United States Patent

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[73] Assignee The Mead Corporation
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[54] ALIGNMENT SYSTEM FOR ARRAYS OF A NONCONTACTING PRINTER
12 Claims, 8 Drawing Figs.

[52] U.S. Cl. 239/536, 118/314, 346/75
[51] Int. Cl. B05b 1/14
[50] Field of Search ..... 239/536; 346/75; 118/313, 314, 320—325

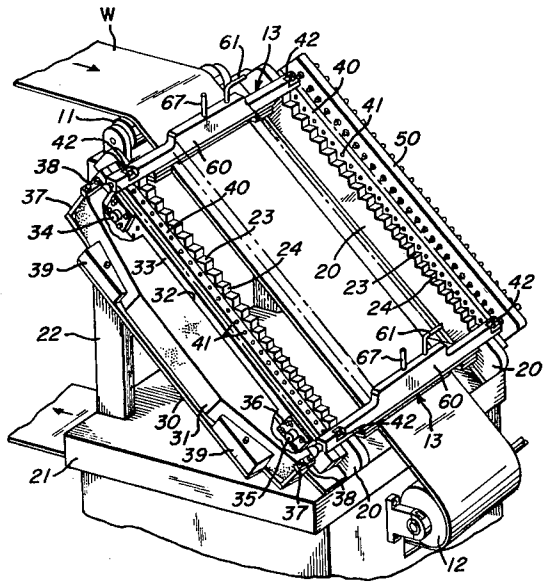
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ABSTRACT: A noncontacting printing system in which images are formed on a moving web by projecting drops of ink or the like onto the web. The drops are projected from a series of coating heads, each of which has a series of passages for projecting the drops, and structure is provided for supporting and positioning the coating heads with their passages offset with respect to each other to the extent that the drops may be projected onto the web in close enough relationship to each other to give a continuous coating, if desired.



