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Cassill

[11] **3,787,883**

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[54] **DEFLECTION ELECTRODE ASSEMBLY FOR A JET DROP RECORDER**

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[73] Assignee: **The Mead Corporation,** Dayton, Ohio

[*] Notice: The portion of the term of this patent subsequent to Oct. 31, 1989, has been disclaimed.

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[21] Appl. No.: **317,074**

[52] **U.S. Cl.** **346/75,** 317/3

[51] **Int. Cl.** **G01d 15/18**

[58] **Field of Search** 346/75; 239/3, 15; 317/3

[56] **References Cited**

UNITED STATES PATENTS

3,701,476	10/1972	Houser	346/75 X
3,701,998	10/1972	Mathis	346/75
3,739,393	12/1973	Lyon et al.	346/75 X

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[57] **ABSTRACT**

There is disclosed a jet drop recorder which generates and switches two parallel rows of jets. The drops from the two rows of jets are selectively charged by two corresponding rows of charge rings and then pass on opposite sides of an electrically conductive strip which in cooperation with other elements of the generator provides an electrostatic deflecting field to deflect charged drops into one or another of a pair of drop catchers. The electrically conductive strip is relatively thin and is maintained in a straight, non-deformed configuration by taut stretching between the catchers.

8 Claims, 5 Drawing Figures

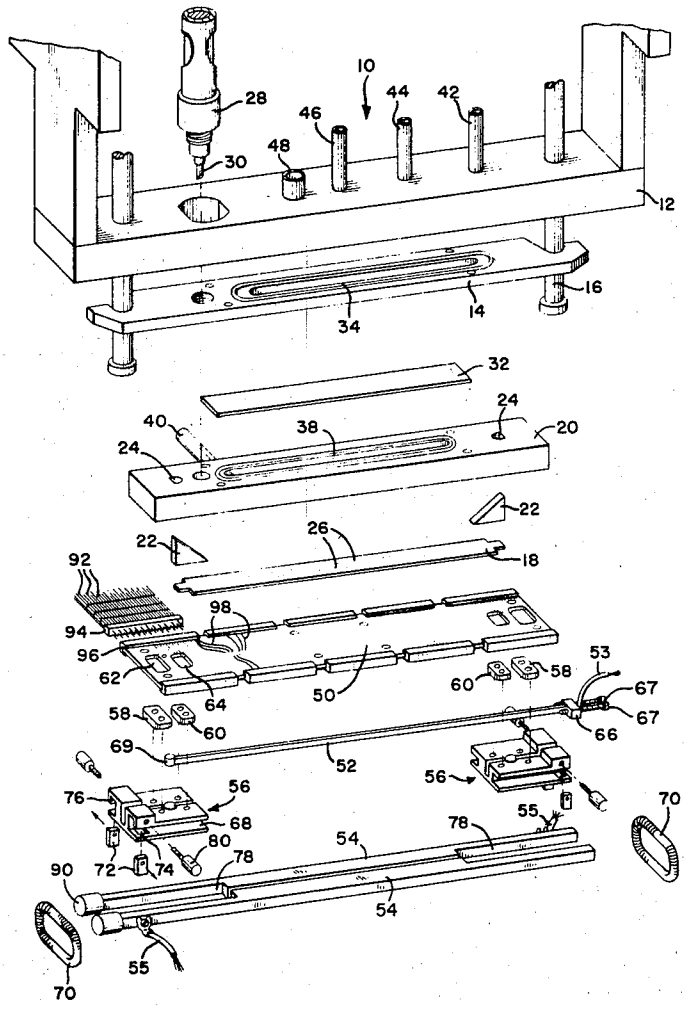


FIG-1

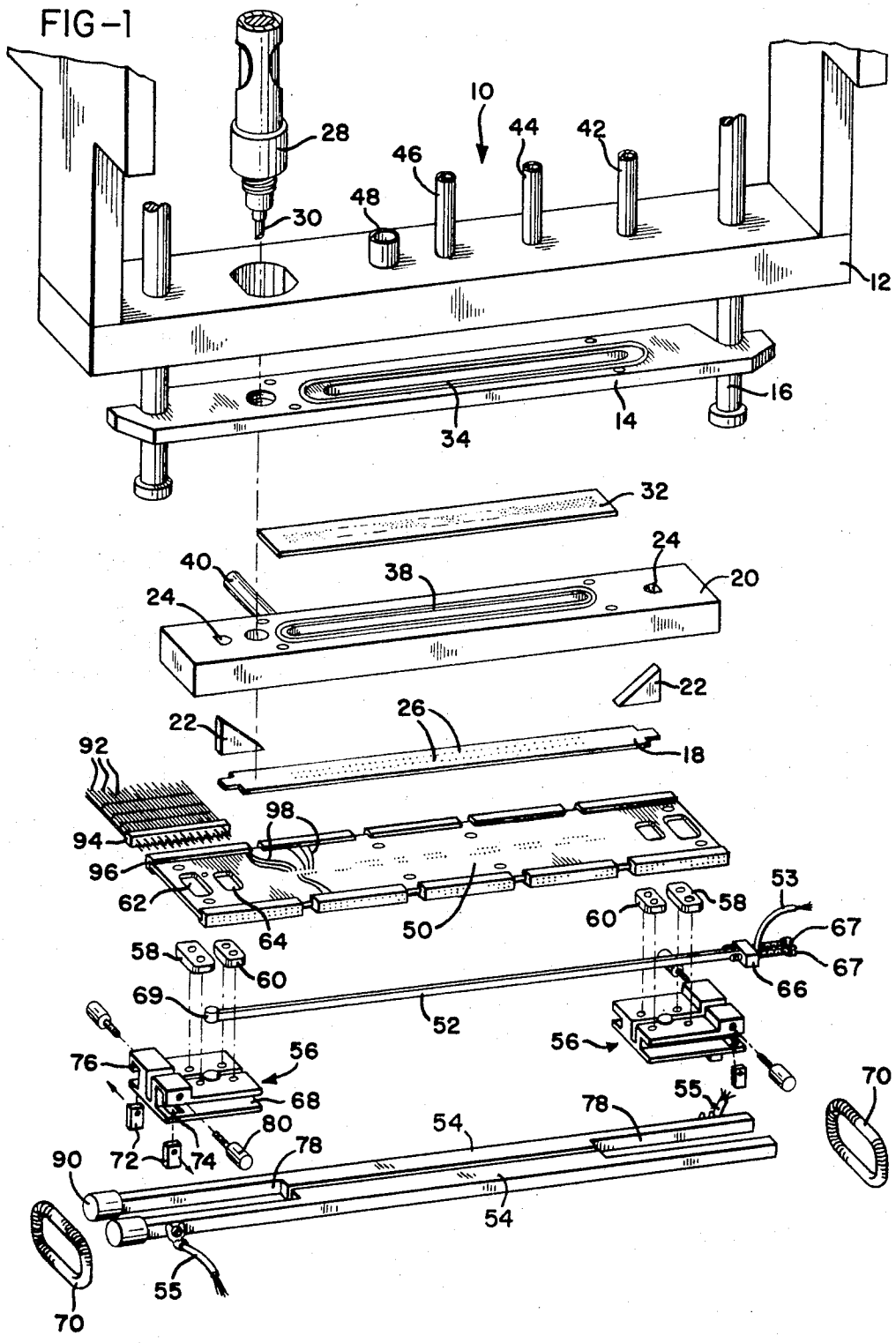

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FIG-1A

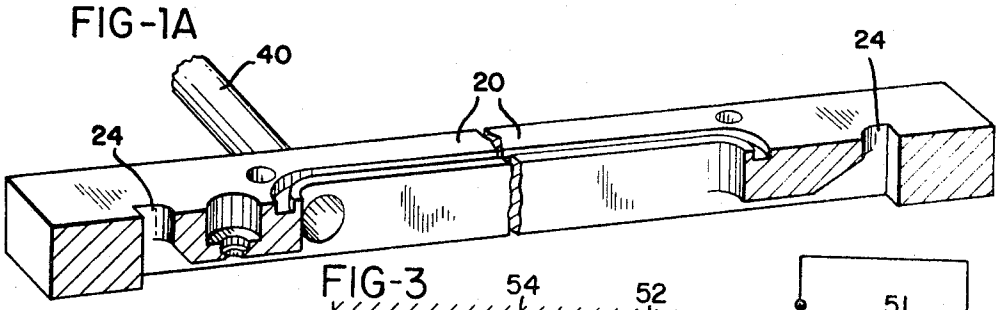


FIG-3

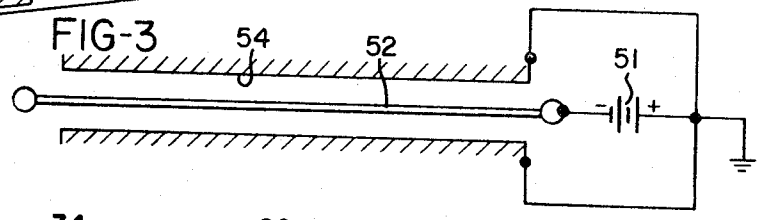


FIG-2

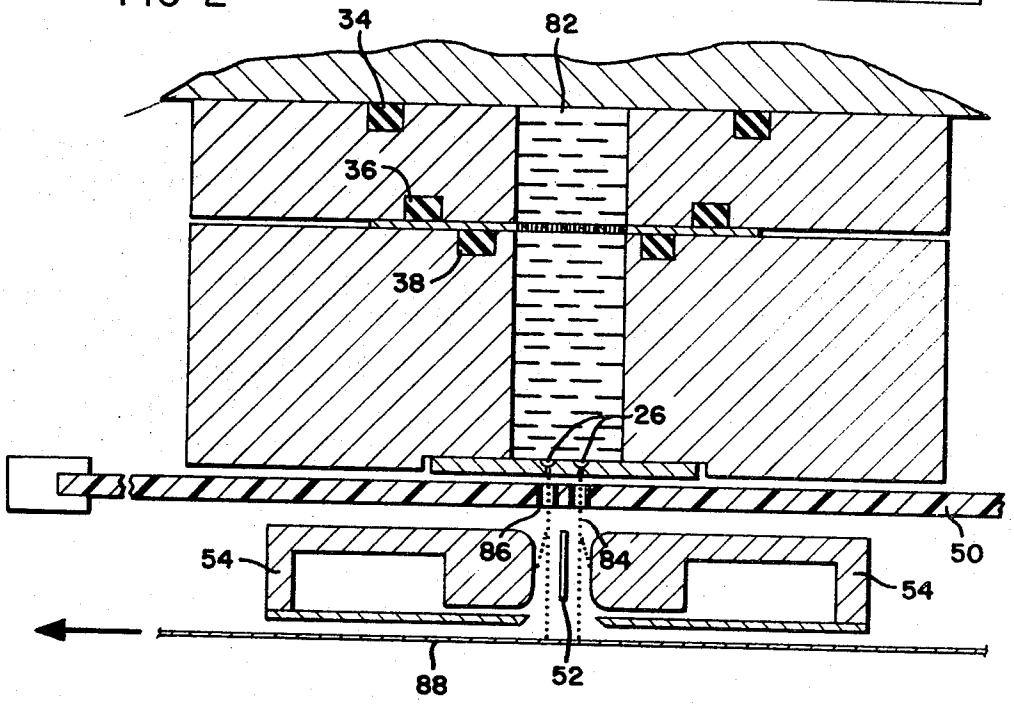
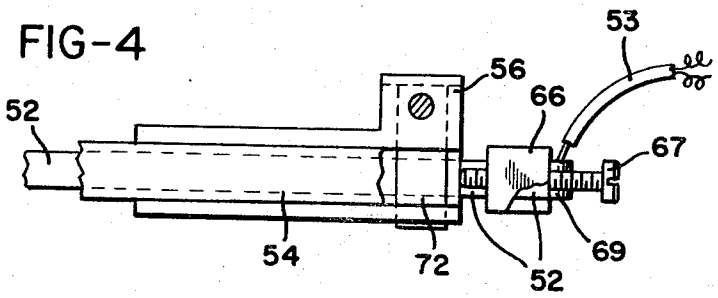


