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Duffield

[11] **3,777,307**

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[54] **CATCHER FOR A JET DROP RECORDER**

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

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[52] **U.S. Cl** **346/75,** 346/140

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

[58] **Field of Search** 346/75, 140

[56] **References Cited**

UNITED STATES PATENTS

3,611,422	10/1971	Rourke	346/75
3,701,998	10/1972	Mathis	346/75

Primary Examiner—Joseph W. Hartary

Attorney—Lawrence B. Biebel et al.

[57] **ABSTRACT**

There is disclosed an elongated catcher for use with a jet drop recorder which comprises a convex catching face and a recessed drop ingesting blade. The catcher is preferably grounded and positioned in spaced relation to an electrically charged deflection ribbon so as to create a static electrical field between the deflection ribbon and the face of the catcher. Drops of recording fluid which are deflected by the electrical field impact against the backwardly sloping upper portion of the catching face and then flow downwardly along the curving surface of the catching face to the upper surface of the blade. The captured recording fluid, which has preferably spread out into a continuous film, is then ingested into an internal cavity via a series of channels in the upper surface of the blade. To prevent build up of accumulated spray at the top of the catcher there is provided a porous upper surface which connects with a special compartment within the catcher. This compartment is separate from a larger main compartment into which is delivered the ink which is ingested by the blade. Each of these compartments has its own vacuum source for drawing off the liquid accumulated therein.

11 Claims, 6 Drawing Figures

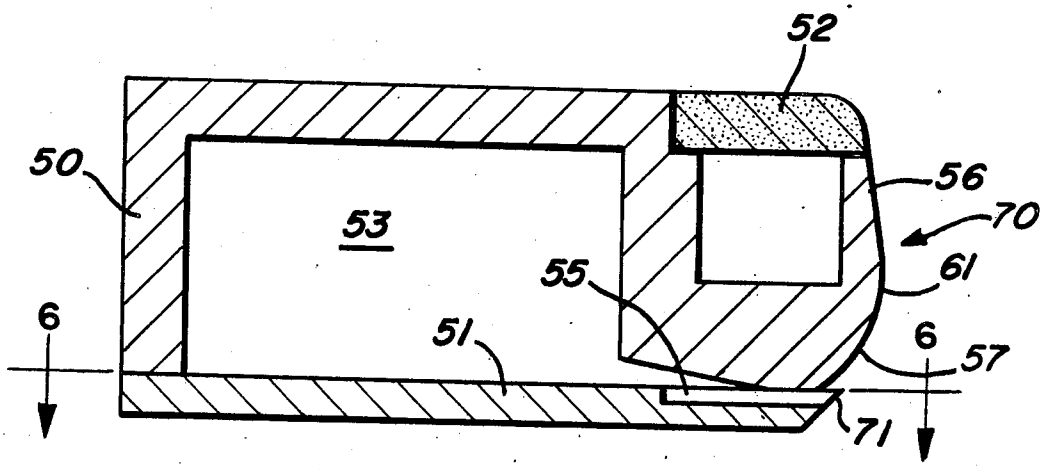
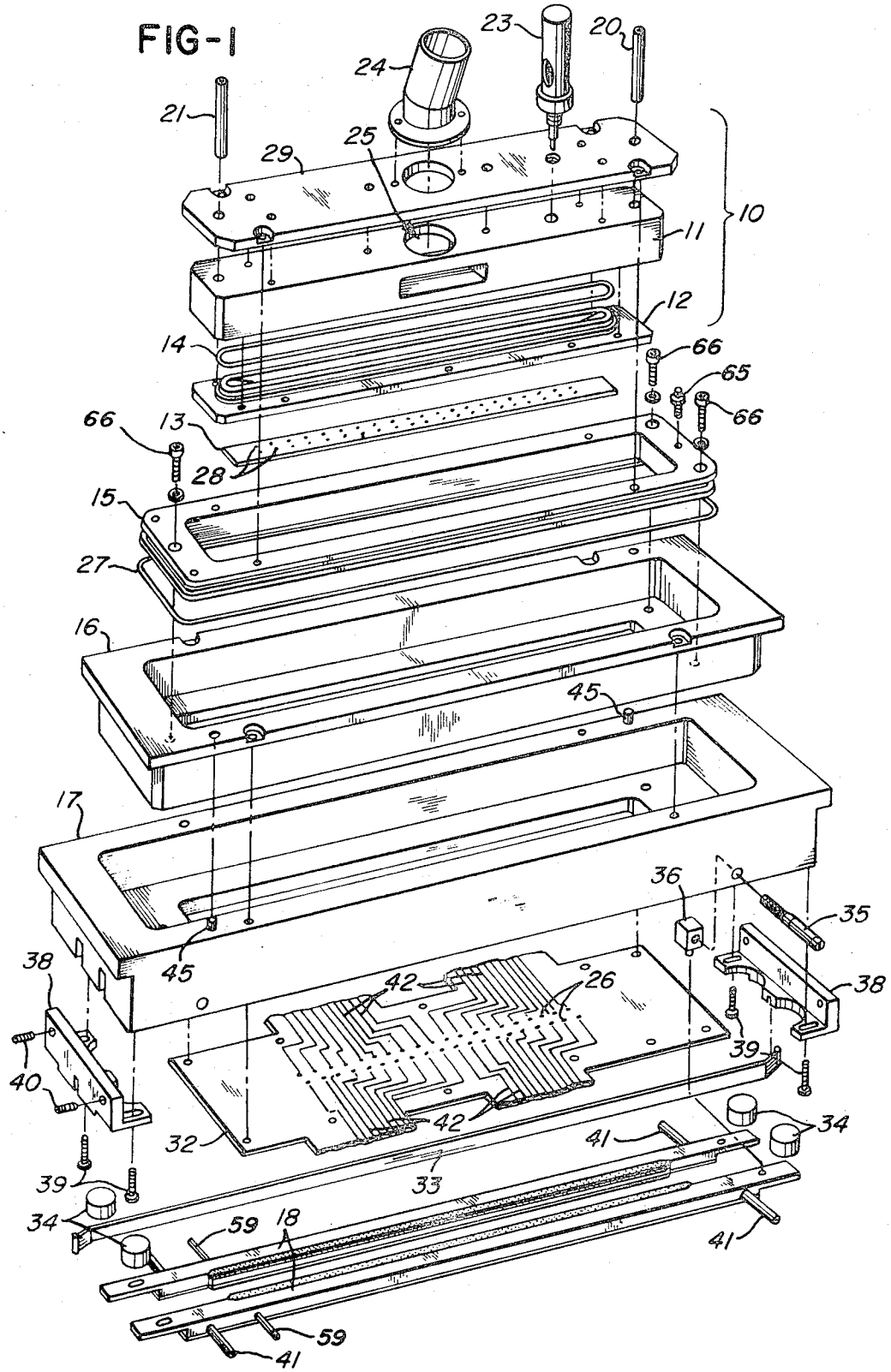


