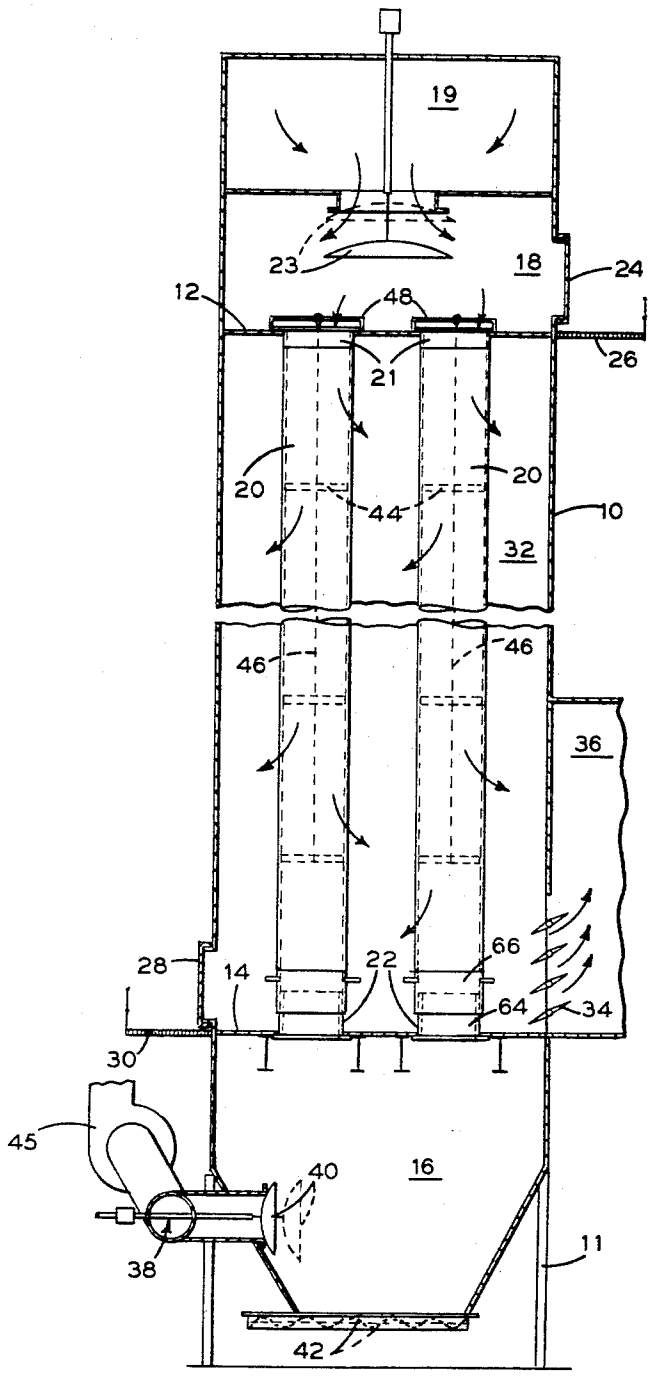
Sept. 17, 1968 W. E. BALLARD 3,401,505

BAGHOUSE APPARATUS

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FIG. 1



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BAGHOUSE APPARATUS

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FIG. 4

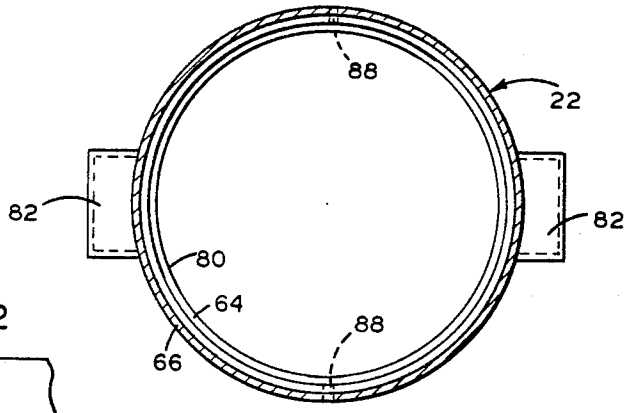


FIG. 2

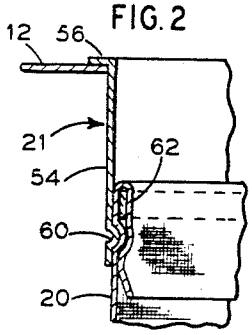
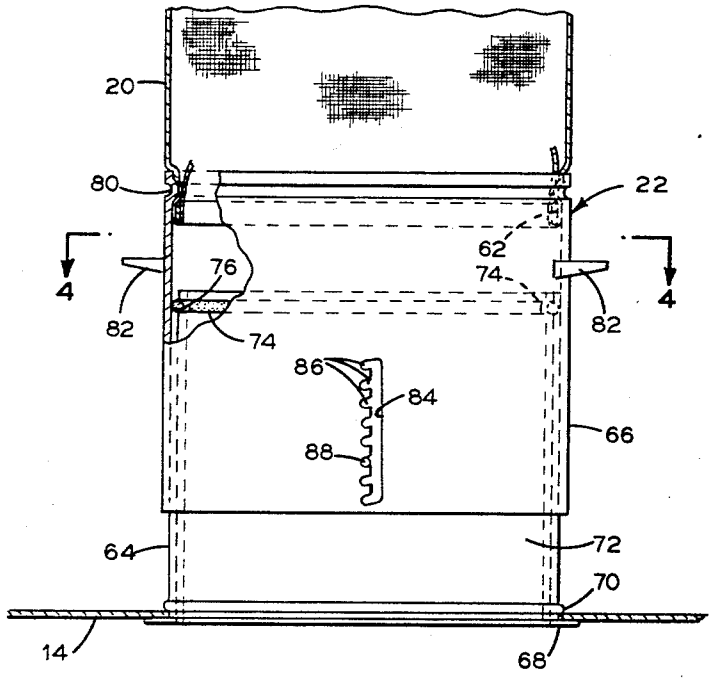


FIG. 3



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3,401,505

BAGHOUSE APPARATUS

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ABSTRACT OF THE DISCLOSURE

A baghouse construction in which a filter chamber is defined by vertically spaced upper and lower apertured tube plates between which extend open-ended tubular bags of gas-pervious particulate material-arresting fabric connecting corresponding apertures. Each bag is fixed at its upper end to the upper tube sheet and at its lower end releasably fixed to a vertically adjustable thimble section arranged to be releasably locked in telescoping relation to a second thimble section fixed in a corresponding aperture in the lower tube sheet, whereby the bags can be mounted and tensioned by a worker in the filter chamber.

This invention relates to apparatus for baghouses of the type employed for filtering entrained particulate matter from air or other gases, and more particularly to improved means for holding the filter bags within the baghouse in proper position and under suitable tension.

Conventional baghouses include a casing having vertically spaced upper and lower tube sheets respectively provided with registering apertures, between which a corresponding number of filter bags are held in tension. Since the bags are usually made of fragile fibers woven to form a rather delicate fabric, it is not advisable to connect the ends of the filter bags directly to the tube sheets when tensioning the bags because the aperture edges may be sufficiently sharp or rough to tear the fabric. In the interest of extending bag life, it is therefore advisable for each end of a filter bag to be connected