FIG-4



DEFLECTION ELECTRODE ASSEMBLY FOR A JET DROP RECORDER

BACKGROUND OF THE INVENTION

This invention relates generally to the field of fluid drop generation and the application thereof to jet drop recorders of the type shown in Mathis U.S. Pat. No. 3,701,998. In recorders of this type there are a pair of rows of orifices which receive an electrically conductive recording fluid, such as for instance a water base ink from a pressurized fluid manifold, and eject the fluid in two rows of parallel streams. These recorders accomplish graphic reproduction by selectively charging and deflecting the drops in each of the streams and thereafter depositing at least some of the drops on a moving web of paper or other material.

The above mentioned charging is accomplished by application of binary or ON/OFF charge control signals to charging electrodes positioned near each of the streams. As the drops separate from their parent fluid filaments they carry with them charges which are in effect samples of the charge control signals. Thereafter the drops pass through electrostatic fields which have no effect upon the uncharged drops but which cause the charged drops to be deflected for catching by one or the other of a pair of catchers which service the two rows of streams.

In order to accomplish such drop deflection in the limited space available in a compactly designed print head, it is necessary to provide a very straight and very thin deflection strip running the length of the active printing area and placed between the two catchers. Any irregularity or misalignment of the deflection strip will disturb the electrostatic fields present on both sides of the strip and interfere with the proper catching of the charged drops.

SUMMARY OF THE INVENTION

In accordance with the practice of the present invention there is provided a very thin electrically conductive deflection strip which is aligned between the above mentioned catchers and placed under tension to avoid any disfiguration thereof. Preferably the deflection strip is stretched between a pair of catcher holders with one end of the strip being grasped by one of the catcher holders and the other end of the strip being grasped by a tightening block having a pair of screws passing therethrough. The screws extend in a direction parallel to the deflection strip for contact with a face of the second catcher holder. The deflection strip may be positioned between the catcher holders in a slack condition and then drawn into a taut condition by adjustment of the tightening screws.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a recording head assembly;

FIG. 1*a* is a perspective view of a portion of the assembly of FIG. 1;

FIG. 2 is a cross section view through the assembly of FIG. 1;

FIG. 3 is a somewhat schematic representation of a preferred embodiment of an electrical circuit for the deflection strip; and

FIG. 4 is an enlarged and partially cut away view of a portion of one end of a recording head assembly.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1 of the drawings it will be seen that the various elements of a head assembly **10** are assembled for support by a support bar **12.** Assembly thereto is accomplished by attaching the elements by means of machine screws (not shown) to a clamp bar **14** which is in turn connected to the support bar **12** by means of clamp rods **16.**

The recording head comprises an orifice plate **18** soldered, welded or otherwise bonded to fluid supply manifold **20** with a pair of wedge-shaped acoustical dampers **22** therebetween. Orifice plate **18** is preferably formed of a relatively stiff material such as stainless steel or nickel coated beryllium-copper but is relatively thin to provide the required flexibility for direct contact stimulation. Preferably dampers **22** are cast in place by pouring polyurethane rubber or other suitable damping material through openings **24** while tilting manifold **20** (orifice plate **18** being attached) at an appropriate angle from the vertical. This is a two step operation as dampers **22** require tilting in opposite directions (See FIG. 1–A).

Orifice plate **18** contains two rows of orifices **26** and is preferably stimulated by a stimulator **28** which is threaded into clamp bar **14** to carry a stimulation probe **30** through the manifold **20** and into direct contact with plate **18.** Orifice plate **18,** manifold **20,** clamp bar **14** together with a filter plate **32** and O rings **34, 36,** and **38** (see also FIG. 2) comprise a clean package which may be preassembled and kept closed to prevent dirt or foreign material from reaching and clogging orifices **26.** Conduit **40** may be provided for flushing of the clean package. Service connections for the recording head include a coating fluid supply tube **42,** air exhaust and inlet tubes **44** and **46,** and a tube **48** for connection to a pressure transducer (not shown).

