

June 23, 1953

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2,642,952

COLLECTING PLATE ASSEMBLY FOR ELECTROSTATIC PRECIPITATORS

Filed Feb. 4, 1950

4 Sheets-Sheet 1

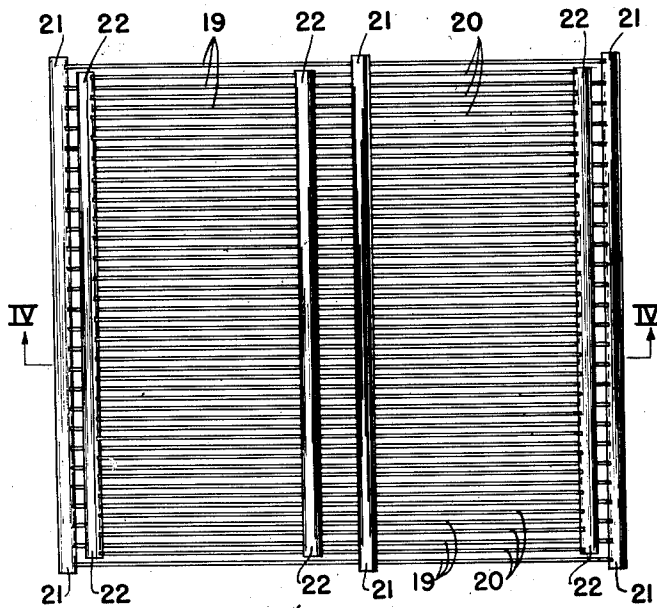


Fig. 1

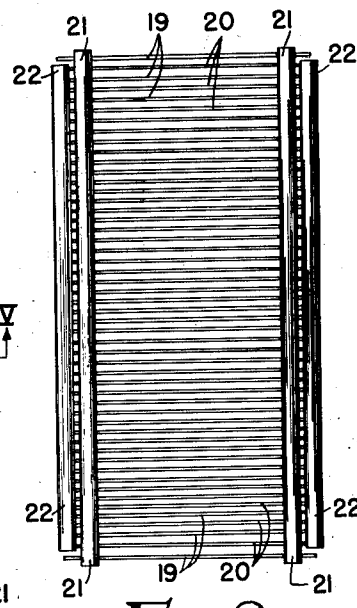


Fig. 2

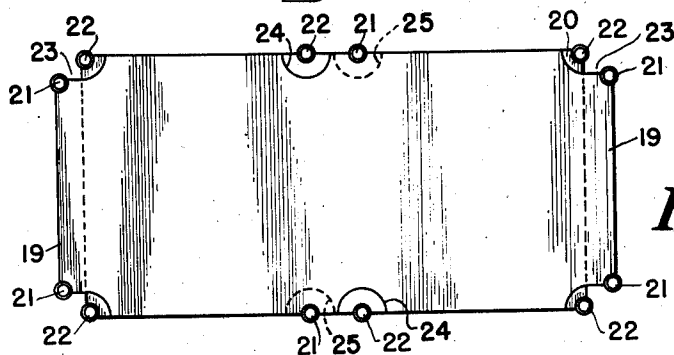


Fig. 3

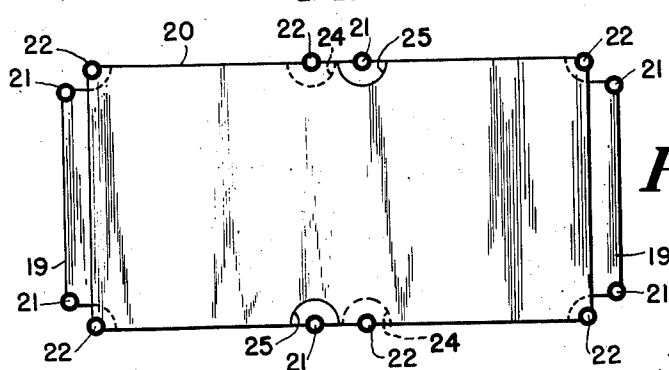


Fig. 4

