May 29, 1962 A. G. RUSSELL 3,036,385

TUBE TYPE DRYER

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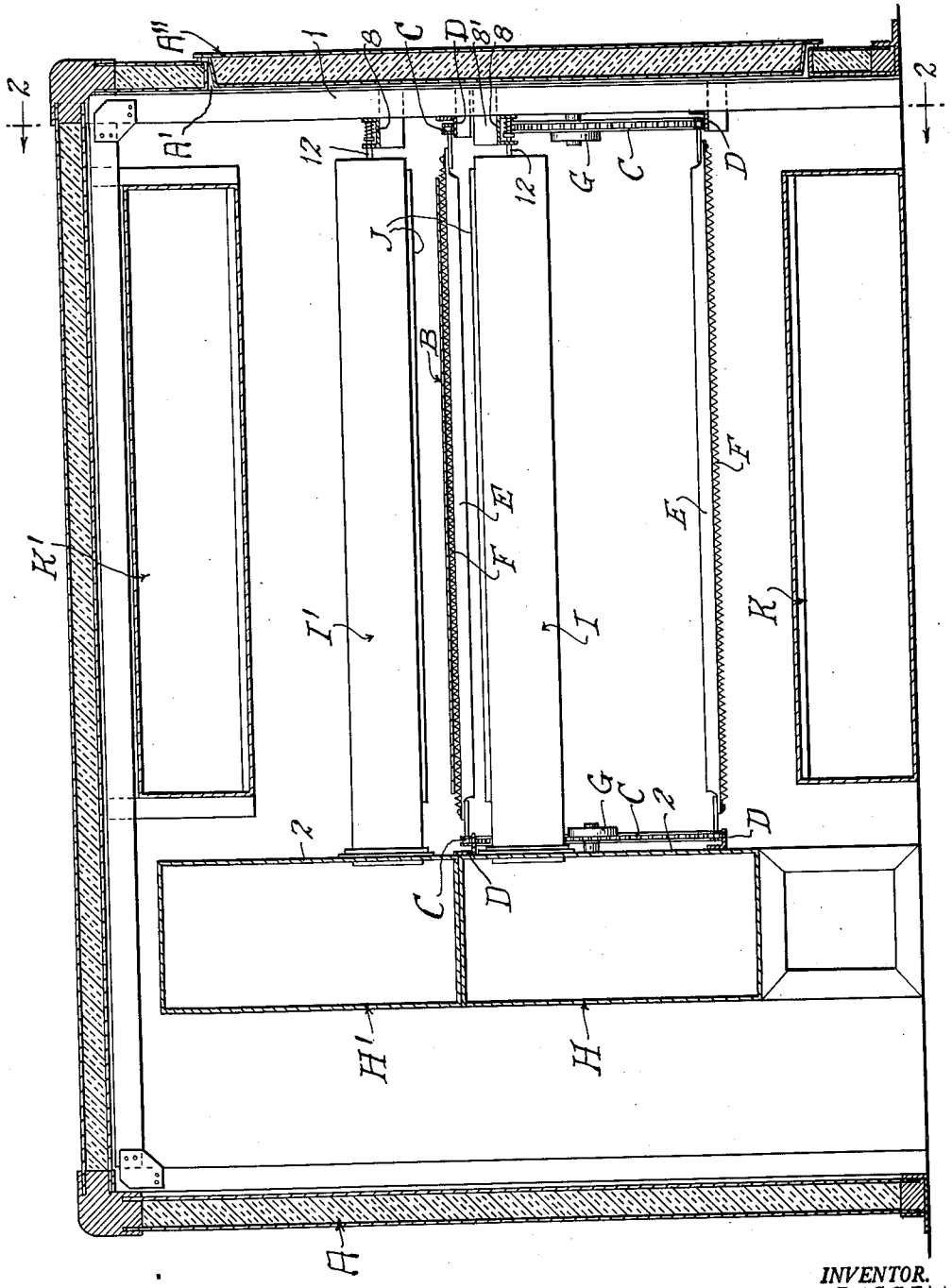


Fig. 1.