FIG-1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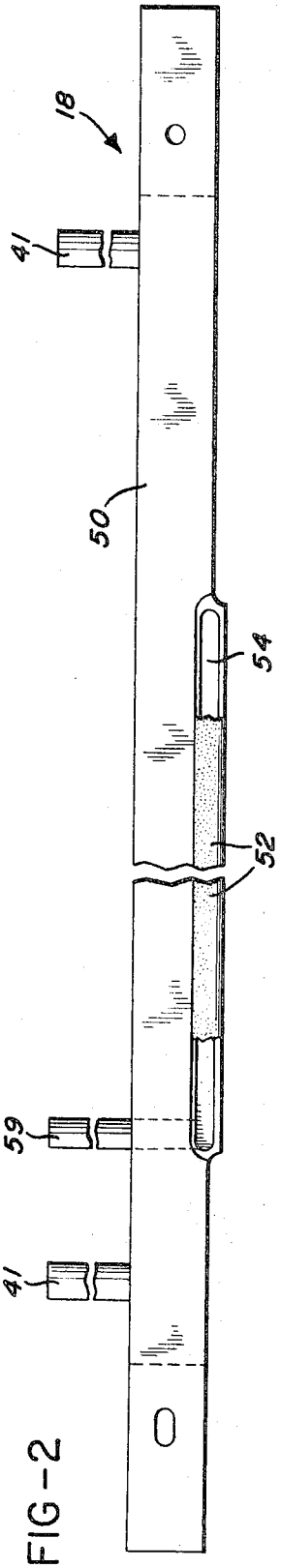