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4 Sheets-Sheet 2

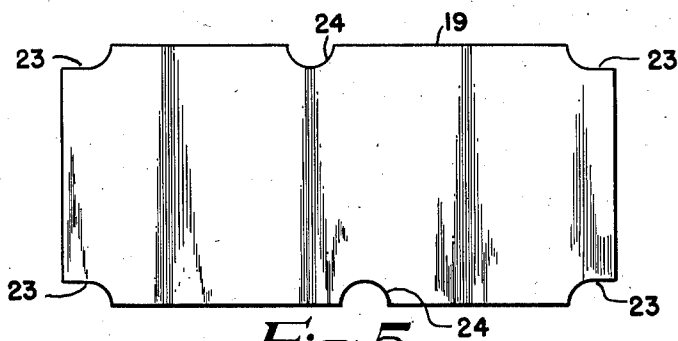


Fig. 5

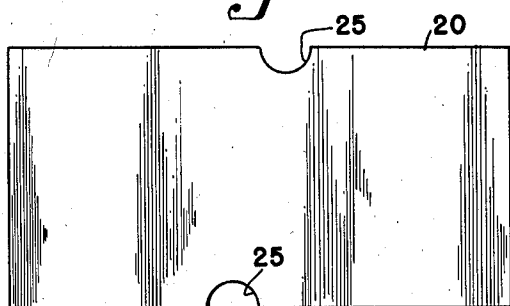


Fig. 6

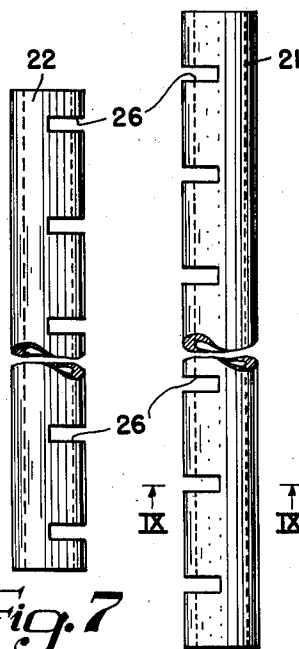


Fig. 7

Fig. 8

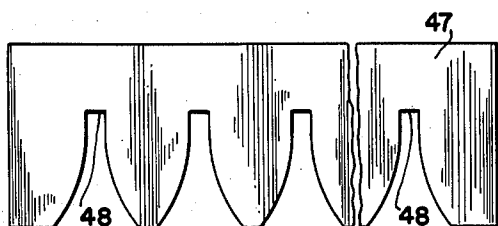


Fig. 16

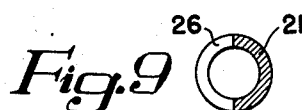


Fig. 9

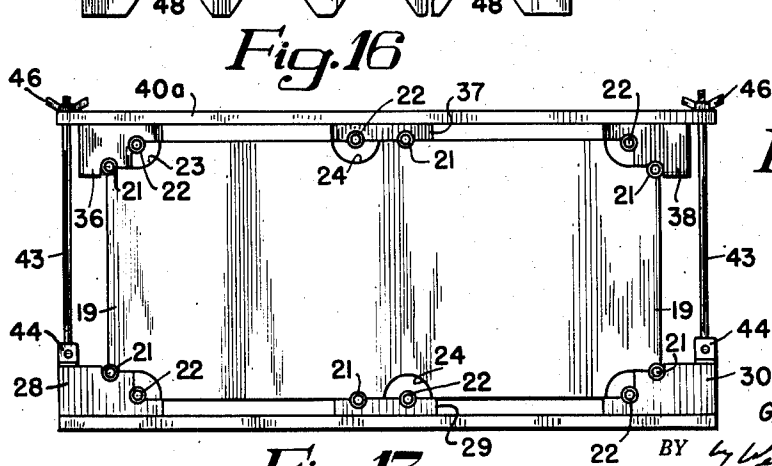


Fig. 17