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TUBE TYPE DRYER

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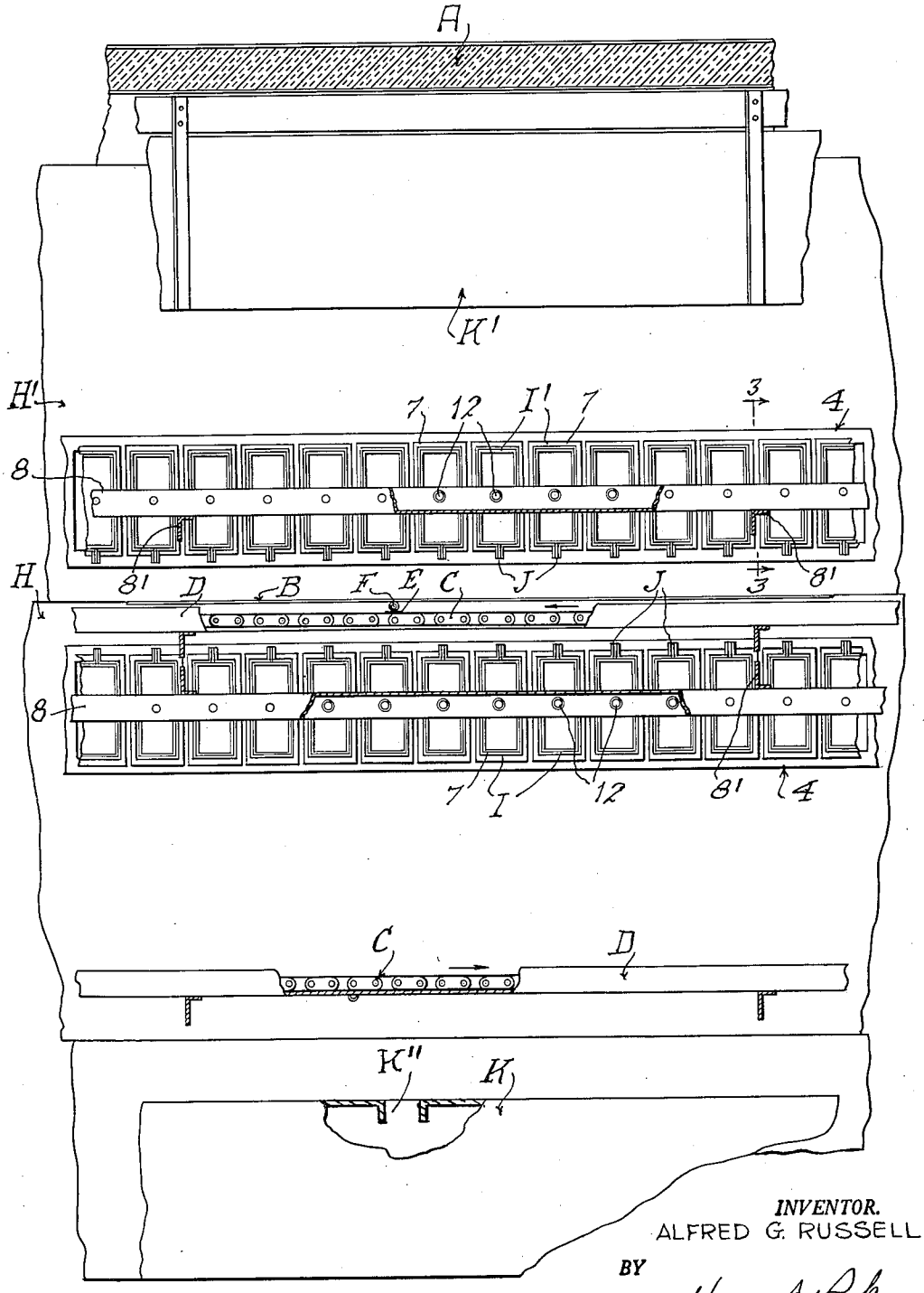


Fig. 2.

