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**TYPES**

**OF**

**FABRIC FILTERS**

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**INDUSTRIAL GAS CLEANING INSTITUTE, INC.**

## INDUSTRIAL GAS CLEANING INSTITUTE, INC.

The National Association of Manufacturers  
of Industrial Air Pollution Control Equipment  
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## STATEMENT OF PURPOSE

■ *The Industrial Gas Cleaning Institute (IGCI) is the national association of stationary source air pollution control equipment manufacturers and suppliers. It was formed in 1960 as a non-profit corporation to promote the industry and encourage improvement of engineering and technical standards. The Institute's members include manufacturers of flue gas desulfurization systems, electrostatic precipitators, fabric filters, wet and dry scrubbers, VOC and NO<sub>x</sub> emission control equipment, and mechanical collectors.*

■ *The Institute's mission is to assure a strong and workable national air quality policy that promotes public health, environmental quality, and industrial progress. As the primary representative of manufacturers of air pollution control systems and associated components, the Institute seeks to evaluate and respond to regulatory initiatives and establish technical standards to the benefit of all citizens.*

## TYPES OF FABRIC FILTERS

### INTRODUCTION

■ The mechanisms of fabric filtration of industrial dusts and fumes are identical regardless of variations in individual equipment designs. In all cases the particulates are removed from the gas stream as it permeates a layer of the same particulates supported on a fabric media and at least a portion of the collected material is removed from the media at intervals by one of the several methods described herein. (Refer to IGCI Publication No. F-2 for description of filtering theory). This basic process may be conducted in many different types of fabric filters in which the physical arrangement of hardware and the method of removing collected material from the filter media will vary.

■ The following is intended to briefly describe the various types of fabric filters so as to facilitate the reader's understanding of the several types which may best serve his particular purpose. This discussion will classify, describe and picture the various types of Fabric Filters as differentiated by (1) types of filter elements, (2) the generally intended use of each type, (3) method of removing the collected material from the media (filter fabric), and (4) position of main fan.

### TYPES OF FILTER ELEMENTS

■ Basically the types of filter elements are restricted to two classifications. These are (1) Inside dust collection (Fig. 1,2, and 3) and (2) outside dust collection (Fig. 4,5, and 6). The inside dust collection unit by virtue of the pressure differential, will be open and self-supporting. The self-supported filter elements are of a tubular shape.

■ When the filtration process is reversed, with the gas flow being from the outside to the inside of the filter element, it is necessary to support the media against the developed pressures so that the degree of collapse is controlled. Supported filter elements are either of the tubular or envelope shape.

■ All types of collectors and cleaning methods described may employ natural or synthetic fabric media. Special care is necessary when using fiber glass fabrics where undue flexing is to be avoided. Felted media are applicable mostly to medium, and high-pressure cleaning methods operating at high ratios on more rapid cleaning frequencies. Woven fabrics are largely applicable to mechanical shaking, and low-pressure reverse air cleaning methods. High temperature pulse jets use special weave fiberglass bags successfully.

■ Another design is the cartridge type of media. Paper, felt and other materials are arranged in a pleated format, much like a car filter, and often use wire as a support.

■ Many types of fabric collectors are "all purpose" in that they can be used to collect any non-corrosive dry dust. Some are special purpose," serving well in some applications but finding limited use in others.