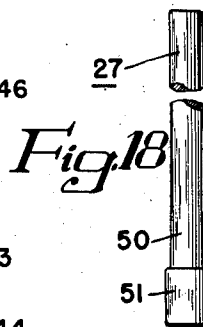


Fig. 18

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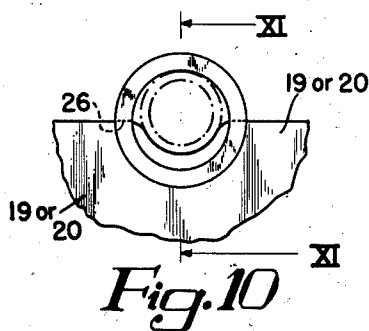
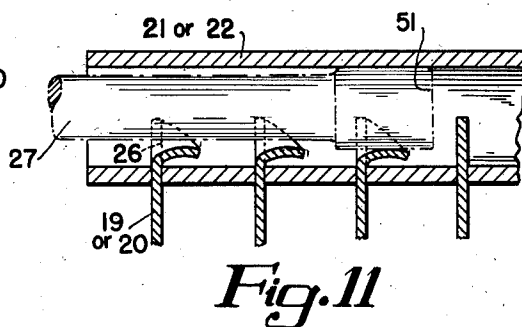
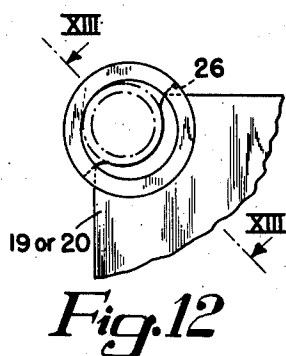
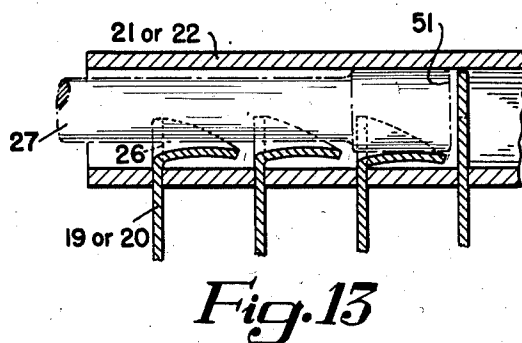
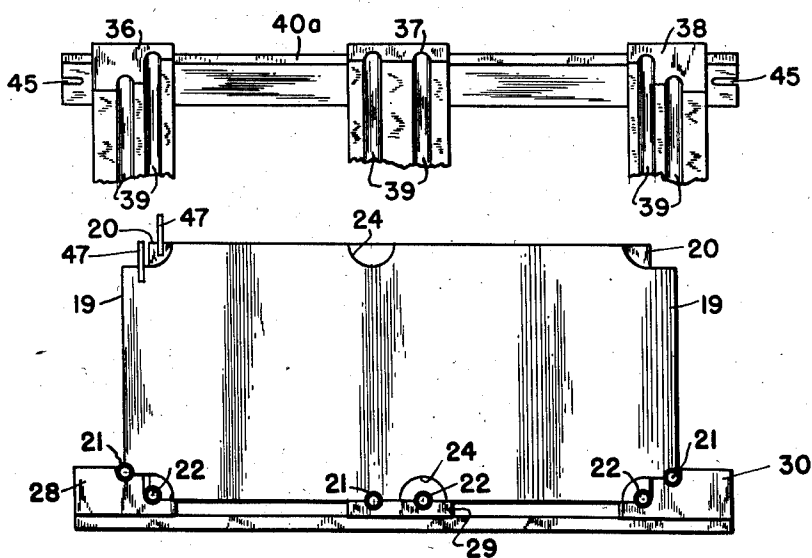
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4 Sheets-Sheet 3