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TUBE TYPE DRYER

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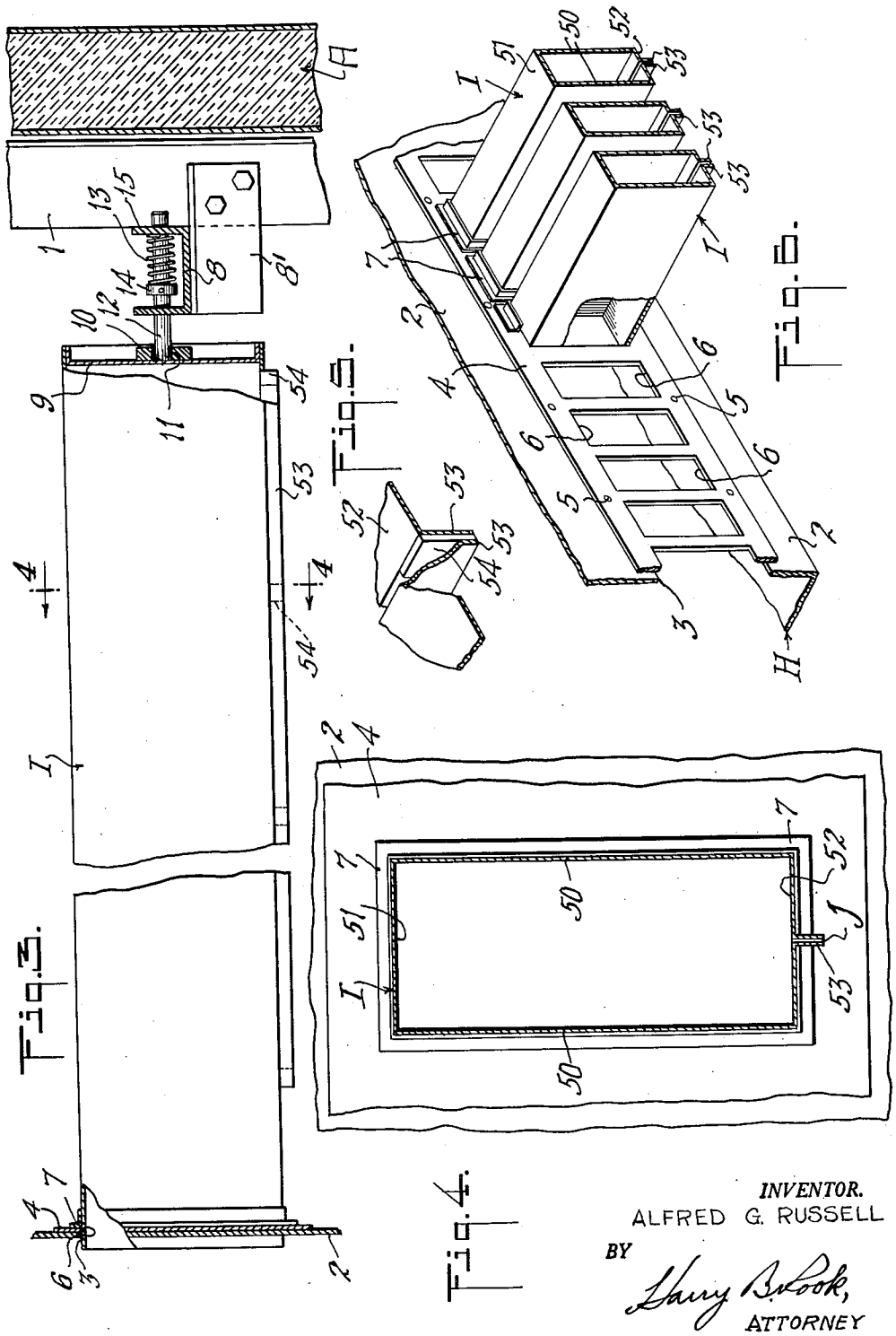


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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TUBE TYPE DRYER

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Fig. 7.