FIG-2

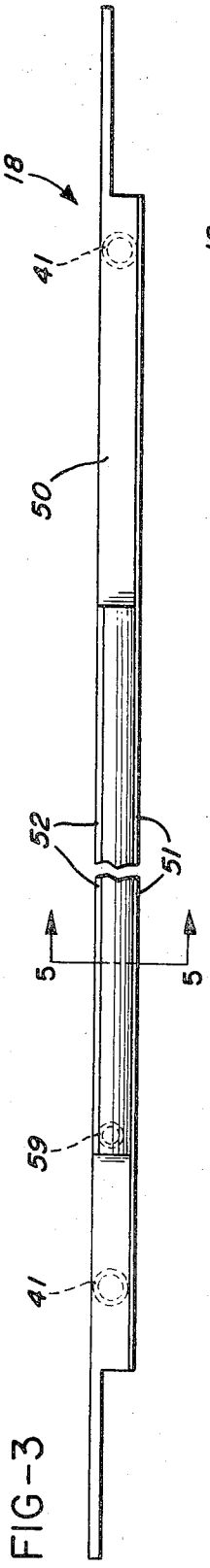

FIG-3

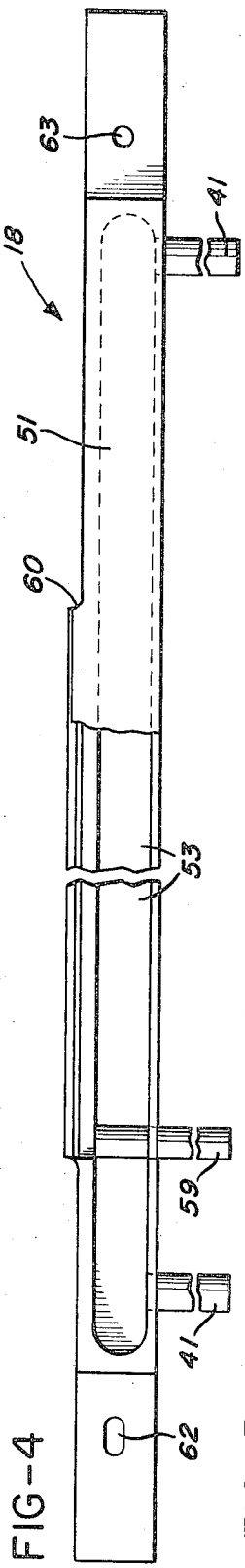

FIG-4

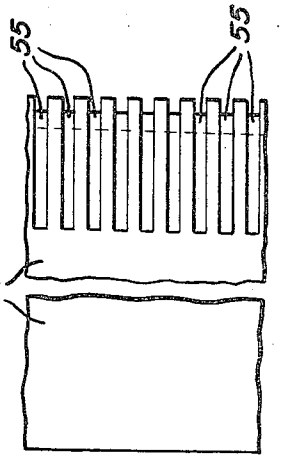

FIG-6

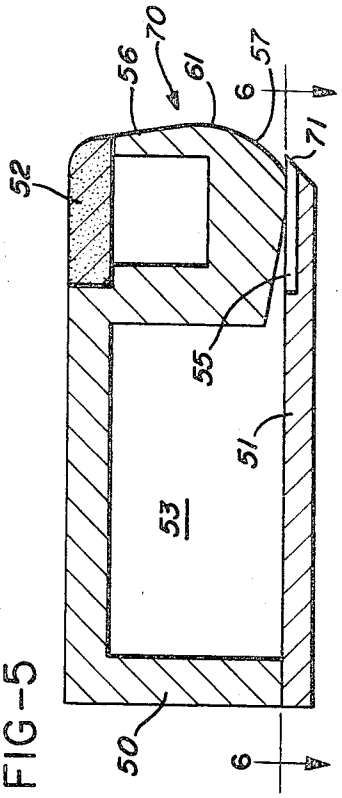

FIG-5

CATCHER FOR A JET DROP RECORDER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to application Ser. No. 317,076 and application Ser. No. 317,075 filed on even date herewith and to Ser. No. 277,999 filed Aug. 4, 1972, all of which applications are assigned to the assignee hereof.