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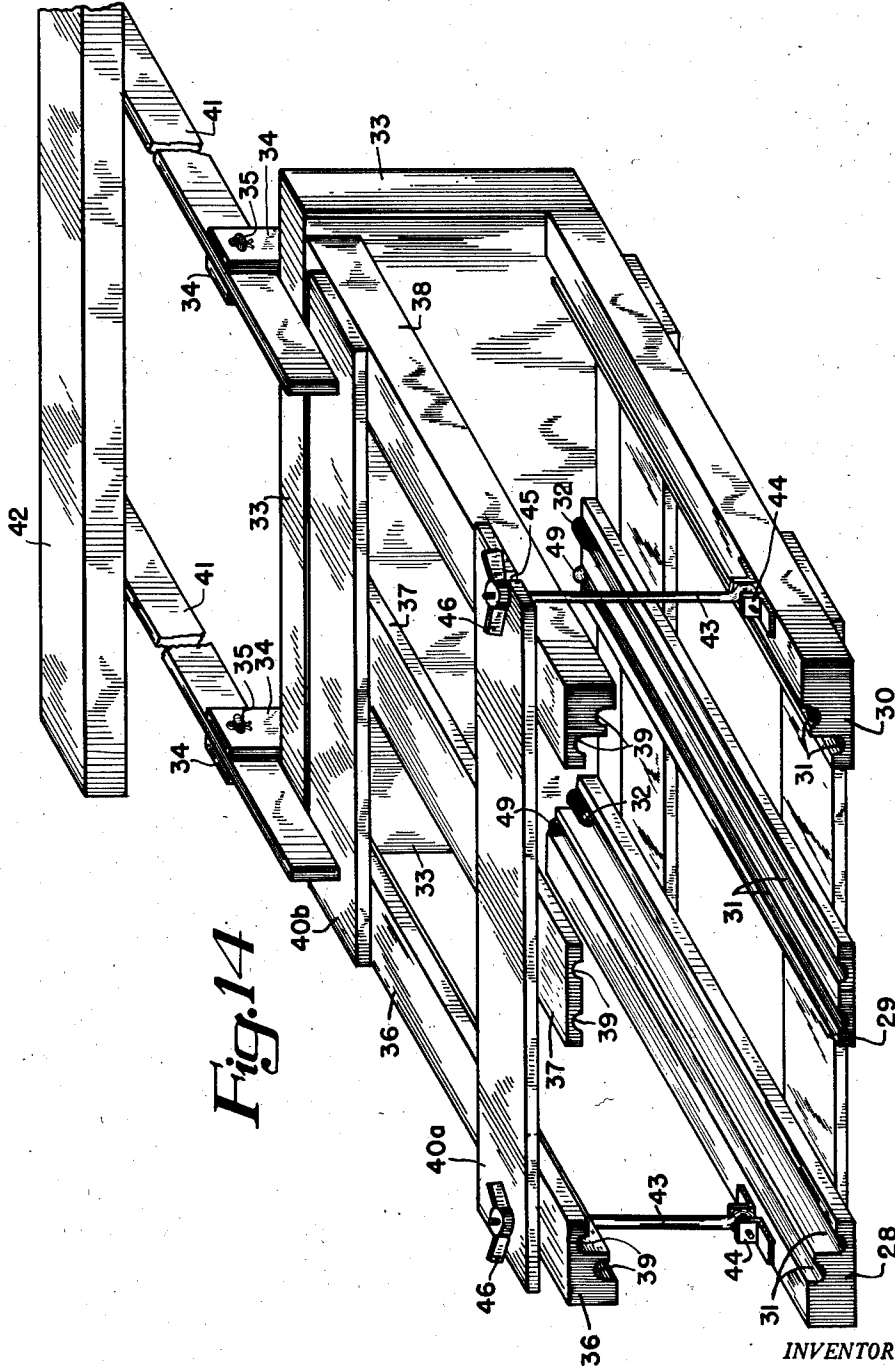
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COLLECTING PLATE ASSEMBLY FOR ELECTROSTATIC PRECIPITATORS

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4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,642,952

COLLECTING PLATE ASSEMBLY FOR  
ELECTROSTATIC PRECIPITATORSGeorge F. Landgraf, Pittsburgh, Pa., assignor to  
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Application February 4, 1950, Serial No. 142,382

3 Claims. (Cl. 183—7)

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This application relates to a collecting plate assembly for an electrostatic air filter. Collecting plate assemblies of the type to which this invention relates are used for gathering and retaining particles in the air being treated by the filter. Quite generally, the air particles have been ionized by passing the air through an ionizing unit before it passes through the collecting plate assembly. The plates are spaced a short distance from each other across the full width of the air passage through the filter so that all the air being treated passes between the plates. Adjacent plates carry opposite high electrostatic charges with the result that the particles in the air are attracted to one plate or the other according to the charges on the plate and on the particle and are held by that plate until physically removed in some manner as by washing. Since adjacent plates are oppositely charged, it is obvious that alternate plates will have the same charge and that the series of plates having the same charge will be insulated from the series of plates having the opposite charge. It is also important that the plates be spaced equidistantly from each other and parallel to each other. Various forms of construction for these collecting plates have been proposed in the past. The one most commonly used heretofore comprises punching holes through the plates adjacent their ends and passing rods through these holes. The plates are kept the proper distance from each other by metal washers strung on the rods. This creates a rather time consuming assembly operation since the rods must first be placed in a vertical position and then plates and washers added thereto in alternate layers. Frequently also the washers do not have exact dimensions so that the plates are not equidistantly spaced from each other or parallel to each other.