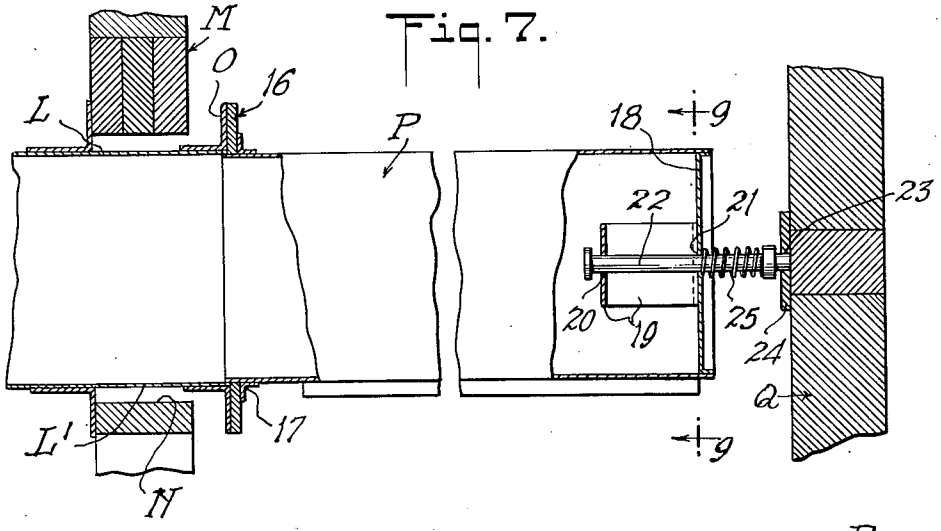
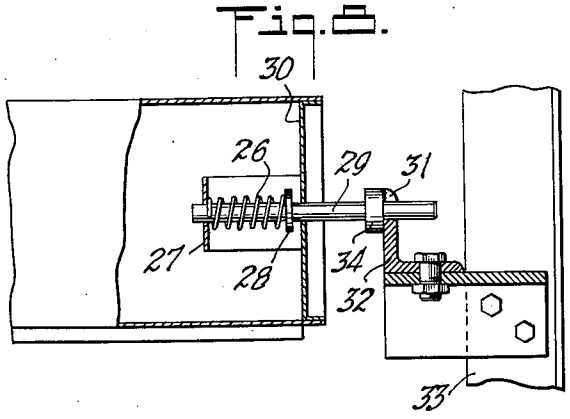


Fig. 8.



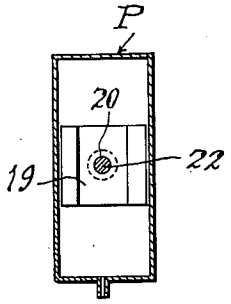


Fig. 9.

Fig. 10.

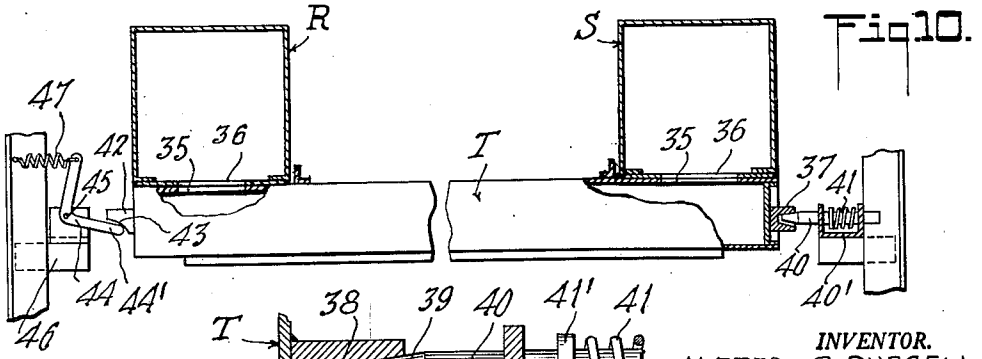
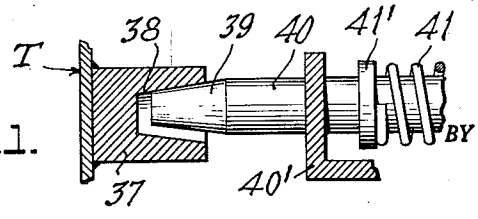


Fig. 11.



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TUBE TYPE DRYER

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Filed Jan. 7, 1960, Ser. No. 968
4 Claims. (Cl. 34—160)

This invention relates to apparatus for treating strip or web material such as fabrics, papers, pulp and other liquid containing or coated materials, by means of a fluid such as steam, air or other gases; and more particularly the invention is directed to apparatus such as so called high velocity dryers that include large conduits or headers for supplying the treating fluid such as steam or air, and fluid-distributing tubes each having at least one inlet end connected to and communicating with at least one of the headers or conduits and also having restricted outlet openings or nozzles for directing the treating fluid at high velocity onto the web or strip to be dried or otherwise treated.

Heretofore in machines of this general character, particularly machines for impregnating paper or textile webs with thermosetting resin, sometimes excessive amounts of resin are applied during adjustment and will drip on the nozzles, or the wet surface of the impregnated web will touch the nozzle if the web breaks or during the threading of the dryer. This resin has to be cleaned off to insure that the air flow is not blocked and also to insure that such accumulations of resin do not accidentally drop off onto the web. Difficulty has been encountered in installing the tubes and in replacing or removing them for repair and cleaning when necessary due to the nature of the tube mounting means, difficulty of access thereto, corrosion of the parts, and accumulation of dirt. Also difficulty has been encountered frequently due to the lack of compensation for expansion and contraction and flexure of the header walls and the tubes as a result, for example, of changes in the ambient temperature or pressures and strains on the parts.