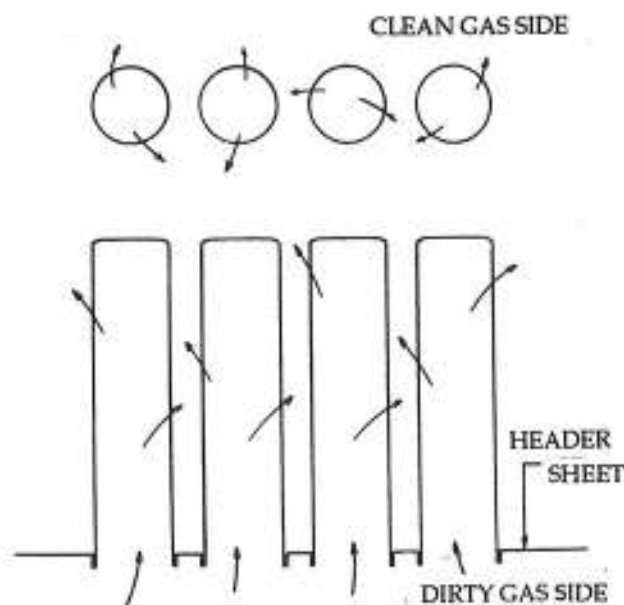


FIGURE NO. 1

INSIDE DUST COLLECTION TUBULAR UNI-BAG  
TYPE BOTTOM ENTRY DESIGN

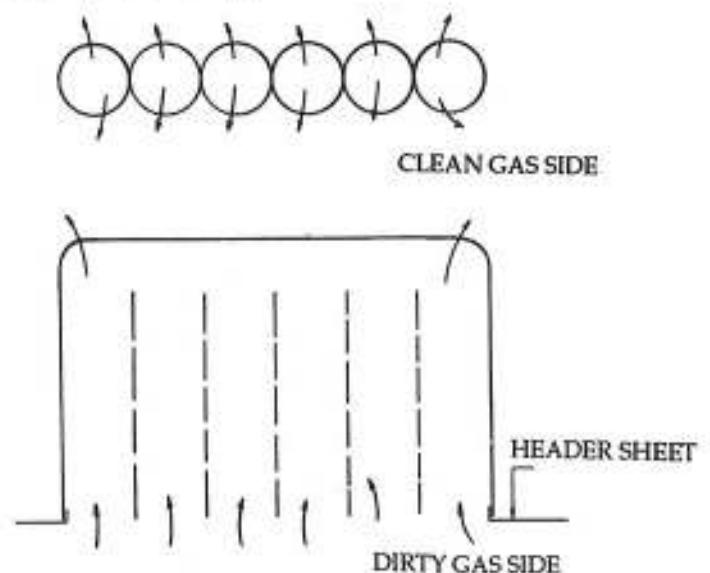


FIGURE NO. 2

INSIDE DUST COLLECTION  
TUBULAR MULTI-BAG TYPE

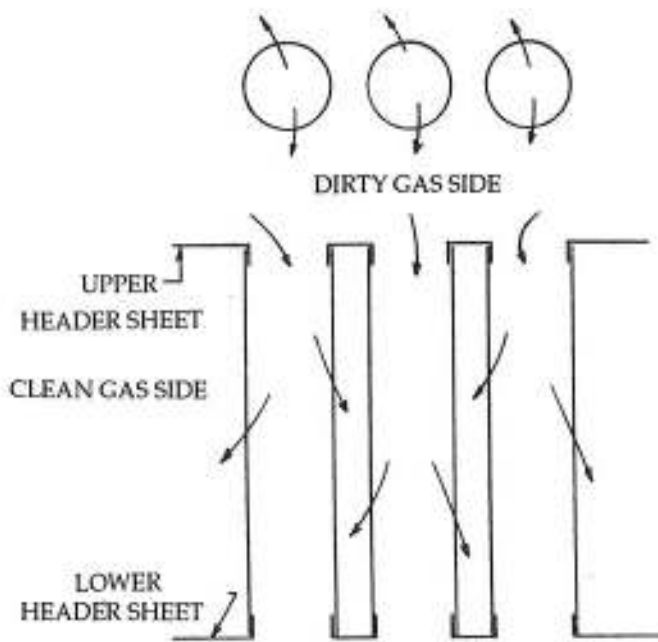


FIGURE NO. 3

INSIDE DUST COLLECTION  
TUBULAR UNI-BAG TYPE,  
TOP ENTRY DESIGN

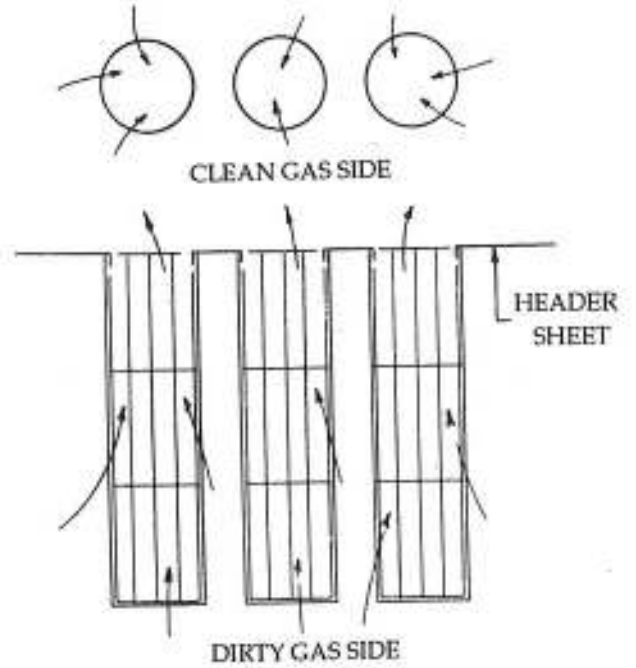


FIGURE NO. 5

OUTSIDE DUST COLLECTION  
TUBULAR UNI-BAG TYPE

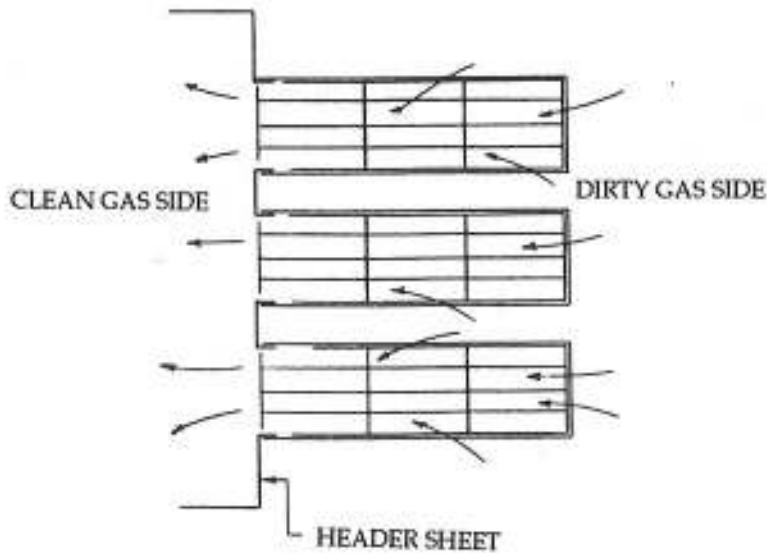


FIGURE NO. 4

OUTSIDE DUST COLLECTION  
ENVELOPE TYPE

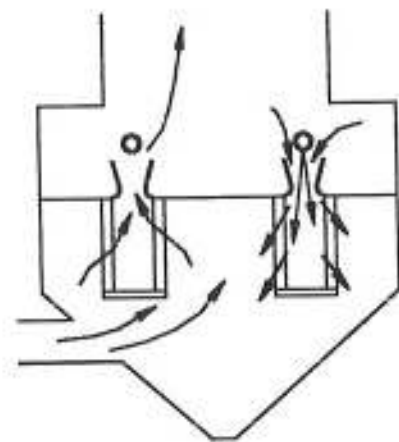


FIGURE NO. 6

OUTSIDE DUST COLLECTION  
CARTRIDGE TYPE FILTER ELEMENT

## INTENDED USE CLASSIFICATION

■ Due to the rather broad variety of designs of fabric filters and the variations in the economics of their installation and operation, special consideration should be given to this category. Obviously the fabric filter should be selected to (1) serve the initial capacity requirement, (2) meet the economic requirements and (3) provide for future capacity if feasible. The following defines the basic types of intended uses and the related types of fabric filters.

■ The major factors in the classification of fabric filters by the Intended Use factor are (1) service and (2) duty.

■ Service defines the operational period requirement, with collectors being available for either intermittent or continuous service.

**Intermittent Service** — where dust producing source operational schedule permits stopping the gas cleaning function at periodic intervals (regularly defined by time or by pressure differential) for removal of the collected material from the filter media (cleaning).

**Continuous Service** — where dust producing source operational schedule requires the gas cleaning function to be continuous, round the clock. The collector is designed so that a portion of the media is cleaned while the balance continues in the filter mode.

■ Duty defines the amount of work the collector is intended to do, generally relating to the inlet dust load and the dust generation periods. Fabric filter designs have been sub-divided to cover (1) light duty, (2) light to medium duty, (3) medium to heavy duty and (4) custom designed.