BACKGROUND OF THE INVENTION

This invention relates to a recording head for jet drop recording apparatus, and more particularly to an elongated catcher for use in combination with such a recording head. Typical prior art catchers are shown in Sweet et al U.S. Pat. No. 3,373,437 and in Rourke U.S. Pat. No. 3,611,422. When using such prior art catchers in recording heads of the type shown in Beam et al U.S. Pat. No. 3,586,907 or, in heads of the type disclosed in Mathis U.S. Pat. No. 3,701,998, serious operating difficulties have been encountered. For instance, if the face of the catcher has a rough porous catching surface of the type disclosed in Sweet et al, then there is a tendency for drops to splatter upon impact thereagainst thereby creating a mist or spray which builds up on electrical components of the head and causes a shorting out thereof. On the other hand, if the droplets are caught by a blade as disclosed in Rourke, then there is a tendency for partially charged drops to strike the tip of the blade thereby splattering and causing ink buildup on the lower surfaces of the blade.

The capillary catcher which is disclosed in Ser. No. 277,999 offers one solution to the above problems, but catchers made in accordance with that invention are somewhat limited in the volume of ink which they can handle. Thus there has existed a requirement for an improved catcher which can handle relatively high fluid flow rates and which is compatible with a jet array arrangement as shown for instance in the Mathis patent or in arrangements such as those described in No. 317,076 and No. 317,075.

SUMMARY OF THE INVENTION

This invention provides an improved catcher having a convex drop catching face and a recessed liquid ingesting blade. The catching face is electrically connected to function as a deflection electrode so that drops of recording liquid which have been charged for catching are deflected to impact the catching face against the backwardly sloping upper portion thereof. Thereupon the captured recording liquid flows downwardly along the curving catching face surface for ingestion by the blade. The blade fits tightly against the lower surface of the catcher and ingests the liquid via a series of channels in the blade upper surface. Preferably the leading edge portion of the upper surface of the catcher is fabricated from a porous material for collection of any mist or spray which may arise due to drop satellites or other causes. This porous face communicates with a small cavity inside the catcher body which in turn communicates with a vacuum source. The spray which settles on the porous area thus is drawn off and build up is precluded. The ink which is ingested by the blade is carried into a second larger chamber within the catcher body and is also drawn off by a vacuum source.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded pictorial view of a jet array printer head incorporating the catcher of this invention;

FIG. 2 is a partially cut away top view of the catcher of this invention;

FIG. 3 is a front view of the catcher of FIG. 2;

FIG. 4 is a partially cut away bottom view of the catcher of FIG. 2;

FIG. 5 is an enlarged section view taken along lines 5—5 of FIG. 3; and

FIG. 6 is a view taken along lines 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the invention as incorporated into a jet drop recording head is illustrated in FIG. 1. The complete head as illustrated in FIG. 1 includes a manifold subassembly **10** which fits into a wobble plate **15**. Wobble plate **15** fits into an inner yoke **16** which in turn fits within a main yoke **17**. There are also provided a charge ring plate **32**, a deflection ribbon **33**, and a pair of catchers **18**, all of which are fastened to the lower surface of main yoke **17** as hereinafter described.

Manifold subassembly **10** comprises a manifold bar **11**, a cover plate **29**, an orifice plate holder **12**, and an orifice plate **13** which fit together as illustrated in FIG. **1**. Thus orifice plate holder **12** fits upwardly into a cavity in the lower surface of manifold bar **11**. Orifice plate holder **12** may be secured in place by screws (not shown) and a fluid tight seal is provided between orifice plate holder **12** and manifold bar **11** by an O-ring **14**. Orifice plate **13** is preferably soldered in place against the lower surface of orifice plate holder **12**. Manifold subassembly **10** is thus an integral unit which may be assembled and flushed clean prior to any association with any of the electrical components of the recording head.

As further illustrated in FIG. **1**, manifold bar **11** and cover plate **29** are provided with internal passages into which may be inserted an ink supply tube **20**, an ink return tube **21**, a stimulator **23**, and an air tube fitting **24**. Stimulator **23** has a probe which reaches downwardly for contact with orifice plate **13**. Orifice plate **13** is excited to propagate a series of traveling bending waves as described in detail in Lyon et al., Ser. No. 189,297, and stimulator **23** is rotatably adjustable as described in Houser, U.S. Pat. No. 3,701,476. Air tube fitting **24** is used for applying a flow of purging air to the recording head. A flow of air supplied by a fan or other means (not shown) flows downwardly through air tube fitting **24** and thence into an air cavity **25** in manifold bar **11**. The purging air then follows a path around orifice plate **13** to exit the recording head through charge ring apertures **26** in charge ring plate **32**. This keeps foreign matter out of the charge ring apertures and also provides a stabilizing effect for the liquid jets. The jet stabilizing effect, which forms no part of this invention, is described in Sweet U.S. Pat. No. 3,596,275.

