surface covered with a viscous fluid or oil; (2) the true dry filter which removes the dirt from the air by passing it through cloth or felt screens, the openings in which are too small to allow the passage of dirt, or by passing the air through tortous passages.

VISCOUS AIR FILTERS

Investigation has shown that the dirt and dust in air including the soot, carbons, etc., are trapped and retained by adhesive impingement on oil coated surfaces. This is not a new idea—as for years roads and floors have been oiled to keep the dust from flying about. Considerable originality has been shown by various arrangements of ferrules, rods, plates, etc., which were formed into filter units and made available for air cleaning work.

While the arrangement of filtering media and the kind of material used are almost unlimited, there are certain rather definite requirements for a practical commercial filter, and these have limited the possible constructions.

To fulfill the essential requirements of the engineer an air filter must:

1. Be efficient in dirt removal.
2. Interpose low resistance to air flow.
3. Have a large dust holding capacity.
4. Be easy to clean and to handle.

There are other factors of importance of course, among them weight, strength, and permanency.

In order to secure maximum efficiency, it is necessary to divide the air into innumerable fine streams; the more intimately and frequently the air is brought into contact with the viscous coated media the better the cleaning will be. Theoretically seven impingements are sufficient; more will give better service.

As the dirt and dust are leached out of the air and collected on the adhesive coated surfaces, additional supplies of the binding liquid are required in order to bind additional layers of dirt.

UNIT VISCOUS FILTERS

Some of these filters are made up of a number of separate units, each easily removed for cleaning.

If the unit air filters are cleaned "progressively" the resistance and volume of air delivered need never vary. By cleaning a pre-determined number of filters every week—or every month—as the case may be, the resistance and consequent air volume can be held at any desired figure.

To make sure of proper periodic cleaning of the units the installation of a simple air vane switch such as is used on air blast transformers is sometimes recommended. The switch is usually placed back of the filter and is so adjusted that if the air flow is cut down due to dirt accumulation in the filter, it rings a bell or lights a light. There are several makes of these air switches on the market at the present and they are not unduly high in price.

It is desirable also to install, on the suction side of the filter, an inclined draft gage giving constant visual indication of the resistance due to dirt-clogging.

AUTOMATIC VISCOUS FILTERS

Unit air filters have certain distinct limitations in the amount of dirt which can be handled. If the dirt reaches the filter too rapidly, or in such quantities that the adhesive liquid does not have sufficient opportunity to soak through and wet the successive layers, the cleaning efficiency drops off. Removals for filter cleansing become so frequent as to be objectionable or impracticable.

This fact, and perhaps the age-old effort to eliminate where possible the human element, brought forth the self-cleaning or automatic viscous filters, several distinct types of which are now available.

DRY AIR FILTERS

These are of no great commercial importance except as used to some extent on the intakes of internal combustion engines, air compressors, etc. There are some successful dry impingement-type filters reported from abroad.

Changes and advances are so rapid and so unexpected in this industry that no safe prediction can be made.

DUST REMOVAL

The comparative efficiency of various air cleaning devices, on the basis of dust removal, can be determined by means of standardized tests operated at rated capacities and when handling air at a definite standard with respect to quantity and quality of dirt content. The determination of the cleaning efficiency may be made according to some standard method such as that described by A. M. Goodloe, member, A. S. H. & V. E. in the February 1924, JOURNAL. The percentage of dust removal as determined by the method of testing for all commercial air cleaning devices should lie between 80 and 95 per cent and the minimum removal under such conditions should be specified and guaranteed by the manufacturer.

The efficiency of dust removal may be expressed by the following formula:

$$E = 1 - \frac{\text{Weight any sample leaving}}{\text{Weight any sample entering}}$$

In case the resistance method is used in accordance with the Anderson-Armspach method of dust determination, the formula will become

$$E = \frac{\text{Time required to give a definite resistance increment with entering sample}}{\text{Time required to give the same increment with leaving sample}}$$

or, if the same time be used in obtaining both samples, which is preferable then

$$E = 1 - \frac{\text{The resistance increment of outgoing sample}}{\text{The resistance increment of ingoing sample}}$$