### Type of Design

#### I. Unit-type collectors for light duty, intermittent service. (Fig. 7 and 8).

- Type of filter element - outside collecting envelopes, inside collecting tubular shapes, or cartridge collection.
- Type of Cleaning Method - generally manual rapping (shaking) but may be power operated. Also pulse jet.
- Characteristics - compact, often portable, built-in or attached exhaustor, drawer-type or self-draining hopper, factory assembled. Bin vents (units attached to silos) fall in this category.
- Preferred Usage - exhaust ventilation or one or more dust points, usually in-plant service, light duty, intermittent service, ambient temperature. Not normally applicable to central-system dust control above 3,000-7,000 cfm capacity.

#### II. Standard collectors, generally light to medium duty, intermittent or continuous service.

- Type of filter element - inside or outside collecting.
- Type of cleaning method - all types.
- Characteristics - modular construction, expandible by standardized increments, shipped either knocked-down or shop-assembled, self-draining hoppers.
- Preferred usage - nearly all light-to-moderate in-plant and air pollution control applications, ambient to 275 Deg. F temperatures.

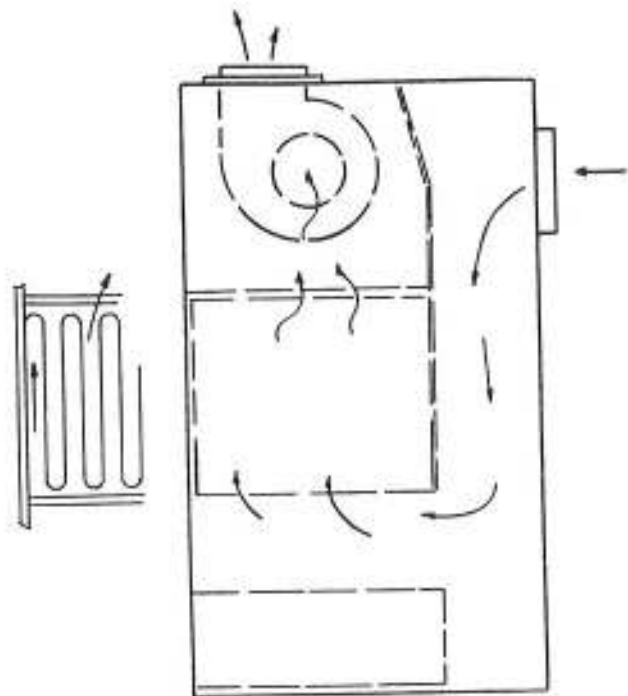


FIGURE NO. 7

### OUTSIDE DUST COLLECTION SUPPORTED ENVELOPE ELEMENTS

#### III. Standard collectors, medium to heavy duty, usually continuous service.

- Type of filter element - As in II, above.
- Type of cleaning method - As in II, above.
- Characteristics - As in II, above, except with modifications to housings, hoppers and other components to suit requirements of the specific application, ease of maintenance and round-the-clock service, modular design but built to order using standard collector components.
- Preferred usage - Selected for each application, capacity limited only by available space, round-the-clock service, ambient to 550 Deg. F temperatures.