Other major elements comprising the recording head are a charge ring plate **50,** an electrically conductive deflection ribbon **52** and a pair of catchers **54.** Catchers **54** are supported by holders **56** which are fastened directly to fluid supply manifold **20.** Spacers **58** and **60** reach through apertures **62** and **64,** respectively in charge ring plate **50** to support holders **56** without stressing or constraining charge ring plate **50.** Deflection ribbon **52** is also supported by holders **56** and is stretched tightly therebetween by means of tightening block **66.** Ribbon **52** extends longitudinally between catchers **54** as best shown in FIG. **2.**

Catchers **54** are laterally adjustable relative to ribbon **52.** This adjustability is accomplished by assembling the head with catchers **54** resting in slots **68** of holders **56,** and urging them mutually inward with a pair of elastic bands **70.** Adjusting blocks **72** are inserted upwardly through recesses **74** and **76** to bear against faces **78** of catchers **54,** and adjusting screws **80** are provided to drive adjusting blocks **72** and catchers **54** outwardly against elastic bands **70.** Holders **56** are made of insulative material which may be any available reinforced plastic board.

The fully assembled recording head is shown in cross section in FIG. **2.** As therein illustrated coating fluid **82** flows downwardly through orifices **26** forming two rows of streams which break up into two curtains of drops **84.** Drops **84** then pass through two rows of charge rings **86** in charge ring plate **50** and thence into

one of the catchers **54** or onto the moving web of paper **88.** Switching of drops between "catch" and "deposit" trajectories is accomplished by electrostatic charging and deflection as hereinafter described. Coordinated printing capability is achieved by staggering the two rows of streams in accordance with the teachings of Taylor et al U.S. Pat. No. 3,560,641. As taught in that patent, the drops in the forward row of streams (i.e. the row most advanced in the direction of web movement) are switched in a time reference frame delayed from that of the rear row by a time *d*/V where d is the row spacing and V is the web speed. This produces a coherence such that the two rows of streams function as a single row with an effective stream spacing equal to half the actual spacing in either of the real rows.

Formation of drops **84** is closely controlled by application of a constant frequency, controlled amplitude, stimulating disturbance to each of the fluid streams emanating from orifice plate **18.** Disturbances for this purpose may be set up by operating transducer **28** to vibrate probe **30** at constant amplitude and frequency against plate **18.** This causes a continuing series of bending waves to travel the length of plate **18**; each wave producing a drop stimulating disturbance each time it passes one of the orifices **26.** Dampers **22** prevent reflection and repropagation of these waves. Accordingly each stream comprises an unbroken fluid filament and a series of uniformly sized and requlary spaced drops all in accordance with the well known Rayleigh jet break-up phenomenon.

As each drop **84** is formed it is exposed to the charging influence of one of the charge rings **86.** If the drop is to be deflected and caught, an electrical charge is applied to the associated charge ring **86** during the instant of drop formation. This causes an electrical charge to be induced in the tip of the fluid filament and carried away by the drop. As the drop traverses the deflecting field set up between ribbon **52** and the face of the adjacent catcher it is deflected to strike and run down the face of the catcher, where it is ingested, and carried off. Drop ingestion may be promoted by application of a suitable vacuum to the ends **90** of catchers **54.** When drops which are to deposit on the web **88,** no electrical charge is applied to the associated charge rings.

Appropriate charges for accomplishment of the above mentioned drop charging are induced by setting up an electrical potential difference between orifice plate **18** (or any other conductive structure in electrical contact with the coating fluid supply) and each appropriate charge ring **86.** These potential differences are created by grounding plate **18** and applying appropriately timed voltage pulses to wires **92** in connectors **94** (only one connector illustrated). Connectors **94** are plugged into receptacles **96** at the edge of charge ring plate **50** and deliver the mentioned voltage pulses over printed circuit lines **98** to charge rings **86.**

Charge ring plate **50** is fabricated from insulative material and charge rings **86** are merely coating of conductive material lining the surfaces of orifices in the charge ring plate. Voltage pulses for the above purpose may be generated by circuits of the type disclosed in Taylor et al, and wires **92** receiving these pulses may be matched with charge rings **86** on a one-to-one basis. Alternatively the voltage pulses may be multiplexed to decrease the number of wires and connectors. For such an alternative embodiment solid state demultiplexing circuits may be employed to demultiplex the signals and route the pulses to the proper charge rings. Such solid state circuits may be manufactured by known methods as a permanent part of charge ring plate **50.**