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2 Sheets-Sheet 1

FIG-1

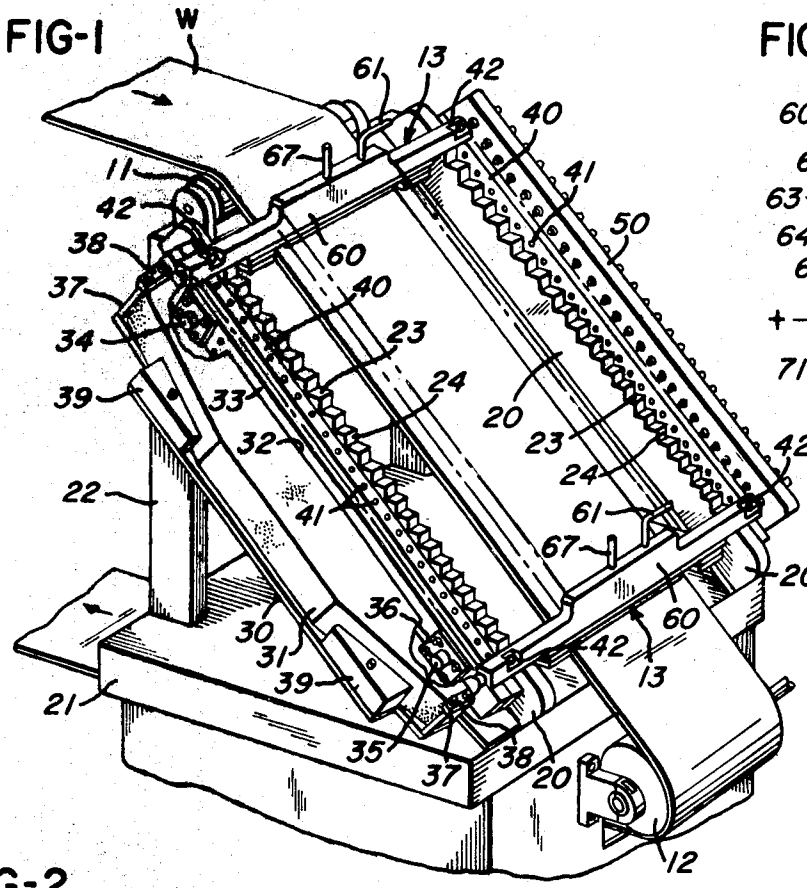


FIG-8

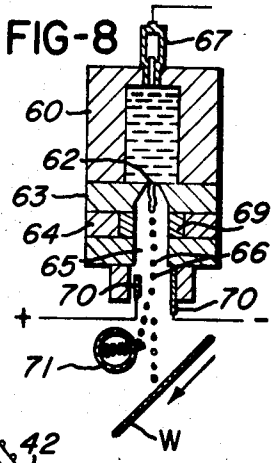
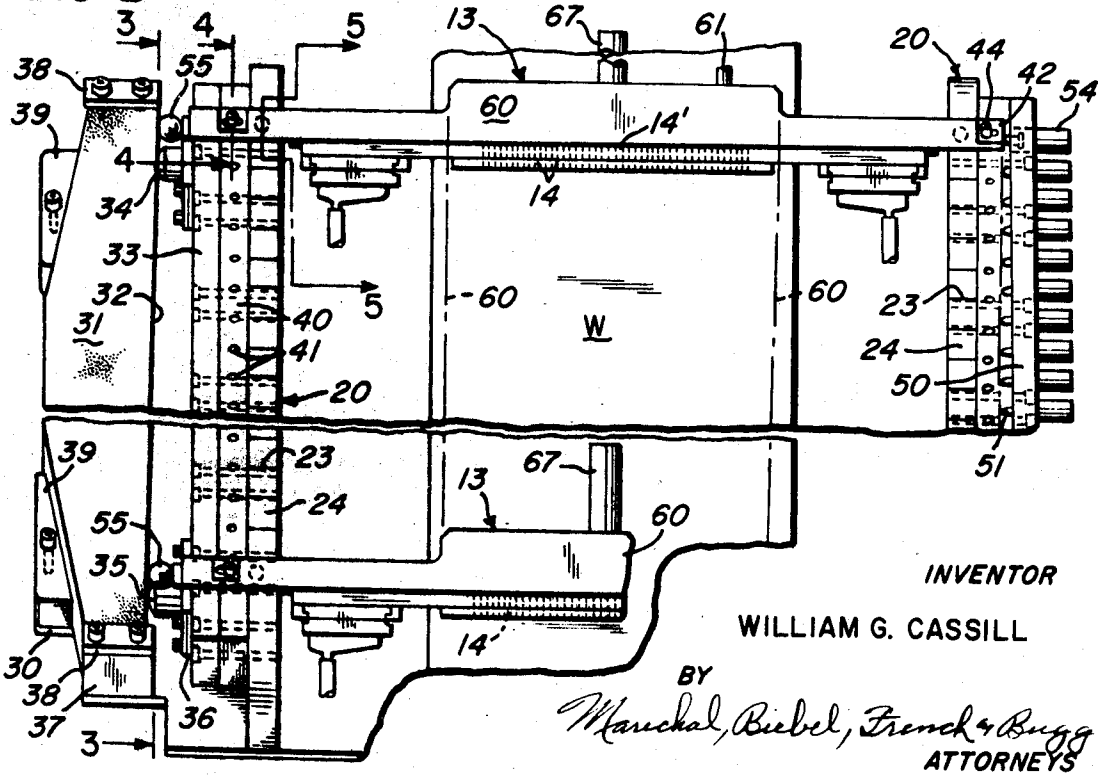