to a smooth tubular metal thimble which, in turn, is received in the associated tube sheet aperture. Thus it is the function of the thimbles to hold the filter bags under tension in expanded condition between the tube sheets to thereby resist collapse of the bags. In addition, the establishment of a sealing relationship between the bags and the thimbles prevents the filtered gas from being vitiated by leaking unfiltered gas.

The bags are held in tension because otherwise the fabric would tend to crease or form pleats and folds which would reduce filtering efficiency and tear the fabric, especially if made of glass, or other brittle fiber which breaks easily when bent.

Various thimble constructions have been proposed in the past. At first their main purpose was to line the rough edged apertures of the tube sheets to protect the delicate, woven filter bags from rips and snags either during installation or subsequent operation. Thimbles have also been used in the past as adapters to which the ends of the filter bags can be secured, albeit not entirely satisfactorily, as with the aid of an external annular groove in each thimble and an external annular garter spring. As the art progressed, thimbles were also used to apply tension to the filter bags, as by making the lower thimble of heavy construction and slidable in its aperture so as to apply tension to the bag, while effecting a sliding seal with the tube sheet. Still other older arrangements involve the use of an adjustably positioned thimble which is secured to the tube sheet after tension is applied to the filter bag.

As will be seen, the present invention involves the concept of securing the thimbles for each bag to the associated tube sheets and to the respective ends of the filter bag, then applying tension to the filter bag and locking the assembly by manipulation of one of the thimbles. With this construction tension may advantageously be applied from within the filter chamber disposed between the tube sheets, rather than from a plenum above the upper tube sheet or from the hopper below the lower tube sheet.