#### IV. Special or Custom Designed collectors, heavy duty continuous service.

- Type of filter element - As in II, above.
- Type of cleaning method - Limited to those compatible with filter elements employed and gas temperatures encountered, for extra heavy duty, provisions for in-service maintenance.
- Characteristics - Usually large in size, with heavy duty components, repetitive sections to permit enlargement, often insulated, provisions for in-service maintenance. May be fabricated outside of vendor's plant or normal supply source.
- Preferred usage - High-Capacity, high temperature (to 550 Deg. F) air pollution control, usually part of an elaborate system, round-the-clock, 30-day month service without downtime (except for selected sections).



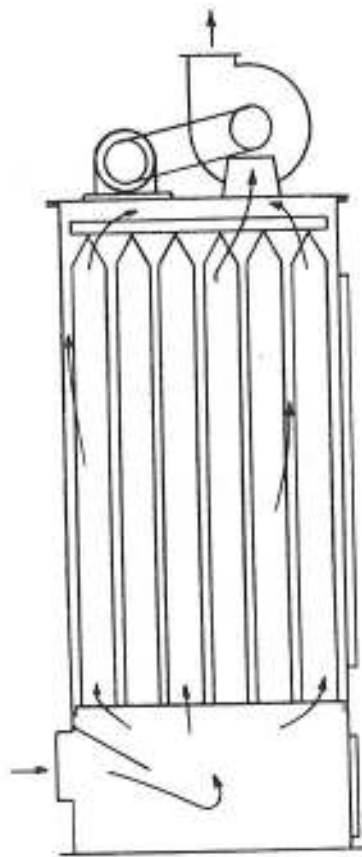


FIGURE NO. 8

INSIDE DUST COLLECTION  
UNSUPPORTED TUBULAR ELEMENTS

### CLASSIFICATION BY METHOD OF CLEANING

Another method of classifying fabric filters is by the method of removing the dust from the filter media. The following outline describes these methods; however, these methods vary widely and may be mixed.

#### A. Mechanical rapping or shaking, (Fig. 9,10 and 11).

1. Inside collecting type elements with pneumatic or mechanically-operated shaker mechanisms for cleaning.

(a) General purpose collector.

(b) Intermittent service.

(1) Shut down exhauster or isolate during cleaning.

(2) Air-to-cloth ratio and rate of pressure buildup determine frequency of cleaning.

(c) Continuous service.

(1) One section isolated at a time by dampers for cleaning.

(2) Cleaning cycle variable but practical limitations on rapid cycling require lower air-to-cloth ratios than in certain other types.

(d) Mechanical shaking plus air reversal, tubular elements only.