FIG-2



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FIG-3

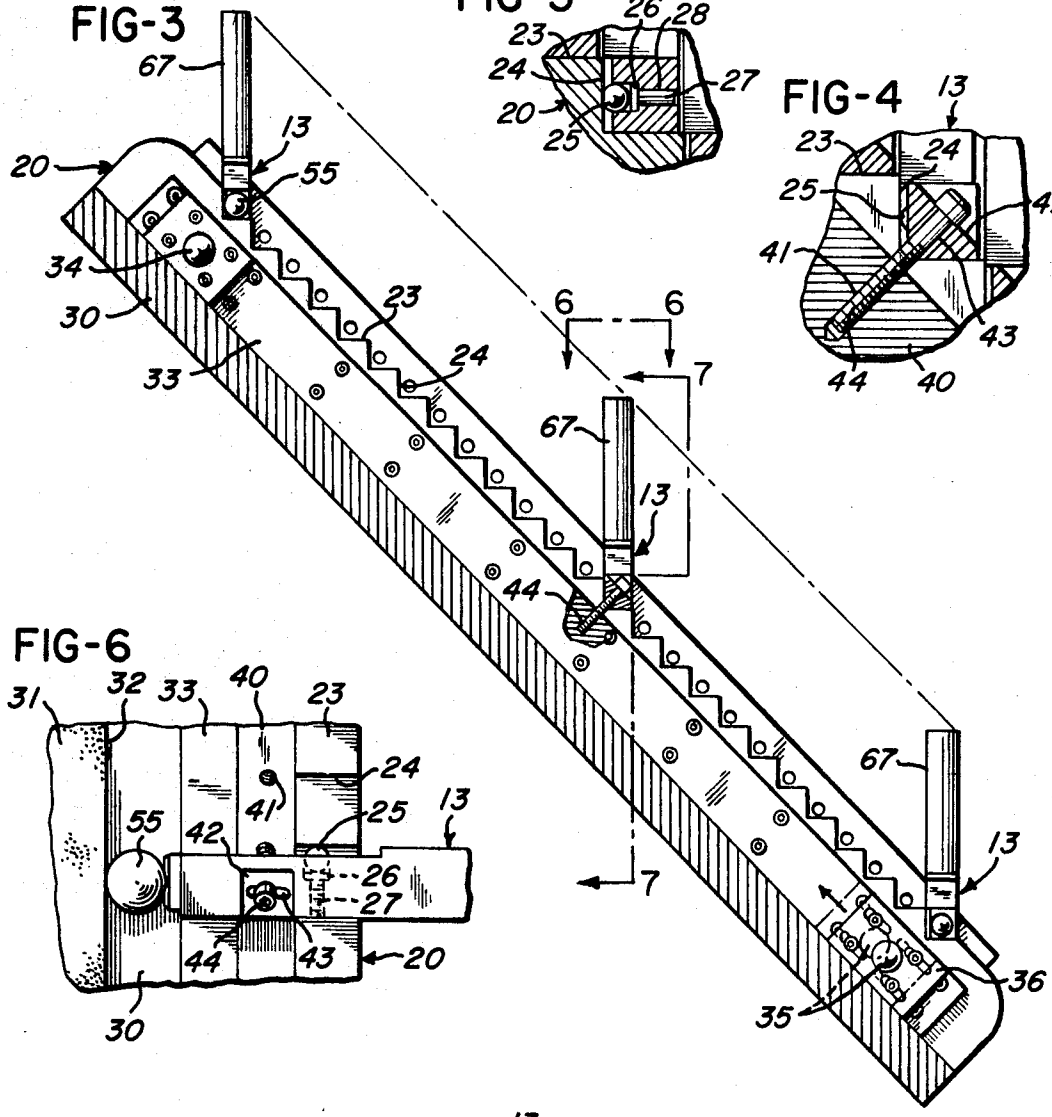
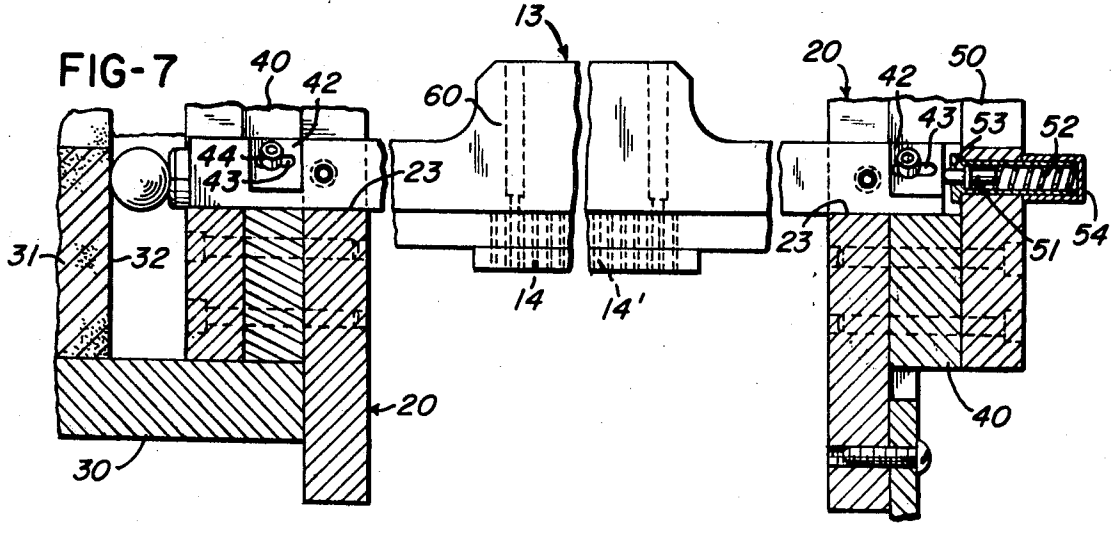