According to the present invention, at least one of the thimbles is constructed of inner and outer tubes in telescoping relationship with an annular seal between them. One tube is stationary, being secured to the tube sheet in registry with an aperture. One end of the filter bag is connected to the movable tube; and the latter slides or telescopes into the stationary tube to apply tension to the filter bag. Further included are devices which provide interlocking formations on the inner and outer tubes, preferably on opposite sides of the thimble **22**, so that by rotation of the movable tube about its axis the tubes can be locked together against axial movement to thereby maintain tension on the filter bag. These interlocking formations may be in the form of a projecting pin on one tube, which pin is movable along an axially extending slot in the other tube. Serrations, or an axial series of transverse notches, are formed along one side of the slot to receive and grip the pin if moved therein by rotation of the pin-carrying tube.

The various objects, features and advantages of the invention will appear more fully from the detailed description which follows, taken in connection with the accompanying drawings forming a part of the present application, and in which:

FIG. 1 is a vertical sectional view of a baghouse incorporating the invention;

FIG. 2 is an enlarged, fragmentary view of the apparatus of FIG. 1;

FIG. 3 is an enlarged view of a fragment of the apparatus of FIG. 1, showing the invention in detail; and

FIG. 4 is a horizontal sectional view, taken along line **4—4** of FIG. 3.

The baghouse of FIG. 1 is a filtering device having a casing **10** supported on legs **11** and equipped with vertically spaced upper and lower correspondingly apertured tube sheets **12** and **14**, a hopper **16** below the lower tube sheet **14**, an upper plenum **18** above the upper tube sheet **12**, and an inlet duct **19** above the upper plenum **18**. A plurality of vertically elongated, tubular filter bags **20**, extending between vertically aligned, corresponding apertures in the respective tube sheets **12** and **14**, are each held between upper and lower thimbles **21** and **22**.

An inlet damper **23** controls the flow of dirty gas from the inlet duct **19** to the upper plenum **18**. A door **24** closes a manhole in the casing **10** and provides access for workmen from an upper platform **26** to the upper plenum **18**, and another normally closed door **28** provides similar access from a lower platform **30** to a vertically elongated filter chamber **32** between the tube sheets **12** and **14**.

During normal filtering operation, with inlet damper **23** open as shown in FIG. 1, dirty gas flows from duct **19** through plenum **18**, and into the open upper ends of the filter bags **20**, as indicated by the arrows. Next the dirty gas flows lengthwise of the bags **20** and clean filtered gas exits through the bag walls, thereafter flowing from the filter chamber **32** through the open exhaust damper **34** into the exhaust duct **36**, from whence the clean, filtered gas is either delivered to a point of use or discharged to the atmosphere via a stack (not shown). Some of the particulate matter separated from the dirty gas clings to the inner surface of the bag walls, but in the main it is deposited in the bottom of the hopper **16** and carried away by a screw conveyor **42**. During the filtering operation, a deflation duct **38** having an inlet in the hopper **16**

is closed by a deflation damper **40**, when positioned as shown in solid lines.

However, during the cleaning operation when particulate matter is removed from the inner surface of the filter bags **20**, the inlet damper **23** and the deflation damper **40** are moved to the positions illustrated with broken lines in FIG. 1 so that inlet damper **23** is closed and deflation damper **40** is open, while exhaust damper **34** remains open in a suitable position. With dampers thus positioned, a fan **45** or other suitable gas translating apparatus is operated to draw clean gas from the exhaust duct **36**, through damper **34**, into the filter chamber **32** for flow first through the walls of the filter bags **20**, next into the hopper **16**, and then through the damper **40** and out the deflation duct **38**, for delivery to the inlet duct **19** where, in preference to discharging the now dirty gas to the atmosphere, the dirty gas can be directed for cleaning into the upper plenum of a separately compartmented, companion filter chamber in the same baghouse which is connected to the common inlet duct **19** and the common exhaust duct **36**. In this way clean gas from a filter chamber set for filtering operation is available for back flow through a filter chamber set for cleaning of its bags, all by suitable positioning of their respective dampers **23**, **34** and **40**.

Although not so limited, the invention is especially applicable to filtering devices employing tubular filter bags **20** woven of fiberglass or other heat resistant ceramic material and which may be open at both ends. Fiberglass can withstand temperatures up to 600° F. so that gases at such a temperature can be introduced directly to the filter chamber **32**, quite unlike the situation when filter bags of other known synthetic materials, such as Dacron, are employed. With the synthetic materials, having temperature capabilities of about 300° F., it is sometimes necessary to employ apparatus and procedure for the preliminary step of reducing the temperature of the gas to be filtered to below the temperature capability of the filter bag material, all because others are unable to obtain satisfactory service life from the more delicate fiberglass filter bags. The other parts of the apparatus may be made of metal, preferably steel.