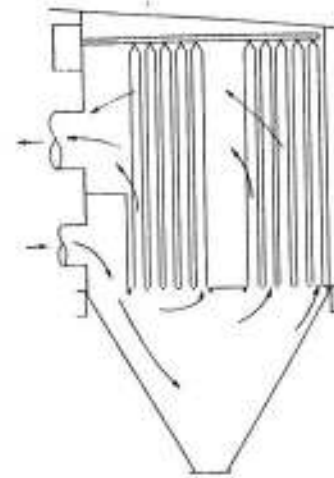


FIGURE NO. 9

(BOTTOM ENTRY DESIGN)  
MECHANICAL SHAKER, INTERMITTENT SERVICE

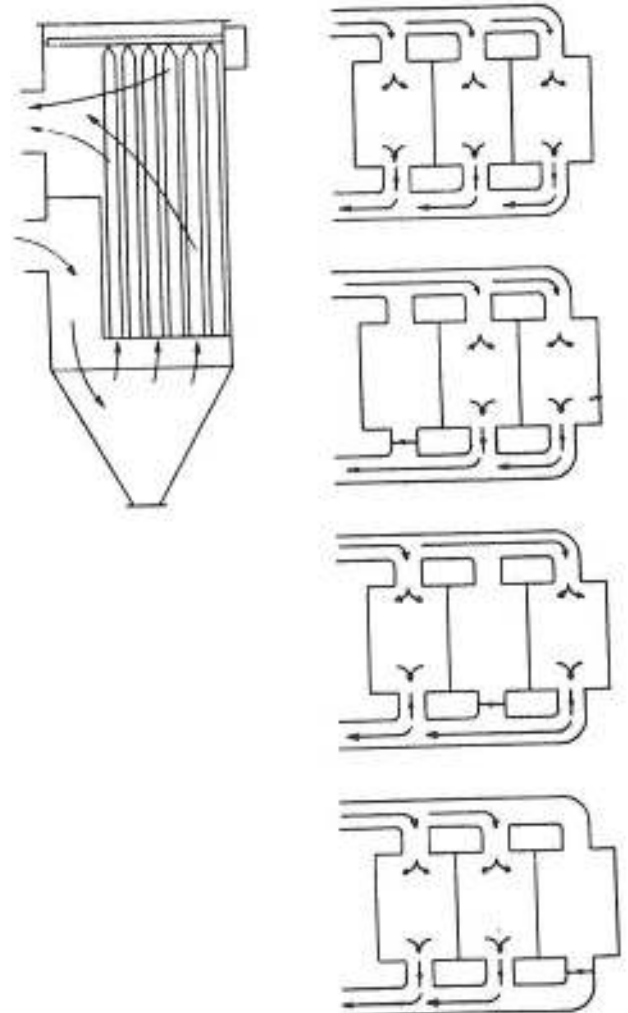


FIGURE NO. 10

TUBULAR TYPE  
SHAKER SYSTEM DUST COLLECTOR  
MECHANICAL SHAKER, CONTINUOUS SERVICE

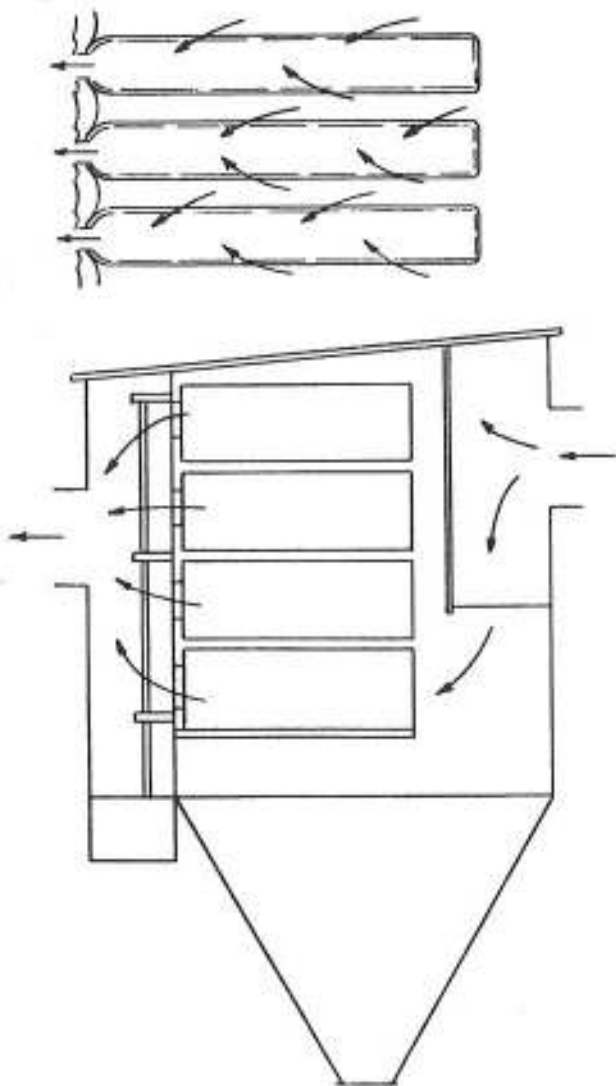


FIGURE NO. 11

SCREEN OR ENVELOPE TYPE COLLECTOR  
MECHANICAL RAPPER, INTERMITTENT SERVICE

**B. Reverse air cleaning tubular elements. Figures 12 through 15 only, dust on inside. (Also known as backwash, re-pressure, collapse-reverse).**

1. Inside collecting type.
2. Continuous service.
3. Bags often installed taut and/or equipped with spacer rings.
4. Air reversal from atmospheric pressure or powered fan system.
5. Sonic cleaning - Often used in connection with reverse air units.