FIG-5

FIG-4

FIG-6

FIG-7



ALIGNMENT SYSTEM FOR ARRAYS OF A NONCONTACTING PRINTER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to copending applications entitled IMAGE CONSTRUCTION SYSTEM USING MULTIPLE ARRAYS OF DROP GENERATORS, Ser. No. 768,790 (Docket 4938) and HIGH SPEED PRECISION PLACEMENT OF LIQUID DROPS, Ser. No. 768,767 (Docket 4994), both filed on Oct. 18, 1968.

BACKGROUND OF THE INVENTION

The above-noted applications describe a system in which a series of coating heads, each having a series of passages therein, are positioned above a moving web to project a series of ink drops or the like through the passages toward the web for coating purposes; the term coating being used in the broad sense to include patterned coating, as in printing, as well as the application of a continuous layer of coating. Since physical limitations preclude placing the passages in a single coating head close enough together to give a continuous pattern or coating on the web, a series of coating heads are utilized positioned one behind the other in parallel relationship with the passages in each head offset with respect to the passages of the other heads to the extent that the drops projected from all of the heads just touch or perhaps slightly overlap on the web to give a continuous coating, if desired.

Obviously the precise positioning of each head with respect to the other coating heads of the series in the manner described above can be an extremely tedious and time consuming task. Thus, it can be readily appreciated that the positioning of each individual head with the use of micrometers and other precision instruments would require an inordinate amount of time.

SUMMARY OF THE INVENTION

The present invention provides a system for supporting a plurality of coating heads above a moving web so that the ink droplets from each head may be projected onto the web as it passes beneath and means for simultaneously positioning all of the heads without the use of precision instruments with the passages of each head offset with respect to the passages of the other coating heads to an extent sufficient to provide a continuous coating on the moving web.