I have invented a collecting plate assembly in which the plates are permanently and securely held in proper position to each other and which requires relatively simple assembly operations which are disclosed and claimed in my copending application Serial No. 332,137, filed January 21, 1953. Generally speaking, my assembly comprises two series of plates which are separately mounted and which are each held in position by metal tubes which are secured to the plates adjacent their ends. The plates are secured to the tubes by forming a series of transverse slots along the tubes, the slots being spaced from each other the distance desired between the plates. Portions of the edges of the plates are inserted into these slots and these portions are then bent over

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within the tubes so as to securely hold the plates and tubes together.

In the accompanying drawings I have illustrated certain present preferred embodiments of my invention, in which—

Figure 1 is a plan view of my plate assembly;

Figure 2 is an end view of the assembly shown in Figure 1;

Figure 3 is a front elevation of the structure shown in Figure 1;

Figure 4 is a section along the lines IV—IV of Figure 1;

Figure 5 shows one of the plates of one of the two series of plates used in my assembly;

Figure 6 shows one of the other series of plates used in my assembly;

Figures 7 and 8 show tubes which I use to hold the plates in proper position;

Figure 9 is a section along the lines IX—IX of Figure 8;

Figure 10 is a fragmentary end view showing a tube assembled to a plate adjacent the midpoint of the plate;

Figure 11 is a fragmentary section along the lines XI—XI of Figure 10;

Figure 12 is a fragmentary end view showing a plate secured to a tube adjacent one end of the plate;

Figure 13 is a fragmentary section along the lines XIII—XIII of Figure 12;

Figure 14 is an isometric view of the jig which I have invented for assembling the plates;

Figure 15 is an end view of the jig shown in Figure 14 with parts broken away and showing some of the tubes and the plates in position in the jig;

Figure 16 is a broken side view of a tool useful for lining up the plates in the jig;

Figure 17 is a front elevation view of the jig shown in Figures 14 and 15 with the plates and all of the tubes assembled and with the jig closed; and

Figure 18 is a broken view of a tool which I have invented for securing the plates to the tubes.

Figures 1 to 4 show my collecting plate assembly. It comprises a series of plates 19 and a second series of plates 20, the individual plates being shown in Figures 5 and 6. Each series comprises a plurality of plates which are held in place by a set of tubes, the plates 19 being held by tubes 21 and the plates 20 being held by tubes 22. The plates 19 and 20 alternate across the plate assembly and are spaced equidistantly from each other. Air being treated passes

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through the plates in a direction parallel to their surfaces, that is, from left to right or from right to left viewing Figure 1 of the drawings.

Figures 5 and 6 show the plates 19 and 20 which make up the two series of plates in the complete assembly. Since a high potential difference is maintained between the plates 19 and the plates 20, the plates are cut out along their edges for clearance between the plates in one series and the tubes which support the plates of the other series. Thus the plates 19 are cut away at each of their corners as at 23 and adjacent their midpoints as at 24 to provide clearance for the tubes 22 which support the plates 20. The plates 20 are shorter than the plates 19 so that there is no problem of clearance between these plates and those of the tubes 21 which support the plates 19 at their corners. However, it is necessary to cut out edges of the plates adjacent their midpoints as at 25 so as to provide clearance for those of the tubes 21 which support the plates 19 adjacent their midpoints. As appears in Figures 5 and 6, the cut out portions 24 and 25 are slightly to one side or the other of the center of the plates so that the tubes 21 and 22 can extend parallel to each other and still be relatively close to the centers of those plates which they support (see Figures 3 and 4).

Figures 7 and 8 are broken views but on an enlarged scale of the tubes 21 and 22 which are used for holding the plates in the proper spaced relationship to each other. The tubes are cut to length from standard seamless tubing, preferably aluminum tubing. Slots 26 are then formed in the tubes as shown in Figures 7, 8 and 9. These slots which may be cut on a conventional circular gang saw are spaced along the length of the tube a distance from each other which is equal to the spacing desired between the plates of one series. As shown in Figure 9, the slots are cut approximately half way through the diameter of the tubes.