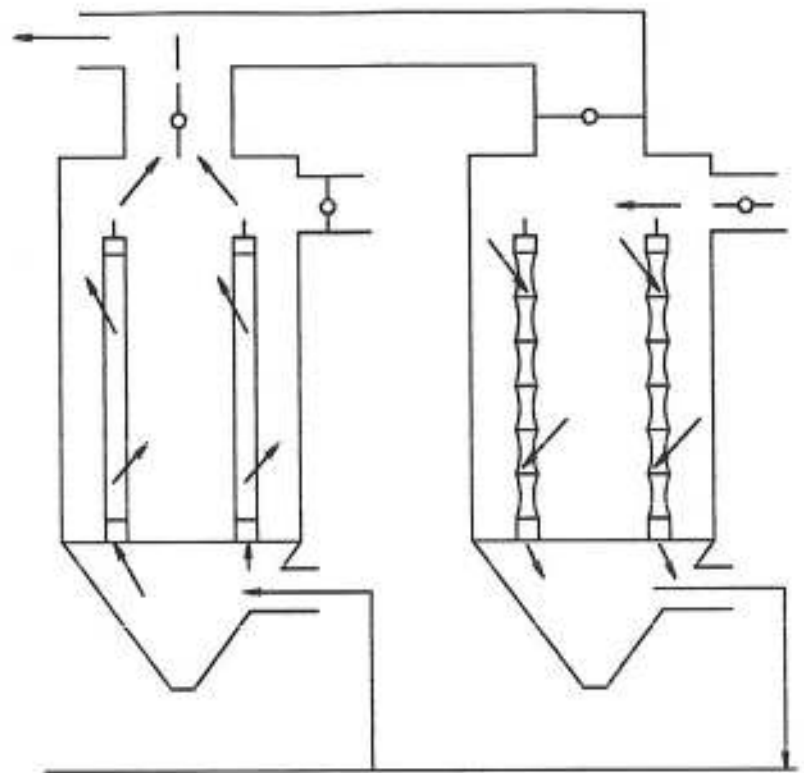


FIGURE NO. 12

CLEANING CLOTH BY REVERSE AIR FLOW  
(ATMOSPHERIC)