This is accomplished by supporting the coating heads on a pair of parallel support members of stepped configuration with a series of spring-loaded plungers engaging the coating heads at one end thereof and pushing them towards a precision finished planar surface. By adjusting the angular relationship of the planar surface with respect to the longitudinal axes of the coating heads, the passages in the coating heads are offset with respect to each other. By observing the pattern printed on the moving web as the adjustment is carried out, this angular relationship can be controlled to give a substantially continuous pattern on the web.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the supporting and adjusting mechanism of the present invention with portions removed for clarity;

FIG. 2 is a front elevational view of the apparatus of FIG. 1;

FIG. 3 is a cross-sectional view taken on line 3–3 of FIG. 2;

FIG. 3 4 is a cross-sectional view taken on line 4–4 of FIG. 2;

FIG. 5 is a cross-sectional view taken on line 5–5 of FIG. 2;

FIG. 6 is a view taken on line 6–6 of FIG. 3;

FIG. 7 is a view taken on line 7–7 of FIG. 3; and

FIG. 8 is a cross-sectional view through a coating head.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As seen in FIGS. 1 and 2 of the drawings, a web W is trained about a pair of rolls 11 and 12 beneath a series of coating heads 13, each having a series of passages indicated by dotted lines at 14, formed at regularly spaced intervals longitudinally of the coating heads. While only two coating heads are shown for purposes of clarity, it will be appreciated that a series of such heads are positioned above the web in contiguous relationship to each other. Positioned on opposite sides of the web member W are a pair of support members 20 extending in parallel spaced relationship to each other. Each of the support members 20 may be supported on a base plate 21 and upright structural members 22. AS best seen in FIGS. 1 and 3, each of the support members 20 is of stepped configuration, having horizontal portions 23 and substantially vertical portions 24. The coating heads 13 extend between the support members 20 with their lower surfaces resting on the substantially horizontal surfaces 23 of the support members.

Each coating head, as best seen in FIGS. 5 and 6, has a ball 25 mounted in the rear surface thereof adjacent each end. The balls 25 are precision finished and are attached to a base 26 having a shank 27 which is press fitted in a bore 28 formed in the head 13. The balls 25 project outwardly from the rear surface of the coating head and the point on each ball positioned farthermost from the surface of the coating head is precisely spaced a predetermined distance from the longitudinal axis of the series of passages 14. Thus, with each of the coating heads resting on the horizontal surface 23 and the heads pushed rearwardly until the balls 25 engage the vertical surface 24 of the support members, the coating heads, and hence, the passages in each coating head are precisely positioned a predetermined distance in the direction of travel of the web with respect to each other.

Adjacent one end of the coating heads, the left-hand end as seen in FIG. 2, is positioned a bedplate 30 supporting a granite block 31 having a precision finished planar surface 32 adjacent the left-hand end of the coating heads 13. Blocks of this type having an optically flat surface of 25 millionth's of an inch accuracy are commercially available and are not, per se, part of the present invention. A plate member 33 extends perpendicularly from the surface of the bedplate 30 and has a fixed protrusion 34 mounted thereon adjacent one end projecting outwardly over the bedplate. Adjacent the opposite end of the plate 33 is a second, movable protrusion 35, which also projects outwardly over the bedplate, but to a greater extent than the protrusion 34. As best seen in FIG. 3, the bracket 36 supporting the protrusion 35 is slotted and screw-threaded members pass through the slots to engage the plate member 33. Thus, by loosening the fasteners passing through the slots of the bracket, the protrusion 35 may be shifted toward and away from the protrusion 34 for purpose to be described presently. A pair of plate members 37 extend upwardly from the bedplate 30 and have plates 38 bolted thereto to retain the block 31 in position. Additionally, wedge-shaped retaining members 39 are bolted to the bedplate 30 and further serve to retain the block 31 on the bedplate.

As best seen in FIGS. 1, 2, and 7, a retaining bar 40 is bolted to the support members 20 outwardly thereof and underlying the outer ends of the coating heads 13. The retaining bars 40 each have a series of screw-threaded apertures 41 formed along their upper faces at points adjacent the intersection of the horizontal and vertical surfaces 23 and 24 of the support members 20, Thus, when the coating heads are assembled on the steps of the support members 20 the outer ends of the heads 13 will overlie the apertures formed in the retaining bars 40. As seen in FIGS. 1, 4 and 7, a portion of each coating head adjacent each end thereof is chamfered, as at 42, at approximately 45°to the vertical and horizontal surfaces of the coating head, and a slot 43 is formed in the head at this portion. A screw-threaded fastener 44 passes through the slot 43 and engages the aperture 41. The coating heads 13 are thus retained on the support members 20 but are permitted to move to a limited extent in a direction along their lengths.

