

Research & Development Establishment,  
British-American Tobacco Co.Ltd.,  
SOUTHAMPTON.

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MECHANICAL CIGARETTE SMOKING.

A number of different types of cigarette smoking machines are used for the production of smoke condensables.

R. & D. Establishment, Southampton:

At present, the machine used is the I. T. Co. Autosmoker described by Iles and Sharman (J.Appl.Chem.,1957, 334-337).

This machine operates under conditions of constant, but adjustable, puff volume, the pressure being variable over a puff and being determined partly by the cam shape and partly by the cigarette characteristics. The duration of the puff is wholly dependent on the cam operating the bellows and on the speed of rotation of the main shaft, which also controls the frequency of puff. The latter parameters are fixed at a 2 sec. puff, taken 4 times a minute. It is not easy to modify these parameters and would mean the changing of the gear box and the provision of new cams. The puff volume can be varied over the range 10-30 ml.

Smoking conditions on this machine are therefore standardised at a puff of 15 ml. volume and 2 sec. duration, taken 4 times a minute.

Smoke is collected by electrostatic precipitation, using a 7 Kv. discharge. Cold traps may, if required, be interposed between the cigarette and the electrostatic precipitator. A blue-print of these traps is attached. They are filled with glass Fenske helices, moistened with ether, and immersed in Dewar flasks filled with dry ice/acetone mixture.

In view of the inflexibility of the I.T.Co.Autosmoker, a new pattern smoking machine has been designed at R. & D. E. This has been built and at present is undergoing trial to discover the weak points in the design.

Briefly, it consists of a single bellows operating 12 times a minute which can be connected in turn to 6 smoking channels through a

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rotary valve, rotating twice a minute and driven, through a 6:1 reduction gear, by the main shaft. In this way, each channel is connected twice a minute to the bellows. The profile and duration of the puff is controlled by the shape of the single cam operating the bellows and this may be readily changed. The volume of the puff is easily altered by moving the fulcrum of the lever and cam follower which is attached to the bellows.

Provision is made for pressure recording on each smoking channel. By means of a second rotary valve, synchronised with the other valve, each pressure point can be connected in turn with a pressure measuring head. Tentatively, this is to be an inductance type pressure transducer, the output of which may be fed to a recorder or a cathode ray oscilloscope with camera, enabling instantaneous measurement of the pressure changes.

This, too, will therefore be a machine operating at fixed volume. Provision has been made for either electrostatic precipitation of smoke or for collection in a cold trap or for both in either order. The smoke collection units are designed to stand above the autosmoker and will be connected to the suction ports by flexible tubing.

It is intended that this machine will be operated to give a 35 ml. puff of 2 seconds duration, twice a minute. We will later adapt the machine to operate also at once a minute.

Scientific Control Laboratory, Liverpool:

It is known that S.C.L. have a Cigarette Components' smoking machine, Ethel Mark V. This pattern of Autosmoker operates at constant pressure. It consists of a rotary vacuum pump, which produces a vacuum of about 25 ins.Hg. This is connected through a throttle valve to the smoking channels. Each of these channels may be connected in turn to the source of negative pressure through solenoid valves operated in sequence by an electric timer. A flowmeter of the Rotameter type is included in each channel together with a fine-control valve. Filters of asbestos paper (similar to the Cambridge Absolute filter) are included to protect the flowmeter and valves from fouling. Smoke is collected by an electrostatic precipitator unit operating at 17 Kv.

A cigarette is inserted in a channel and, before it is lit, the fine-control valve is used to give an airflow of 17.5 ml./sec. Since the solenoid valves are open for two seconds once a minute, this corresponds to a 35 ml. puff of 2 sec. duration taken once a minute. These conditions can be altered, of course, by suitable adjustment to the electric timer. It is not possible to adjust the puff profile in any way.

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A new machine, ETHEL Mark VI, is now available. This is the easiest on which to alter any variable. Its drawbacks are that it is difficult to be precise about the total puff volume, or the puff shape, and it is not easy to clean.

Hamburg:

The German laboratory has been interested in a simple smoking machine for filter evaluation. This is a 15-channel unit, employing a conical-shaped rotary valve, connecting each channel in sequence to a source of negative pressure. The duration of the puff is determined solely by the shape of the valve ports and the frequency by the speed of rotation and is 2 seconds twice per minute. The smoke from all 15 channels is collected in a common trap, filled with cotton wool.

COMMENTS

I.T.Co. Autosmoker.

This has the following drawbacks:

- (a) The shape of the puff profile alters if the volume of the puff is changed and it is difficult to ensure that the profile is the same for all six cigarettes.
- (b) It is driven by a very small motor and as the cams operate arms with strong springs attached the speed of the driving shaft is continually varying, according to whether the springs are being compressed or released.
- (c) It is fixed up as a machine for using electrostatic precipitation and, though it can be used for cold trap smoking, it cannot be used with the cold trap after the electrostatic precipitator.

The R. & D. Machine.

The primary purpose of this machine is to make it possible to smoke cigarettes under accurately controlled and reproducible conditions, and it has been designed in three units, smoking machine, electrostatic precipitator unit, and cold trap unit, so that either of the last two may be used singly or together with either first. We have just got the prototype models and are in process of ironing out the snags. We will let you have full details as soon as we are ready, which should be within a month.

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Ethel Mark V & Mark VI.

Although these are supposed to be constant airflow machines, the airflow does not vary with the varying resistance of the cigarette as it burns, since the only method of control is that of a needle valve. It is easy, by the electric timer, to alter the time of puff and number per minute, but quite impossible to have any control over puff profile, and difficult to assess total puff volume.

German Smoking Machine.

We intend to order one of these. It seems a very useful, cheap machine for smoking cigarettes under semi-controlled conditions to obtain small quantities of tar for analytical work.

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