Recognizing that fiberglass filter bags **20** are easily torn when pleated or sharply bent, the present invention provides means for securing the filter bags **20** gently and under tension in order to avoid bruises and sharp bends, of which the latter may be occasioned by the formation of pleats or creases, as during normal cleaning operation. Furthermore, by preventing the formation of pleats and creases, the filtering effectiveness of the bags is improved.

The apparatus shown in FIG. 1 employs a vertically spaced series of anti-collapse rings **44** loosely disposed within each filter bag **20** and carried on a longitudinally extending rod or cable **46** depending from an upper support **48**.

The present invention provides means for tensioning the filter bags **20** from within the filter chamber **32** and specifically eliminates any need to enter the upper plenum **18** or the hopper **16**. Only one workman is required to effect tensioning of a bag during either installation or replacement of the filter bags **20**.

In the drawings, the upper and lower thimbles **21** and **22** are of different construction, since it is the lower thimble **22** that is employed both to hold the filter bag and apply adjustable tension, while the upper thimble **21** simply serves to hold the filter bag while resisting tensioning forces and therefore can be of simple construction.

Referring now to FIG. 2, the upper thimble **21** comprises a tubular body portion **54** having an outwardly flared flange **56** which seats on top of tube sheet **12** and thus supports the thimble **21**. At the lower end of the upper thimble **21** there is formed an inwardly extending rim or lip **60** which serves as a ledge for holding the upper end for the filter bag **20** against downward movement. It will be noted that both ends of the filter bag **20** are provided with a hem in which is received a ring **62**, preferably of stainless steel material, sewn or otherwise secured in place to provide circular form to the ends of the filter bag **20** and also, in the case of the upper end of the filter bag, to engage the rim or lip **60** of the upper thimble **21**. With this arrangement the upper end of the filter bag **20** is open to receive gases to be filtered, and it is supported and retained against downward movement by the inturned rim **60**, even when a tensioning force is applied at the lower end of the bag.

The lower thimble **22** is an assembly which serves to connect the lower end of the filter bag **20** to the lower tube sheet **14** and also to apply tension to the bag at the lower end thereof. The lower thimble **22** comprises inner and outer tubes **64** and **66** in telescoping relationship formed about the longitudinal axis of the bag **20**. Stated another way, one of the tubes is slidably received within the other and is relatively movable by rotation about the axis or linearly in axial direction. As shown in FIGS. 3 and 4, the inner tube **64** is somewhat similar in construction to the upper thimble **21**, since it includes an annular flange **68** which is peened after installation so that it flares outwardly to cooperate with an outwardly extending annular projection **70** at the lower end of a generally cylindrical body portion **72** for gripping the portion of the lower tube sheet **14** rimming the aperture through which it extends, and thereby securing the inner tube **64** stationary with respect to the lower tube sheet **14**. Optionally the lower end of the tube **64** can be welded to the lower tube sheet **14**, as from a position inside the filter chamber **32**, instead of peening the flange **68**. Formed in the upper end of the inner tube **64** is an external annular groove **74** receiving a seal ring **76**, preferably of resilient material resistant to heat and chemical attack, the purpose of which is to maintain the inner and outer tubes **64** and **66** in sealing relationship in all relative positions thereof.

At the upper end of the outer tube **66** is formed an inturned rim or annular lip **80** which, like the inturned lip **60** of the upper thimble **21**, serves as a retaining ledge for the lower end of the filter bag **20** by engaging the ring **62'** within its lower hem to thereby provide a positive stop against upward movement of the lower end of the filter bag **20** when the bag is tensioned. A pair of handles **82** are attached on the outer surface of the outer tube **66** for convenience in manually manipulating the outer tube.

The lower thimble assembly **22** is provided with a ratchet and pin device to facilitate interlocking the inner and outer tubes **64** and **66**. Broadly stated, it is the function of the interlock device to permit the inner and outer tubes **64** and **66** to be telescoped, or moved in axial direction relative to each other, in order to apply tension to the filter bag **20**, as by moving the outer tube **66** axially downwardly. Then, after the desired tension has been applied to the filter bag **20**, the outer tube **66** may be rotated relative the inner tube **64** in order to lock the outer tube **66** against axial movement, with the result that the tension applied to the bag is maintained. As best seen in FIG. 3, the preferred form of interlock comprises axially elongated slots **84** formed at diametrically opposite locations in the outer tube **66**, with an axial series of transverse notches **86** along one edge of each slot **84**. The slots **84** and the notches **86** receive and cooperate with corresponding outwardly extending pins **88** on the inner tube **64** to secure the lower thimble against axial movement when the pin **88** is received in one of the notches **86**.