A primary object of the present invention is to provide in apparatus of this character, novel and improved means whereby the tubes can be easily and quickly mounted in and removed from the apparatus and connected to and disconnected from the associated header or conduit, for example, to facilitate repair and cleaning of the tubes.

A further object is to provide in such apparatus a quickly separable, for example, slidable, connection between one end of the tube and the header or conduit and also provide a quick-releasable means for separably connecting the other end of the tube to a support frame for ready access and manipulation, for example, adjacent an access door opening in the wall of the apparatus casing, whereby the tube can be connected to and removed from the header and the frame by an operator standing at one end of the tube adjacent said access door opening and without the necessity for reaching into the casing to the relatively inaccessible header.

Another object is to provide a novel and improved construction and combination of a header or conduit, a tube, and means for removably supporting the tube with at least one end thereof in separably connected relation to the header or conduit.

Still another object of the invention is to provide such a combination wherein the connection between the tube and the header is separable and normally maintained under spring pressure to permit easy and quick mounting and removal of the tube and to compensate for thermal expansion and flexure of the header or tube.

A further object is to provide a combination wherein connection of the end of the tube to the conduit shall include associated parts on the conduit or header and the

tube, one to fit within the other, a stop member limiting the relative movement of the tube and the header in one direction, and means for yieldingly longitudinally pressing the tube to cause abutment of said stop with the header so as to prevent accidental displacement of the tube from the header and yet permit easy and rapid disconnection of the tube from the header when desired.

It is a further object of the invention to provide a novel and improved tube of the general character described which shall be rectangular in cross-section and shall have integral lips extending longitudinally of one side of the tube held in spaced apart relation to each other by rigid spacers, thereby forming a simple and relatively inexpensive tube, and extensive distribution of the air through the outlet slots between said lips and the possibility of readily varying the cross-sectional area of the openings between the lips by the variations in the spacing of the lips.

Other objects, advantages and results of the invention will be brought out by the following description in connection with the accompanying drawings in which

FIGURE 1 is a schematic transverse vertical sectional view through a tube type dryer embodying the invention;

FIGURE 2 is a greatly enlarged fragmentary vertical longitudinal sectional view approximately on the plane of the line 2—2 of FIGURE 1 with portions broken away for clearness in illustration;

FIGURE 3 is an enlarged vertical sectional view approximately on the plane of the line 3—3 of FIGURE 2 with portions broken away and shown in section;

FIGURE 4 is a further enlarged transverse sectional view approximately on the plane of the line 4—4 of FIGURE 3;

FIGURE 5 is a fragmentary sectional perspective view through the discharge lips of the tube and one of the spacer blocks;

FIGURE 6 is a fragmentary perspective view, partially in section, of a portion of one wall of the header and portions of three tubes;

FIGURE 7 is a view similar to FIGURE 3 showing a modification of the invention;

FIGURE 8 is a view similar to FIGURE 7 showing one end of a tube and means for separably mounting the tube;

FIGURE 9 is a transverse sectional view on the plane of the line 9—9 of FIGURE 7;

FIGURE 10 is a view similar to FIGURE 3 on a reduced scale, illustrating another form of the invention; and

FIGURE 11 is a fragmentary vertical sectional view through the means for separably mounting one end of the tube on a support frame.

While the invention has been illustrated in connection with a generally known type of apparatus for drying or otherwise treating strip materials or webs, it will be understood that the invention may be utilized in other types of apparatus and apparatus wherein the web travels in vertical, horizontal, or cambered paths, within the spirit and scope of the invention.

Specifically describing the embodiment of the invention illustrated in FIGURES 1 through 6, the reference character A generally designates a housing or casing providing therein a treatment chamber through which a strip or web of material B is conveyed in horizontal position by a suitable conveyor which in the present instance is shown as including two horizontally spaced chains C slidably mounted on tracks D within the housing and driven by suitable means such as sprockets G and power operated drive means such as a motor (not shown), the chains supporting cross bars E that are spaced apart longitudinally of the chains and preferably have connected thereto helical springs F or the like on which the web B is laid so that

there is a minimum of area of contact between the web and the conveyor. One track D is shown as mounted on a vertical frame piece 1 in the housing while the other track D is shown as mounted on the inner side of one of two supply conduits or headers H for the treating fluid such as steam or air.

