultaneously to open the valve and permit the flow of smoke through the butt end of the cigarette and through said passage into the manifold chamber.

3. A test apparatus according to claim 2, wherein a plurality of tubes connect the manifold chamber to the treating chamber through which tubes smoke is injected into the treating chamber to effect uniform distribution of smoke herein, and an agitator disposed in the treating chamber is adapted to spread the smoke uniformly throughout the treating chamber.

4. Test apparatus according to claim 1, comprising vent means in a wall of the treating chamber.

5. Test apparatus according to claim 3, wherein the agitator in the treating chamber is rotatable therein to mix smoke which enters the treating chamber through said tubes.

6. Apparatus according to claim 2, wherein the holder is adapted to hold a plurality of cigarettes.

7. Test apparatus according to claim 1, comprising a plurality of peripherally spaced specimen holders supported about the wall of the treating chamber.

8. Test apparatus according to claim 1, wherein a circumferential wall defines said treating chamber and said

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wall contains equally spaced holes through it and an adapter is mounted in each hole, each of said adapters having at its radially outward portion a circular recess for removably receiving the tube to support the latter in a radial position and a its inner portion a circular boss removably receiving a wire cage having an open end at the open end thereof.

9. A holder for treating a specimen comprising a cage, a tube connected to the cage, an elastic collar adjacent the junction of the cage and tube, said collar containing an opening of smaller size than the head of the specimen through which the head is adapted to be thrust, and a stopper provided with a handle by means of which said stopper may be thrust into the tube behind the specimen to retain the specimen therein, said cage being adapted to receive the head of the specimen for exposure to treatment and said collar being adapted to form a seal at the neck thereof to isolate the body of the specimen from exposure to treatment.

10. Apparatus according to claim 9, wherein the cage is wire mesh.

11. Apparatus according to claim 1, wherein the tube is of sufficient inside diameter to admit the body of the specimen.

12. Apparatus according to claim 8, wherein said adapter contains an opening larger than the tube for receiving an end of the tube and between it and the end of

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the tube the collar by means of which the collar is held taut across the tube.

13. Apparatus according to claim 11, wherein the hollow tube contains an axial slot extending from the radial outer end partway toward the end connected to the adapter.

14. Apparatus according to claim 2, wherein the valve extends into the treating chamber and has means providing an inlet port adapted by said displacement of the valve to be placed in communication with the interior of the treating chamber.

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