A bar 50 is mounted outwardly of the retaining bar 40, on the right-hand side as seen in FIG. 7 of the drawings. Mounted in the bar 50 are a series of spring loaded plungers 51 which

are urged to the left as seen in FIG. 7 by means of the springs 52 bearing against a collar 53 surrounding the plungers 51 and against a casing 54 which encloses the spring and plunger.

At their left-hand end, as viewed in FIG. 7, for example, each of the coating heads 13 has attached thereto a ball member 55 which is mounted in the end of the coating head 13 similarly to the manner in which the balls 25 are mounted in the rear surface of the coating heads. The balls 55 project outwardly from the left-hand end of the coating head and the point on each ball 55 farthermost from its associated coating head is precisely positioned a predetermined distance from a master aperture 14' located near the center of the series of apertures 14 formed in the coating head 13. The ball 55 at this farthermost point contacts the planar surface 32 of the block 31 and is continuously urged against the surface 32 by means of the plungers 51.

With a coating head resting on each of the horizontal surfaces 23 of the stepped supporting members 20 and the web W passing beneath the coating heads, a supply of ink or other printing material is pumped to the interior of the coating head and ejected through the passages 14 towards the web. The operation of the printing system is explained in detail in the above noted, related applications. For present purposes it is sufficient to note that each coating head includes, as seen in FIGS. 1, 2 and 8, a manifold 60 fed with a supply of coating material through conduit 61. Coating from the manifold is ejected through a series of apertures 62 in an aperture plate 63 and thence through a charge plate 64 having a series of openings 65 therethrough. As coating is ejected through the apertures 62 it tends to break into a series of discrete drops 66. A vibrating device, such as the sonic vibrator 67, applies a vibration of a predetermined frequency to the coating head, causing the drops 66 to be of uniform size and shape. A charge ring 69 surrounding each opening 65 selectively imparts a charge to drops passing therethrough. Those drops which are charged are deflected as they pass between the deflecting electrodes 70 and are caught by a catcher 71, while those that are not charged pass freely through the electrostatic field set up by the electrodes 70 and strike the web W. It will thus be apparent that by selectively charging or not charging the individual drops as they pass through the charge rings 69 a desired pattern of coating can be applied to the web W. It is essential, however, that the passages in each head be offset with respect to the passages in each of the other heads so that solid areas of coating or printing can be produced if desired. This is accomplished with the apparatus of the present invention as follows.

Ink drops are ejected from each of the passages 14 on a continuous basis and the pattern resulting on the web observed. If, as in the usual case, there is not a complete coverage of the web, the protrusion 35 is adjusted by means of the slotted brackets 36 towards and away from the protrusion 34. Since the protrusion 35 extends outwardly over the bedplate a greater distance than the protrusion 34, movement of the protrusion 35 towards the protrusion 34 causes the block 31 to pivot outwardly with respect to the web about the protrusion 34 and vary the angular relationship of surface 32 with respect to the heads 13. Since the coating heads 13 are urged toward the planar surface 32 by the plungers 51, movement of the protrusion 35 toward protrusion 34 causes the coating heads 13 to shift longitudinally thereof an increasing distance from top to bottom, as indicated at 60, FIG. 2, thereby offsetting the coating heads, and the passages 14 of each, with respect to each other. When a solid pattern is observed, thereby indicating that the heads are offset exactly the right amount, the bolts on members 38 and 39 are tightened, locking the block 31 in place.

It will thus be seen, that all of the heads 13 may be simultaneously positioned with respect to each other to give the precise offset relationship necessary without the use of micrometers and other precision instruments.