In the present instance two horizontal banks of fluid-distributing tubes I and I' have been shown, one bank above and one bank below the web B, and each of the tubes of one bank has one end connected to one of the headers H while each tube of the other bank has one end connected to the other header H', and the treating fluid is conducted from the headers through the respective tubes I and I' and their outlets J into contact with the corresponding sides of the web B, whereupon the treating fluid passes into outlet or exhaust ducts K and K' through slots K''.

In accordance with the invention each tube is removably mounted in the apparatus and has one end held in separably connected relation to the corresponding header under yielding or spring pressure; and preferably the spring pressure is applied through a connector device by which the other end of the tube is separably connected to a support element such as the frame 1.

More specifically describing the invention, one vertical wall 2 of each header has an opening therein to receive each tube, and as shown the said wall has a longitudinal slot 3 best shown in FIGURE 6 and a plate 4 extending across said slot and secured to said wall by suitable means such as rivets or bolts 5, said plate having openings 6 each to snugly slidably receive one end of one of the tubes. Each tube has a stop member or flange 7 in spaced relation to the end of the tube to abut the side of the plate 4 and limit insertion of the tube into the opening 6 as best shown in FIGURES 3 and 6. The plate 4 serves in the nature of an escutcheon plate or a back-up plate or support plate for the tubes.

The other end of each tube is separably connected to the support frame 1 by a connector device that is shown as including a channel 8 secured to the frame 1 by brackets 8' and projecting horizontally inwardly from the frame in spaced relation to the corresponding end of the tube. The said end of the tube that is opposite the header wall 2 is shown as closed by an end wall 9 that has a socket member 10 secured thereto and provided with a socket 11 to separably receive a pin or rod 12 that is horizontally slidably mounted in the channel 8 and is normally spring pressed inwardly toward the end of the tube by an helical spring 13 that is interposed between a collar 14 on the pin and one flange 15 of the channel 8.

With this construction, it will be observed that the tubes will be made of such length that they may be easily disposed endwise between the side wall of the header and the connector device. The tube can be easily and quickly mounted and connected to the header by retracting the pin 12 against the influence of its spring and simply slipping the open end of the tube through the corresponding opening 6 in the escutcheon plate 4 until the stop flange 7 abuts the escutcheon plate, after which the socket or recess 11 can be moved into alignment with the pin, whereupon the pin can be released so that its end is pressed into the socket by the spring 13. Obviously the tube can be as easily removed by simply withdrawing the pin 12 from the socket 11 and then pulling the end of the tube out of the opening 6 in the escutcheon plate. It will be observed that when the tube is connected to the header, the stop flange 7 also serves as a packing element to reduce the possibility of leakage of the treating fluid between the walls of the opening 6 and the tube.

With this construction, the mounting and removal of the tube may be easily and quickly effected, the tube is held in normally connected relation to the header under the pressure of the spring 13, and the spring may yield to

compensate for thermal expansion or flexure of the header wall and the tube.

A modification of the invention is shown in FIGURE 7 which is intended especially for use where the header is to be disposed outside the casing or housing, for example, where it is desired to mount rollers from the web in bearings that are spaced apart the minimum possible distance, and also to provide a less expensive apparatus. In this figure, the reference character L designates the main portion of the header that is disposed outside the casing wall M and which has an extension L' projecting through an opening N in the housing wall into the housing. On the inner end of the extension L' is mounted a flange O to which is secured the escutcheon plate or tube supporting plate 16 that may be identical with the plate 4. The tube P has one end slidably fitted into a corresponding opening in the escutcheon plate and also has a stop member 17 like the member 7 to abut said plate. The other end of the tube is closed by an end wall 18 on the inner side of which is rigidly secured a U-shaped bracket 19 that has in its base portion an opening 20 aligned with an opening 21 in the tube end wall 18 for slidably supporting a connector pin 22 that projects beyond the end of the tube with its outer end arranged to removably seat in a socket 23 formed in a plate 24 that is secured to the inner side of the other housing wall Q. The pin 22 is normally pressed into the socket 23 by a spring 25.