Once assembled, manifold subassembly **10** is fitted downwardly into wobble plate **15** and fastened thereto as by screws (not shown). Wobble plate **15**, with manifold subassembly **10** attached thereto, is fitted downwardly into inner yoke **16** with an O-ring **27** therebetween. It will be appreciated that wobble plate **15** may

be adjusted upwardly or downwardly or tilted within inner yoke **16** for adjustment of jet filament lengths to meet requirements as discussed in Ser. No. 189,297. For this purpose there are provided three lifting screws **65** and three hold down screws **66.**

Independently of the assembly of manifold subassembly **10,** the electrical elements of the recording head may be assembled as a unit by fastening to main yoke **17** as illustrated also in FIG. **1.** Charge ring plate **32** is attached directly to the main yoke **17,** as are also catchers **18.** Charge ring plate **32** is fastened in place by a series of screws, and catchers **18** are secured by means of four cylindrical magnets **34** which are bonded into recesses in the lower surface of main yoke **17.** Magnets **34** are common insulated ceramic magnets which are commercially available from many sources. Preferably magnets **34** are made of barium-ferrite ceramic embedded in insulating plastic and are provided with lead-out pole pieces. Catchers **18** are preferably fabricated from a magnetic stainless steel material so that they are firmly grasped by magnets **34.**

Lateral adjustment of catchers **18** is provided by set screws **35** and adjusting nuts **36.** Each adjusting nut **36** is provided with a small downwardly projecting pin **37** which reaches into a mating recess **62** or **62** (see FIG. **4**) in the associated catcher **18.** Set screws **35** reach through openings in yoke **17** for threaded engagement with nuts **36.** Thus catchers **18** may be adjusted inwardly or outwardly to provide any desired spacing between the catcher faces and the surfaces of deflection ribbon **33.**

Deflection ribbon **33** is stretched between a pair of tension blocks **38** which in turn are fastened to main yoke **17** as by screws **39.** Tension blocks **39** are provided with set screws **40** so that the tension blocks may be adjusted back and forth in the longitudinal direction. Set screws **40** are initially adjusted to enable easy insertion of deflection ribbon **33** between tension blocks **38.** Thereafter deflection ribbon **33** is drawn to a taut condition.

In operation catchers **18** are connected to a common electrical potential source, and deflection ribbon **33** is connected to a source of different electrical potential, so that there are set up a pair of oppositely directed static electrical fields between deflection ribbon **33** and the faces **70** of catchers **18.** Droplets of recording liquid which are to be caught are impressed with an electrical charge during the formation thereof and thus are deflected away from ribbon **33** during their transmit through the above mentioned electrical fields. This deflection of the charged droplets causes them to impact against one or the other of catcher faces **70.**

As shown in FIG. **5** catcher faces **70** have a generally convex configuration comprising a backwardly sloping upper portion **56,** a recessed lower portion **57** and a nose or transition area **61.** Drops which are to be caught are deflected to strike the backwardly sloping face area **56** and then flow downwardly along the curve of the catcher face. Preferably the catcher faces **70** are finished sufficiently smooth to avoid drop splattering upon impact but not so smooth as to cause the downwardly flowing recording fluid to bead up into rivulets. Preferably also, the backwardly sloping face portion **56** slopes backwardly at an angle ranging between about **5** degrees and **20** degrees from the vertical, but a slope angle of about **10** degrees has been found to be nearly optimum for effective drop catching.

After the downwardly flowing recording fluid rounds tne nose area **61,** it flows across the area **57** and toward the blade **51.** Blade **51** has a projecting edge **71** which projects out away from the surface area **57,** but not as far outwardly as the nose **61.** Thus blade **51** intercepts only fluid flowing down the face **70** and does not catch any drops in free flight.