Deflection of those drops **84** which are to be caught is accomplished by setting up appropriate electrical fields between deflection ribbon **52** and each of the catchers **54.** The preferred arrangement for this function is shown in FIG. **3** wherein catchers **54** and one side of an electrical potential source **51** are all connected to a common ground. The other side of source **51** is connected to deflection ribbon **52** thereby setting up a pair of equal strength, oppositely directed electrical deflection fields. As illustrated in FIG. **3** with the ground at the positive side of source **51,** it is necessary that drops **84** be charged negatively in order to be caught. However, it is also possible to obtain mutual outward deflection of the two curtains of drops **84** by charging the drops positively and reversing the terminals on source **51.**

It will be appreciated that deflection ribbon **52** must be very thin, and straight for proper operation in a compactly arranged head. Moreover the deflection ribbon must be relatively tough and electrically conductive. Thus in preferred embodiment the deflection ribbon is fabricated from stainless steel about 0.010 inches thick. However, even stainless steel is flexible and readily deformable at such thicknesses, and therefore a special arrangement is employed to meet geometrical design requirements for the deflection ribbon. Accordingly deflection ribbon **52** is provided with an enlarged head **69** at each end and is stretched between catcher holders **56** as above mentioned. One of the heads **69** is grasped by the left hand holder as viewed in FIG. **1,** and the other head **69** is grasped by tightening block **66.** A lead wire **53** is soldered to one of the heads **69** as illustrated.

The operation of tightening block **66** is best illustrated in FIG. **4** wherein it may be seen that screws **67** extend through the tightening block to bear against a face of catcher holder **56.** Deflection ribbon **52** extends through a slot in tightening block **66** so that its enlarged head **69** may rest against the tightening block face. Thus screws **67** may be initially adjusted so that there is sufficient slack in deflection ribbon **52** for ease of head assembly. Later after catcher holders **56** are mounted in place with deflection ribbon **52** extending therebetween, screws **67** may be tightened to draw the deflection ribbon longitudinally and stretch it to a taut condition.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. In a twin row drop generator comprising means for generating two parallel curtains of drop streams, means for selective charging of the drops in said streams, and a pair of opposed catchers for catching of drops so charged; a deflection electrode assembly comprising:

an electrically conductive deflection ribbon oriented parallel to said curtains of drops and extending therebetween,

means for grasping said deflection ribbon at two spaced support points along the extent thereof and

supporting said deflection ribbon in spaced relation to said catchers, and

means for adjusting said grasping means to extend the distance between said support points and stretch said deflection ribbon to a taut condition.

2. Apparatus according to claim **1** said deflection ribbon being positioned midway between said catchers.

3. Apparatus according to claim **1** wherein said catchers are supported by a pair of catcher holders and said grasping means comprises a tightening block and one of said catcher holders.

4. Apparatus according to claim **3** said adjusting means comprising means for adjustably moving said tightening block relative to the other of said catcher holders.

5. Apparatus according to claim **4** said means for moving said tightening block comprising a pair of screws extending through said tightening block and bearing against a face of said other of said catcher holders.

6. In a twin row drop generator comprising means for generating two parallel curtains of drop streams, means for selective charging of the drops in said streams, and a pair of opposed catchers for catching the drops so charged; a deflection electrode assembly comprising;

an electrically conductive deflection ribbon oriented parallel to said curtains of drops and extending therebetween along a line midway between said catchers,

means for grasping and supporting one end of said ribbon, and

means for grasping the other end of said ribbon and stretching it to a taut condition.

7. Apparatus according to claim **6** said last named means being longitudinally adjustable for assembling said drop generator with said deflection ribbon in a slack condition and thereafter adjusting the deflection ribbon to said taut condition.

8. Apparatus according to claim **7** said deflection ribbon comprising a stainless steel strip approximately 0.010 inch thick and provided with an enlarged head at each end thereof.

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