The operation of this form of the invention will be readily understood, the open end of the tube being removably connected to the header and the other end of the tube being yieldingly and separably connected to the support element or wall Q by the spring-pressed pin 22 and socket 24.

A somewhat similar construction and combination of parts is shown in FIGURE 8 wherein the spring 26 is interposed between the base portion of a U-shaped bracket 27 and a collar 28 welded on a pin 29 that is slidably mounted in the bracket and an opening in the end wall 30 of the tube. The outer end of the connector pin 29 is cooperative with a notch 31 in a bar 32 that is secured to the support element or frame 33, the pin preferably having a circumferential projection 34 to abut the flanges and normally exert spring pressure longitudinally of the tube to hold the open end of the tube connected to the header and to compensate for the thermal expansion or flexure of the header wall and tube.

Another form of the invention is shown in FIGURES 10 and 11 wherein there are two horizontally spaced headers R and S and the tube T has an opening 35 in the top wall thereof to register with a corresponding opening 36 for each header. In this form of the invention, the tube T is connected to and disconnected from the two headers by vertical movement of the tube instead of endwise movement as in the hereabove described constructions. For the purpose of illustration, different supporting means for the two ends of the tube are shown, both ends of the tube are closed and one end is shown as provided with a socket member 37 that has a socket 38 formed with beveled or tapered sidewalls that coact with a beveled or tapered surface 39 on a connector pin 40 that otherwise corresponds to the pin 12 and is slidably mounted in a support channel 40', so that as the spring 41 of the pin interposed between the channel and a collar 41' presses the end of the pin into the socket, the corresponding end of the tube will be elevated and pressed into contact with the header wall and at the same time the endwise movement of the tube, for example, due to expansion or contraction, will be compensated.

At the other end of the tube is mounted a block 42 having a cam surface 43 coacting with one arm of a bell crank connector element 44 that is pivotally mounted at 45 on the support element or frame 46 and is normally urged by a spring 47 to swing the arm 44' of the bell crank upwardly. With this construction, in mounting the tube, the bell crank arm 44' is pulled downwardly

and placed in contact with the cam surface **43** of the block **42** on the tube, with the end of the tube disposed beneath the corresponding header R. Thereupon the bell crank is released and the spring **47** elevates the end of the tube and presses it firmly into contact with the header wall. At the same time endwise or longitudinal movement of the tube is yieldingly limited.

As hereinbefore indicated, another feature of the invention is the tube itself which is shown as rectangular in cross-section and having side walls **50**, a top wall **51** and a bottom wall **52** intermediate the width of which are the outlets J which are formed by integral parallel lips **53** projecting from the bottom wall and rigidly held in predetermined spaced apart relation by spacer blocks **54** that may be welded to the lips and disposed in spaced relation to each other longitudinally of the lips. Desirably the side, top and bottom walls of the tube are made of one piece of sheet metal suitably shaped in dies and the lips **53** being formed by the ends of the sheet; and the closed end of the tube is formed by a separate piece of metal. With this construction it will be noted that there is an outlet passage or nozzle between each two adjacent spacer blocks **54** but that the passages are closely spaced so that in effect there will be a substantially continuous sheet of fluid discharged from each tube into contact with the web. Preferably, the spacer blocks of adjacent tubes are arranged in staggered relation.

Obviously the dimensions of the tubes will vary according to the conditions of intended use, as will also the lengths of the lips **53** and the spacing of the blocks **54**. The ratio of cross-sectional area of the tube to the area of the discharge openings or slots may be varied but preferably are such as to obtain substantially equal fluid distribution along the length of the tube. My experience shows that desirable ratios are of 2.5/1 upward to 10/1, the most desirable ratio being between 5/1 and 8/1.

It will be noted that the parallel side walls of the tubes make it possible to closely space the tubes where desired and to provide a greater range of spacing than would be possible if the tubes were for example circular and of the same cross-sectional area. While the distance of spacing of the lips **53** from the web may be greatly varied, a range of from one-quarter inch to four inches, depending upon the conditions of use, appears to give excellent results.

It will be observed that in the forms of the invention shown in FIGURES 1 through 9, one end of each tube has a quick-separable connection to a header or the like within a casing such as the casing A, while there is a quick-separable connection between the other end of each tube and a support element that is arranged adjacent an access opening A' that is normally closed by a door or removable wall section A", so that the tubes can be installed and removed by an operator standing at the second-mentioned ends of the tubes and adjacent the access opening. In other words, the tubes can be quickly removed and replaced without crawling or reaching into the casing to detach the tubes from their headers or other supporting structure.