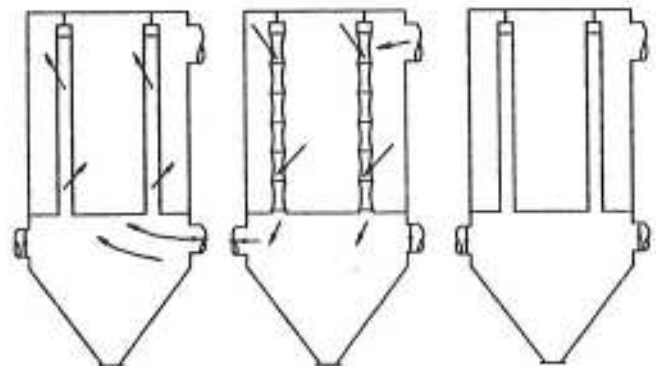


FIGURE NO. 13

CLOTH CLEANING BY RE-PRESSURING SYSTEM



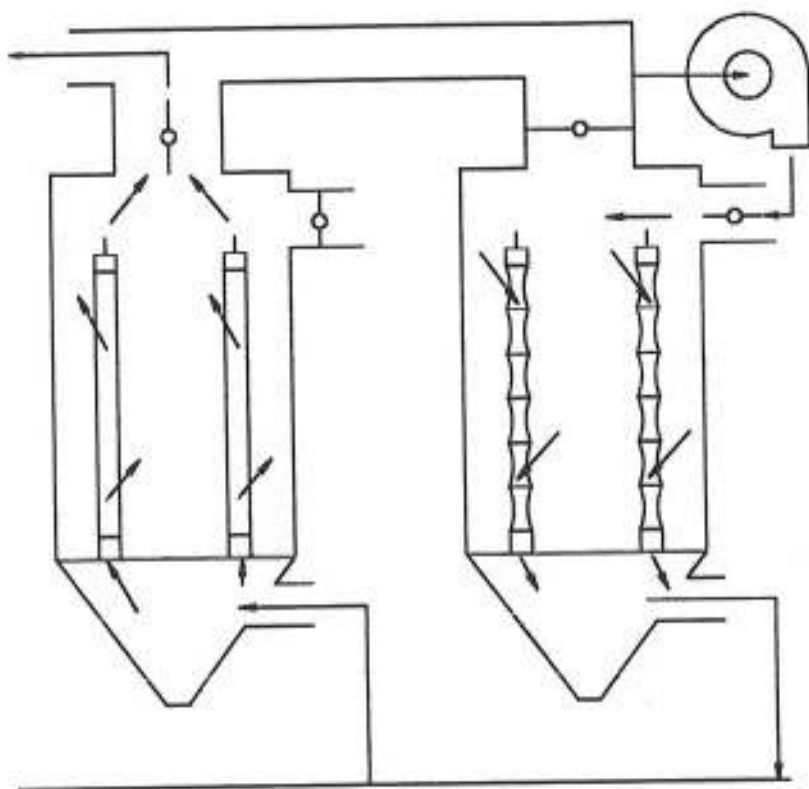


FIGURE NO. 14

NEGATIVE PRESSURE TYPE  
REVERSE AIR FLOW CLEANING UNIT

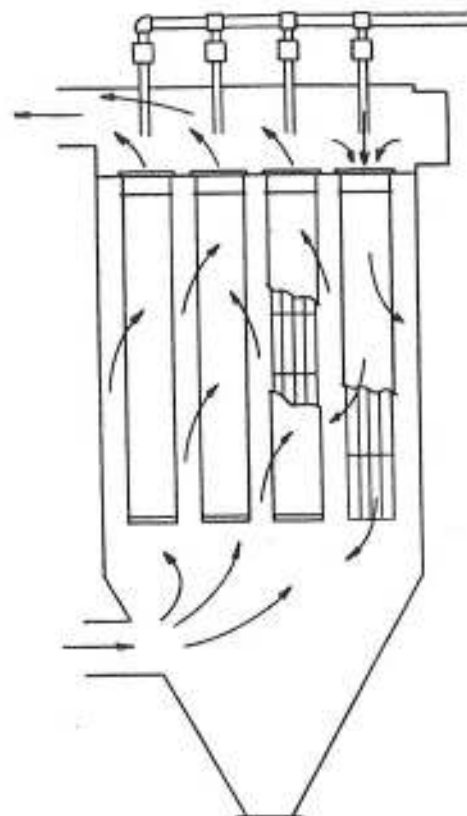


FIGURE NO. 16

PULSE-JET CLEANING TYPE COLLECTOR

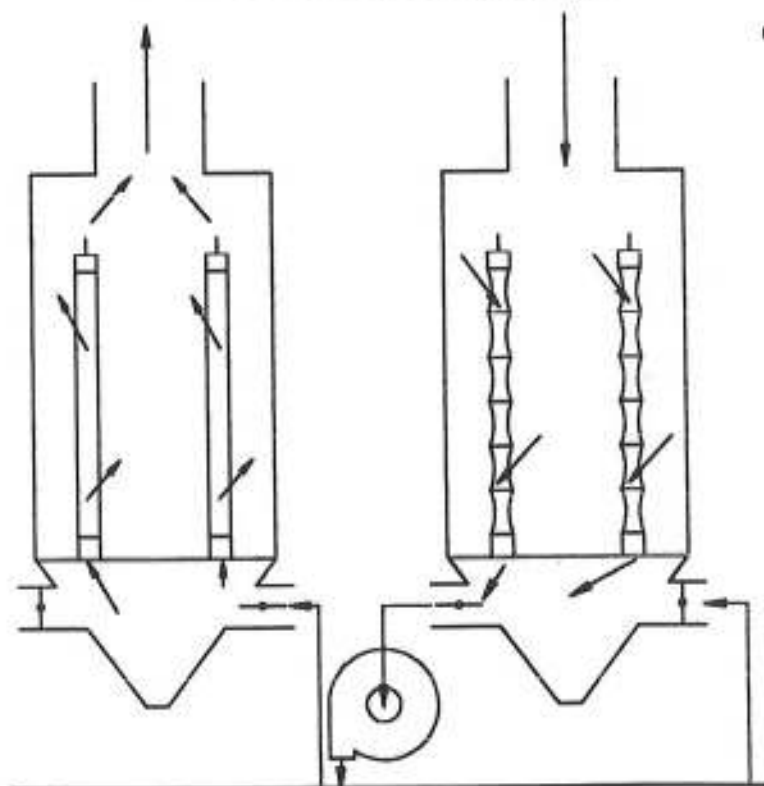


FIGURE NO. 15

REVERSE AIR FLOW  
POSITIVE PRESSURE TYPE UNIT

### C. Pulse-Jet Cleaning (Fig. 16 and 17).

1. Outside collecting unit.
2. Compressed air (usually 10-95 PSI) released momentarily at clean air mouth of element stops filter flow and reverse-inflates filter element, causing inertial rejection of filter cake by filter media. The wide range of compressed air pressures is based on supplier's use of low pressure blowers (10-15psi) with relatively high quantities of air and higher pressures (50-90psi) using air compressors with lower quantities of air. Some vendors also classify their units as low pressure when using 50-60 psi air.
3. Air jet often induces additional clean gas flow for blow back cleaning.
4. A portion of the jets operate simultaneously. However, a majority of the elements remain in the filter mode, eliminating the need for dampers and spare capacity.
5. Custom units for applications, such as boilers or metallurgical fume, may need to be compartmentalized and cleaned "off line" for better cleaning capacity.
6. Compartment-Pulse cleaning (trade name "Plenum Pulse") supported tubular elements, dust on the outside (Fig. 17).

(a) When a poppet valve is closed, a burst of compressed air (from a storage receiver) is discharged into a compartment of bags reverse-inflating the bags and backwashing them.

## CLASSIFICATION BY POSITION OF THE MAIN FAN

- I. **Suction units** have the fan located downstream of the fabric filter. The advantages are a clean fan which minimizes wear. Since leakage is into the system, these units are used where noxious gas, such as  $SO_2$ , are present.
- II. **Positive Pressure Units.** The fan is located upstream of the fabric filter. These units are popular where direct discharge from each compartment is desirable.