As shown by FIGS. **2** through **5,** a complete catcher **18** comprises a main body **50,** the blade **51** and a porous metal insert **52.** The main body **50** has a large elongated cavity **53** and a smaller elongated cavity **54.** The larger cavity **53** serves as collection chamber for fluid which runs down the catcher face and is ingested by blade **51.** Accordingly blade **51** covers the lower surface of main body **50** to close out the cavity **53.** Blade **51** fits tightly against main body **50** and protrudes slightly forward of the recessed lower portion of the catcher face. To enable ingestion of fluid by blade **51** there are provided a series of channels **55** as best seen in FIG. **6.** A pair of vacuum tubes **41** are connected to communicate with cavity **53** so as to draw off the ink accumulating therein. The vacuum provided by tubes **41** also provides a pressure gradient along channels **55** to cause ingestion of ink by blade **51.** In theory only one tube **41** is required, but is has been found that catcher operation is improved by providing vacuum at both ends of cavity **53.** As best seen in FIGS. **2** and **4** the catching face **70** of catcher **18** protrudes outwardly from the main body **50** as shown at **60.**

The smaller elongated cavity **54** runs substantially the full length of the catching face **70.** This cavity communicates with the upper surface of the catcher **18** and is closed out by the porous metal insert **52.** There is also a vacuum tube **59** which communicates with cavity **54.** In normal operation of a print head of the type shown in FIG. **1** there is created an unavoidable liquid mist or spray in the interelectrode space. This mist, which may be due to drop satellites or other causes, tends to accumulate on the leading edge portions of the upper surface of catchers **18.** In addition to the spray accumulation there may also be a build up of liquid on the top of the catcher in the event of a crooked jet. This build up if not removed may bridge across to the charge ring plate and cause electrolytic etching damage. In accordance with this invention any liquid accumulation at the top of the catcher is drawn through the porous metal **52** into the cavity **54.** Thereafter accumulations of liquid in cavity **54** are drawn off by tube **59.** There is no interconnection between cavity **54** and cavity **53** because of different vacuum requirements for the two cavities. Typically the catchers operate best with a vacuum in cavity **53** of about **12** inches of mercury, while a vacuum in the order of about **8** inches of mercury is satisfactory for cavity **54.**

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 jet drop recording apparatus comprising means for generating a row of parallel drop streams, means for selective charging of drops within said streams, means for establishing an electrical field to deflect those of said drops which are charged as aforesaid, and means for catching the drops so deflected, the im-

provement wherein said catching means comprises an ingesting blade and a convex catching surface, said surface having a drop catching first portion sloping backwardly away from the paths of said streams and a second portion curving downwardly and inwardly to carry liquid from said first portion to said blade.

2. The improvement of claim **1**, the angle of slope of said backwardly sloping surface ranging from about **5** degrees to about **20** degrees from the direction of said stream paths.

3. The improvement of claim **2** said angle of slope being about **10** degrees from the direction of said stream paths.

4. The improvement of claim **1** said catching means being provided with a porous area in the top wall thereof for ingestion of accumulated liquid.

5. The improvement of claim **1** said ingesting blade having a tip which projects outwardly away from said second surface portion a distance less than the maximum outward projection of said convex catching surface.

6. Catching apparatus for a jet drop recording head comprising:

an elongated main body provided with a fluid collection cavity and a convex working face; said face having a projecting nose portion, a drop catching surface sloping backwardly above said nose, and an inwardly recessed fluid guiding surface below said nose, and

a fluid ingesting blade arranged to receive fluid from said inwardly recessed lower surface and deliver it to said fluid collection cavity; said blade projecting outwardly from said recessed surface a distance less than the greatest outward projection of said nose.

7. Apparatus according to claim **6** said cavity being an elongated cavity in the lower surface of said main body and said blade being arranged to cover said cavity.

8. Apparatus according to claim **7** said blade being provided with a series of fluid conveying channels on the upper surface thereof.

9. Apparatus according to claim **8** further comprising means to remove accumulated fluid from the top surface thereof.

10. Apparatus according to claim **9** said main body being provided with an elongated second cavity in the upper surface thereof and said fluid removal means comprising a porous insert for said second cavity.

11. Apparatus according to claim **10** the angle of slope of said backwardly sloping surface being about **10** degrees from a tangent to said nose.

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