It is to be understood that the positions and function of the inner and outer tubes **64** and **66** may be transposed; and, likewise, either tube may have the slots **84** and the other pins **88**, in practicing the invention.

To install a filter bag **20** in the position shown in FIG. 1, the upper end of the filter bag is first secured to the upper thimble **21** by seating the upper end of the bag and its ring **62** against the upper surface of the inturned rim **60**. The lower thimble **22**, which is in vertical alignment with the upper thimble **21**, is then made ready for reception of

the lower end of the filter bag **20** by rotating the outer tube **66** either until the pins **88** if free of the notches **86** or the outer tube **66** is in an elevated position. Next, the lower end of the filter bag **20** and its ring **62'** are seated against the lower surface of the inturned rim **80**. The desired tension is then applied to the bag **20** by applying equal downward force to the handles **82**, with the pins **88** free to slide upwardly in the slot **84** as the outer tube **66** is pressed downwardly in telescoping relation to the inner or stationary tube **64**. The lower thimble **22** is then locked, with the selectively applied tension maintained substantially constant, by simply rotating the outer tube **66** so that each pin **88** is received in a selected one of the notches **86**. With a suitable angular inclination of each of the notches **86**, the pins **88** may be held captive until the outer tube **66** is rotated in opposite direction, after which the pins **88** are released for free sliding movement in the slot **84**. Manual manipulation of the outer tube **66** may be performed by a workman standing in the filter chamber **32** on the lower tube sheet **14**.

Although the invention has been shown specifically it will be obvious to those familiar with the art that it is not so limited, but it is susceptible of various changes and modifications without departing from the spirit thereof, as covered by the claims which follow.

What is claimed is:

1. A filtering device comprising:

a casing having a gas inlet and outlet,

upper and lower spaced apart tube sheets within said casing provided with a plurality of corresponding vertically aligned apertures and defining with said casing a filter chamber communicating with said gas inlet and outlet,

a plurality of fiberglass filter bags of axially elongated tubular construction in said filter chamber extending between respective corresponding apertures of said tube sheets for filtering particulate matter from gases flowing through said casing,

means including first and second thimbles attached to said upper and lower tube sheets respectively for securing opposite ends of each filter bag to the respective upper and lower tube sheets under tension between them and in registry with corresponding apertures in said tube sheets,

an inner tube fixedly mounted in its corresponding aperture and extending into the space between said tube sheets, means for adjustably tensioning said filter bag comprising an outer tube having one end secured to the respective end of its respective bag and its other end surrounding and in telescoping relation with said inner tube, a sealing ring positioned between the telescoping portions of said inner and outer tubes,

one of said tubes having an axially elongated slot with an axial series of transverse notches formed therein, and a locking member on the other of said tubes received in said slot and axially movable therein incident to movement of said second tube relative to said first tube, said locking member being adapted for reception in one of said notches upon relative rotational movement of said tubes about said axis for securing said tubes against relative axial movement,

the construction and arrangement being such that said filter bag is placed in tension by relative movement of said tubes in one axial direction and said tubes are locked against relative axial movement and said filter bag is maintained in tension by relative movement of said tubes in one direction of rotation.

2. In a baghouse for filtering particulate material from a gas, a pair of vertically spaced horizontally arranged upper and lower apertured tube sheets arranged to define the top and bottom of a filter chamber therebetween, an open-ended tubular filter bag of gas-pervious particulate material-arresting fabric arranged to connect corresponding vertically aligned apertures in said tube sheets, a thimble seated in an aperture in the upper tube sheet, means for holding the upper end of said filter bag in said thimble against downward movement, a lower thimble assembly comprising an inner tube having its lower end fixedly mounted in the corresponding aperture in said lower tube sheet and projecting upwardly therefrom towards said upper tube sheet, and means for adjustably tensioning said filter bag from within said filter chamber comprising an outer tube in said lower thimble assembly having its upper end secured to the lower end of said filter bag and its lower portion surrounding and in telescoping relation with the upwardly projecting portion of said inner tube, a sealing ring positioned between the telescoping portions of said inner and outer tubes, and means above the level of said lower tube sheet for releasably interlocking the telescoping portions of said inner and outer tubes by relative axial and rotational movement of said tubes to hold said bag in its desired tensioned position comprising one of said tubes having an axially elongated slot with an axial series of transverse notches formed therein, and a locking member on the other of said tubes received in said slot and axially movable therein incident to movement of said other of said tubes, said locking member being adapted for reception in one of said notches upon relative rotational movement of said tubes about said axis for securing said tubes against relative axial movement.

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