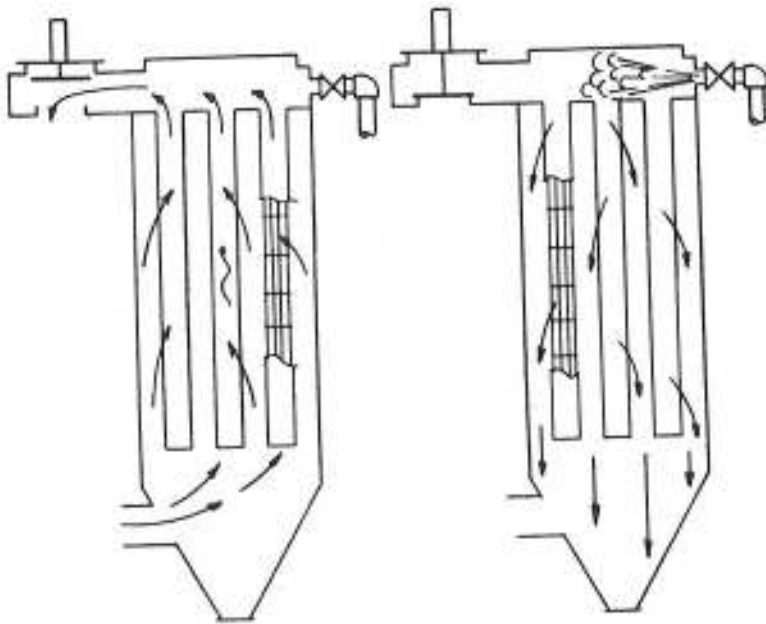


FIGURE NO. 17

COMPARTMENT-PULSE CLEANING

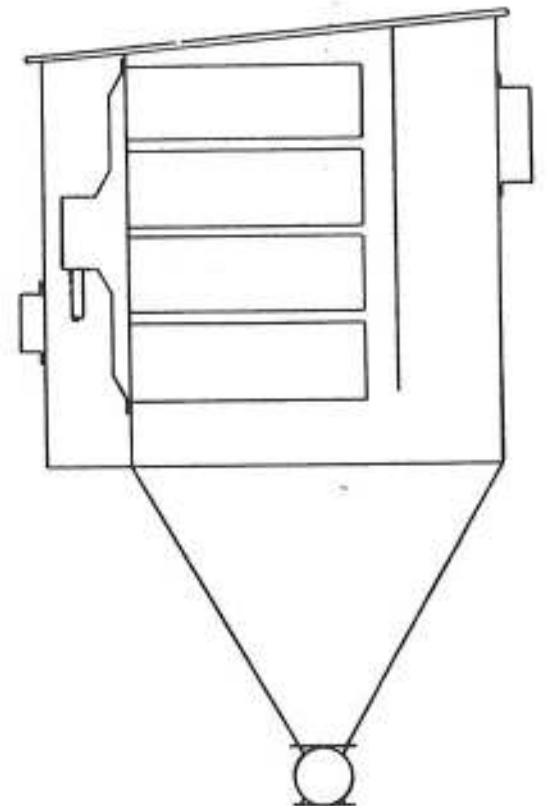
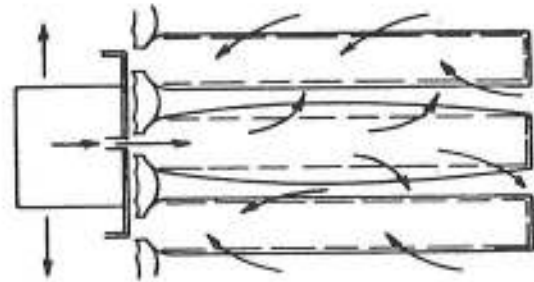


FIGURE NO. 18

REVERSE FLOW CLEANING SCREEN  
FRAME TYPE UNIT

D. **Air Reversal** (supported elements, envelope shape or tubular dust on outside (Fig. 18).

1. Blow back carriage traveling across open end of envelopes (on clean air side) source of cleaning air may be atmospheric pressure or a separate blower.

## AUXILIARIES

■ Many fabric filters, especially the custom designed units, include complete systems. The following items are available from many IGCI members:

- I. **Dampers and duct work.** Inlet and outlet manifolds are critical to provide even distribution of air and dust to multiple compartment units. For reverse air, shake deflate and repressurized units, the fans and interconnecting duct work must be supplied. Dampers for isolation for cleaning are usually poppet or tight sealing butterfly dampers. Maintenance dampers are usually butterfly or louver. Bypass dampers may be specially constructed guillotine or poppet dampers. The bypass dampers must provide a very tight seal so no dust can leak to the clean gas discharge.
- II. **Acid gas removal and filter aid.** Dry injection and spray dryers are placed ahead of fabric filters for acid gas removal. Substances such as lime or sodium compounds absorb the gas as a solid which is then captured in the fabric filter. Dry injection is also used as a filter aid in some applications.
- III. **Performance improvement devices.** A number of devices and methods are available as a means to improve the performance of the fabric filter. Examples of such devices include:
  - (a) A perforated tube placed in pulse jet tubes has lowered pressure drop in some cases.
  - (b) Sonic horns have been added to some units to reduce pressure drop.
  - (c) A knitted "Teflon" sleeve which covers the pulse-jet cage under the bag has lengthened bag life.
  - (d) Pressure sensors for "clean on demand" has extended bag service life by eliminating unnecessary cleaning.
  - (e) Tensioning devices that provide variable rates depending on operating conditions have extended bag life.
  - (f) Fluorescent powder and monochromatic light leak detection testing system has saved man hours by locating leaks in bags and tubesheets.
  - (g) Non-hazardous artificial dust cake has extended bag service life by protecting the fabric from abrasion, moisture and hydrocarbons.
  - (h) Leak detection devices to monitor bag failures.
  - (i) Electric Enhancement. The EPA has performed laboratory and pilot testing on placing an electric charge on filter media to enhance collection. This should be an improvement in the future.