Other modifications and changes in the structural details of the invention will occur to those skilled in the art as within the spirit and scope of the invention.

I claim:

1. Apparatus for treating a web of material with a gaseous fluid, comprising the combination with a housing providing a treatment chamber therein for material to be treated and having a frame piece therein, of a supply header for said gaseous fluid and a plurality of fluid-distributing tubes, said header having an opening therein for each tube and each tube having an inlet at one end thereof that is slidably removably inserted into said opening in the header and also having outlets for directing said fluid from said header to said web, the other end of said tube being closed and spaced from said frame piece, stop means comprising a flange encircling said tube adjacent said inlet end of the tube to abut the portion of said header that surrounds said opening for limiting movement of the tube into the header opening, and to limit leakage of fluid between the tube and the walls of said opening, a pin for each tube slidably mounted on the frame piece, a part on said closed end of the tube having a recess in which one end of said pin is seated, and a spring having one end abutting said frame piece normally biasing said pin into said recess and constantly exerting yieldable pressure on the tube to press and hold said flange in contact with said portion of the header that surrounds said opening.

2. Apparatus for treating a web of material with a gaseous fluid, comprising the combination with a housing providing a treatment chamber therein for material to be treated and having a frame piece therein, of a supply header for said gaseous fluid and a plurality of fluid-distributing tubes, said header having an opening for each tube and each tube having an inlet at least at one end thereof communicating with said header opening and each tube also having outlets for directing said fluid from said header to said material, said inlet end of each tube being slidably inserted into said opening in the header and the other end of each tube being closed and spaced from said frame piece, and there being means for removably mounting said tube in said housing with a portion of the tube that surrounds said inlet in abutting contact with the portion of said header that surrounds said opening, said means including at least one part on said frame piece in the housing, another part on said tube, one of said parts having a recess to separably receive a portion of the other part, and a spring coacting with said parts providing for application by said spring of yieldable pressure on said closed end of the tube to support the tube at its closed end and hold said portion of the tube surrounding said inlet in contact with said portion of the header that surrounds said opening.

3. Apparatus for treating a web of material with a gaseous fluid, comprising the combination with a housing providing a treatment chamber therein for material to be treated, and having a frame piece therein, of a supply header for said gaseous fluid and a plurality of fluid-distributing tubes, said header having an opening therein for each tube and each tube having an inlet at one end thereof that is slidably removably inserted into said opening in the header and also having outlets for directing said fluid from said header to said material, the other end of said tube being closed and spaced from said frame piece, stop means comprising a flange encircling said tube adjacent said inlet end of the tube to abut the portion of said header that surrounds said opening for limiting movement of the tube into the header opening, and to limit leakage of fluid between the tube and the walls of said opening, a pin slidably mounted in and projecting from the closed end of the tube, a part on said housing having a recess in which one end of said pin is seated, and a spring on the projecting end of said pin having one end connected to said pin and its other end abutting the closed end of the tube providing for application of constantly yielding pressure on said tube to press and hold said flange into contact with said header.

4. Apparatus for treating a web of material with a gaseous fluid, comprising the combination with a housing providing a treatment chamber therein for material to be treated and having a frame piece therein, of a supply header for gaseous fluid and a plurality of fluid-distributing tubes, said header having an opening therein for each tube and each tube having an inlet at one end thereof that is slidably removably inserted into said opening in the header and also having outlets for directing said fluid from said header to said material, the other end of said tube being closed and spaced from said frame piece, stop means comprising a flange encircling said tube adjacent said inlet end of the tube to abut the portion of said header that surrounds said opening for limiting move-

ment of the tube into the header opening, and to limit leakage of fluid between the tube and the walls of said opening, a pin slidably mounted in said closed end with its opposite ends projecting into and out of the tube, respectively, and said closed end having an inwardly extending bracket, a part on said housing having a recess in which the outwardly projecting end of the pin is seated, a spring within said tube on the inwardly projecting end of said pin with one end connected to said pin and the other end connected to said bracket on the closed end of the tube, said outwardly projecting end of the the pin having a collar to abut said part on the housing, providing for application of constantly yielding pressure on said

tube to press and hold said flange in contact with the portion of the header that surrounds said opening.

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