Figures 10 to 13, inclusive, show the manner in which the tubes and plates are secured to each other; Figures 10 and 11 showing the manner in which a tube is secured to the edge of a plate adjacent its midpoint and Figures 12 and 13 showing how a tube is secured to a corner of a plate. Referring first to Figures 10 and 11, a plate 19 or 20 is inserted in a slot 26 in the tube and the portions of the plate within the tube is bent within the tube as shown in Figure 11. In actual assembly operations I first insert all of the plates to be secured to a tube and then bend over all of the plates in one operation. Figure 11 shows in chain lines a tool 27 which I have found useful for bending over the plates within a tube. Referring now to Figures 12 and 13, a corner of a plate is inserted into a slot 26 and the corner is then bent over within the tube as shown in Figure 13.

Figure 14 shows a jig which I have invented for assembling the plates and tubes as described above. The jig comprises a base made up of three longitudinally extending members 28, 29 and 30. These members have circular troughs 31 which are designed to hold the tubes 21 and 22 in the position which they will have when the plate assembly is completed. Thus the troughs 31 in the members 28 and 30 hold the tubes 21 and 22 which engage the plates in the bottom corners and the troughs in the member 29 holds the tubes 21 and 22 which engage the edges of the plates adjacent their midpoints.

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The tubes 22 are shorter than the tubes 21 (see Figure 1) and therefore the troughs 31 which support these tubes carry stops 32 which position these tubes for assembly.

My jig also has a wall 33 which extends vertically from one end of the longitudinal members 28, 29 and 30. Vertical plates 34 are welded to the back of the wall 33 and pivotally support a top for the jig on pins 35. The top comprises three longitudinally extending members 36, 37 and 38 which have troughs 39 similar in design and purpose to the troughs 31 above described. The members 36, 37 and 38 are in effect mirror images of the members 28, 29 and 30. The members 36, 37 and 38 are held in proper position relative to each other by two plates 40a and 40b which extend from one side to the other of the jig. Lever arms 41 welded to the plate 40b are pivoted on the pins 35 and carry a counterweight 42 so that the top of the jig may be easily raised and lowered. The free end of the top of the jig is held down in proper position relative to the base by bolts 43 which are pivotally mounted in brackets 44 on the longitudinal members 29 and 30. The bolt may be slid into slots 45 cut in the plate 40a and the plates held down by wing nuts 46.

Figures 15 and 17 show steps in the manufacture of the plate assembly. Slotted tubes, such as shown in Figures 7 and 8, are placed in the troughs 31 of the end members 28, 29 and 30. The slots in the tubes placed in the corner of the members 28 and 30 are turned so that their bases form an angle of 45° with the horizontal. The slots in the tubes in the members 29 are placed so that their bases are horizontal. Thereupon, plates 19 and 20 are placed in the slots across the tubes. Slotted tubes, such as those shown in Figures 7 and 8, are then placed at the upper corners of the plates 18 and 20 and on the edges of the plates adjacent their midpoint. In order to place the tubes on the top edges of the plates with the edges extending into the tube slots, it is necessary to line up the top edges of the plates so that they will be spaced from each other a distance equal to the distance between the slots in the tubes. To facilitate this positioning of the plates I use a "comb" such as is shown in Figure 16. This comb is actually a strip of metal 47 with slots 48 which have been cut on the same gang saw that is used to form slots 26. As shown in Figure 16 the sides of the slots 48 are beveled to widen the slots at their open ends and guide the plates to their proper position at the closed end of the slot. The plates are then spaced properly so that a tube 21 or 22 can be placed on the plates with the plate edges in the slots. After the tubes are placed along the top edges of the plates, the top of the jig shown in Figure 14 is brought down over the assembly so that the tubes along the top edges of the plates fit into the troughs 39 in the longitudinal members 36, 37 and 38. The assembly is then clamped in the jig by moving the bolts 43 into the slots 45 in the plate 40a of the jig and turning down the wing nuts 46. Thereupon a tool 27 (see Figure 18) is driven through the tubes to bend over the portions of the plates within the tubes as shown in Figures 11 and 13. In order to drive the tool 27 from one end of each tube to the other end of the tube and withdraw the tool in the same direction as it entered, holes 49 are drilled in the end wall 33 of the jig in line with the interior of the tubes when they are resting

in the troughs 31 and 39 so that the tool 27 can be withdrawn from the rear side of the jig. After the assembly has been completed as described above, it can be removed from the jig and long bolts threaded at each end passed through the tubes so that the assembly can be bolted in place in the housing of an air filter. These bolts serve not only to hold the assembly in the housing but also further secure the plates to the tubes in that they fill up the free space in the tubes left by the bent over portions of the plates and thus prevent movement of the plates relative to the tubes.

