the temperature of 1,000 cu. ft. of air per minute between the limits specified. The heat required for heating the air is given by the formula

$$H = 1{,}000\ \frac{t_2 - t_1}{55.5}$$

where

H = B.t.u. required to raise 1,000 cu. ft. of air from a temperature of t_1 to a temperature of t_2 deg. fahr.

TABLE 1. HEAT REQUIRED TO RAISE 1,000 CU. FT. OF AIR FROM VARIOUS OUTSIDE ENTERING WET-BULB TEMPERATURES TO VARIOUS DEW-POINT TEMPERATURES AND CORRESPONDING RELATIVE HUMIDITIES AT 70 DEG. FAHR.

See Marks' Engineers Handbook.

WET-BULB TEMPERATURE OF ENTERING AIR, DEG. FAHR.	RELATIVE HUMIDITY, PER CENT AT 70 DEG. FAHR. (AND DEW POINT, DEG. FAHR.)					
	30% (37.25)	40% (44.5)	50% (50.5)	60% (55.3)	70% (59.6)	80% (63.5)
−10	1194	1452	1653	1860	2044	2245
0	984	1246	1447	1663	1840	2039
10	750	1025	1228	1445	1621	1822
20	510	779	983	1200	1377	1581
30	300	496	700	920	1097	1300
40	.....	178	384	603	783	987
50	.....	.....	.....	220	394	619
60	.....	.....	.....	.....	.....	181

AIR FILTERS

Air filters are distinguished from air washers in that they clean the air without the use of water and without the addition of a water spray. They are usually of the following types:

1. The viscous filter, depending upon the dirt impinging on a surface covered with a viscous fluid or oil.

2. The dry filter, which removes the dirt from the air by straining or filtering it through cloth, felt or paper screens, the openings in which are too small to allow the passage of dirt, or which removes the dirt by passing the air through tortuous passages.

Viscous Air Filters

All of the so-called viscous type air filters operate on the principle of *adhesive impingement.* Investigation has shown that the dirt and dust in air, including the soot and carbons—the great destructive elements in modern ventilation work—are trapped and retained by successive impingements on oil coated surfaces. This is not a new idea—for years roads and floors have been oiled to keep the dust from flying about. Considerable ingenuity, however, has been shown in the various arrangements of metallic surfaces which are formed into filter units and made available for air cleaning work.

While the arrangement of filtering media and the kind of materials 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 clean air 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, of course, other factors of importance, including 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. Practically 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 binding liquid are required

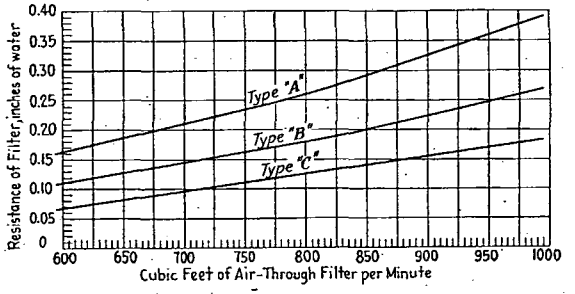


FIG. 1. RESISTANCE TO AIR-FLOW OF A TYPICAL UNIT AIR FILTER

in order to bind further layers of dirt. For this reason filters are usually designed to hold somewhere within the unit, additional supplies of the binding liquid, capable of distribution by capillary attraction, or by some mechanical means.

Investigations in this country and abroad demonstrate that the first impingement of dust-laden air on a viscous-coated surface removes 60 per cent of the dust, the next impingement takes 60 per cent of what then remains—that is, 24 per cent—the next impingement removes 9.6 per cent, etc. The principle of progressively packed media is embodied to a greater or less extent in all unit viscous filters. This arrangement gives relatively large spaces for the collection of dirt in the front part of the filter, where the bulk of the solids are taken out, without undue increase in resistance. At the back of the filter the openings are smaller and finer dust particles are removed.

The binding liquid used with these filters should be odorless, fire-proof, and germicidal in its action.

Unit Viscous Filters

Unit viscous filters usually are made up of a number of separate filter units with a frame or frames designed to support them and arranged so