While the form of the 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 I claim is:

1 Apparatus of the character described comprising:
- a. a plurality of elongated coating heads each having a series of longitudinally aligned, regularly spaced passages formed therein throughout a portion of their lengths;
- b. means for supporting said coating heads in parallel relationship to each other;
- c. means providing a substantially planar surface for engaging one end of each of said coating heads;
- d. means for adjusting the angular relationship of said planar surface to said coating heads; and
- e. means for urging said coating heads toward said planar surface.

2. The apparatus of claim 1 wherein:
- a. said means for urging said coating heads toward said planar surface engage each of said coating heads at the end thereof opposite said one end.

3. The apparatus of claim 2 wherein:
- a. said means for urging said coating heads toward said planar surface include a series of spring loaded plungers.

4. The apparatus of claim 1 wherein:
- a. said coating head supporting means includes a pair of spaced parallel support members extending transversely of said coating heads adjacent the ends thereof.

5. The apparatus of claim 4 wherein:
- a. said support members are formed in a stepped configuration;
- b. the steps of each support member are aligned with the corresponding steps of the other support member; and
- c. said coating heads are supported by said steps.

6. The apparatus of claim 5 further including:
- a. a ball mounted in each of said coating heads adjacent each end thereof with a portion of each of said balls projecting outwardly beyond the surface of its associated coating heads;
- b. a point on said ball located farthermost from said surface of said coating head engaging a portion of said steps;
- c. said point on each said ball being precisely positioned a predetermined distance from the axis of longitudinal alignment of said passages.

7. The apparatus of claim 6 wherein:
- a. portions of each coating head adjacent each end thereof define longitudinally extending slots through said coating head;
- b. a retaining bar contiguous with each of said support members and underlying the slotted portions of said coating heads;
- c. screw-threaded apertures formed in said retaining bars beneath said slotted portions of said coating heads; and
- d. screw-threaded fasteners engaging said slotted portions of said coating heads and said screw-threaded apertures.

8. The apparatus of claim 1 wherein said adjusting means comprises:
- a. a pair of protrusions projecting outwardly toward and in engagement at spaced points with said planar surface;
- b. said protrusions projecting toward said planar surface different amounts; and
- c. said protrusions being mounted for movement relative to each other in a direction substantially parallel to said planar surface.

9. The apparatus of claim 8 further comprising:
- a. a bedplate supporting said planar surface providing means; and
- b. a plate member extending substantially perpendicularly to said plate member and mounting said protrusions thereon.

10 The apparatus of claim 8 further comprising a ball member mounted in said one end of each of said coating heads and projecting outwardly of the surface into contact with said planar surface, the point on each of said ball members con-

tacting said planar surface being precisely positioned a predetermined distance from a master one of said passages in the coating head in which said ball member is located.

11 The apparatus of claim **10** further comprising:

a. means for locking said planar surface providing means in a desired angular relationship with said coating heads.

12. Noncontacting printing apparatus comprising:

a. a pair of spaced parallel support members having a series of regularly spaced steps formed in an upper surface of each with said steps in substantial alignment;

b. a retaining bar contiguous with each of said support members and positioned outwardly of said support members;

c. said retaining bars each having a series of screw threaded apertures formed therein with an aperture positioned adjacent an intersection of the vertical and horizontal portions of said steps;

d. a series of coating heads each having a series of regularly

spaced passages formed therein longitudinally thereof; each coating head extending substantially perpendicularly of said support member with a lower surface of each coating head resting on a horizontal portion of a step;

e. a bedplate positioned adjacent one end of said coating heads and supporting a block having a substantially planar surface extending substantially perpendicularly to said coating head and facing said one of said print bars;

f. a ball mounted in said one end of each of said coating heads with a portion of said ball projecting outwardly of the head in which it is mounted;

g. a point on said ball positioned farthermost from the coating head in which it is mounted contacting said planar surface and being precisely spaced a predetermined distance from the nearest one of said passages; and

h. means for adjusting the angular relationship of said planar surface to said coating heads.