Figure 18 shows the tool which I have invented for bending over the edge portions of the plates within the tubes. The tool comprises a rod having an elongated body portion 50 which, as shown in Figures 11 and 13, has an outer diameter less than the interior diameter of the tubes 21 or 22. The body portion 50 carries at one end an enlarged head 51 which has a diameter larger than the body portion 50 but which is still less than the interior diameter of the tubes 21 or 22. The length of the head is less than the distance between the plates. I have found that after a rod is driven partially through a tube to bend over the plates within the tube, a very considerable amount of friction develops between the rod and the plates and the sides of the tubes. If I use a rod with an enlarged front end or head, the plates which are bent over by this head leave clearance for the body portion 50 with the result that at any particular instant there is a frictional grip between the tool and only one plate.

It will be noted that the lines formed by the intersection of the plates in the slots with the inside surface of the tubes are curved. Therefore, when the plates are bent over within the tubes by driving through them the tool shown in Figure 18, the portions of the plates within the tubes are bent along a curved line. They are not bent along a straight line in the manner in which tabs have heretofore been used to fasten two pieces of metal together.

Because the portions of the plates within the tube are bent along a curved line, there results an actual deformation of the plate portions in the tube, as is evidenced by the fact that a considerable amount of force is required to drive the tool through the tubes. The head 51 is forced between the inner walls of the tubes and the portions of the plates within the tubes, and it has been found that pressure of the head on the plates actually thickens the plates adjacent the slots so that they are expanded into tight engagement with the edges of the slots.

From the foregoing description it is apparent that I have invented a collecting plate assembly for an air filter which meets all of the rigid requirements for such an assembly, but which at the same time can be readily manufactured. The two different series of plates making up the as-

sembly can be stamped out. The tubes for holding the plates are a standard article of manufacture and can easily be prepared for use in my assembly by slotting them on a conventional circular gang saw. The jig which I have invented for holding the plates and tubes in position reduces the time of the assembly operation to a minimum. The plates are always accurately spaced relative to each other since the individual blades of a gang saw can be spaced from each other very accurately. The distance between the plates is not dependent upon the varying thickness of mass produced washers.

While I have described certain present preferred embodiments of my inventions, it is to be understood that they may be otherwise variously embodied within the scope of the following claims.

I claim:

1. A collecting plate assembly for an electrostatic air filter comprising a plurality of plates spaced from but parallel to each other and extending the length of the assembly, and hollow tubes extending generally at right angles to the plates and having transversely extending slots spaced along their lengths, the slots extending only part of the distance across the tube, the distance between the slots corresponding to the distance between the plates, said plates having portions of their edges extending into said slots and bent over along a curved line within said tube towards the inside surface of the tube, said portions also having thickened sections adjacent the slots whereby a tight fit between the plates and the edges of the slots is obtained.

2. A collecting plate assembly as defined in claim 1 in which the hollow tubes extend across the plates at the corners of the plates.

3. A collecting plate assembly as defined in claim 1 in which the plates have cut out portions in their edges adjacent the midpoint of the assembly, the cut out portions of alternate plates being in line, and in which the hollow tubes lie at least partially in the spaces formed by the cut-outs, said tubes engaging the edges of alternate plates.

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# References Cited in the file of this patent

## UNITED STATES PATENTS

| Number    | Name       | Date          |
|-----------|------------|---------------|
| 728,118   | Lehrmann   | May 12, 1903  |
| 1,042,121 | Kerrigan   | Oct. 22, 1912 |
| 1,450,961 | Otterbein  | Apr. 10, 1923 |
| 1,516,877 | Anekee     | Nov. 25, 1924 |
| 1,697,316 | Horny      | Jan. 1, 1929  |
| 2,392,549 | Rice       | Jan. 9, 1946  |
| 2,441,208 | Roeder     | May 11, 1948  |
| 2,470,356 | MacKenzie  | May 17, 1949  |
| 2,476,248 | MacKenzie  | July 12, 1949 |
| 2,542,262 | Richardson | Feb. 20, 1951 |