

United States Patent

[11] 3,610,397

[72]	Inventor	Hendrik F. Bok North Dartmouth, Mass.
[21]	Appl. No.	804,523
[22]	Filed	Mar. 5, 1969
[45]	Patented	Oct. 5, 1971
[73]	Assignee	Epec Systems Corporation New Bedford, Mass.

2,593,627	4/1952	Stover	198/33
2,661,879	12/1953	Lee et al.	294/87
2,734,619	2/1956	Labombarde	198/33
3,161,431	12/1964	Francis	294/87
3,347,349	10/1967	Carlson	198/33 R
3,380,570	4/1968	Jordan	198/33 R
2,932,825	4/1960	Vaughan, Jr.	294/99

Primary Examiner—Harvey C. Hornsby
Assistant Examiner—Merle F. Maffei
Attorney—Semmes & Semmes

[54] **METHOD AND APPARATUS FOR TURNING OVER
A PLATE**
2 Claims, 19 Drawing Figs.

[52] U.S. Cl..... 198/33 AD,
198/33 R

[51] Int. Cl..... B65g 47/24

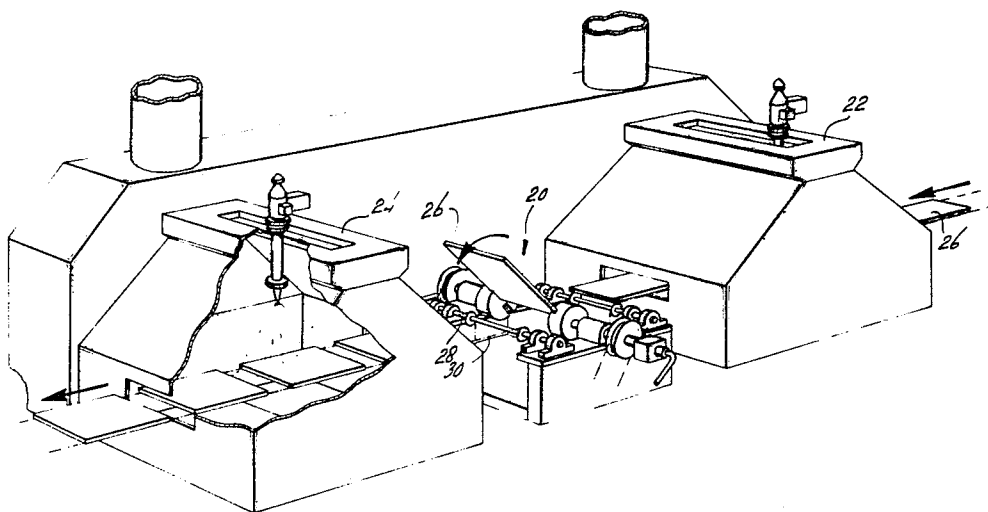
[50] **Field of Search**..... 198/33.4,
33 R; 294/87, 99

[56] **References Cited**

UNITED STATES PATENTS

1,462,468	7/1923	Schaller.....	198/33 R
-----------	--------	---------------	----------

ABSTRACT: Method and device for turning over a plurality of plates being advanced sequentially in a horizontal plane, a suggested structure including a pair of slotted heads which engage the leading edge of the advancing plate and upon being rotated 180° flip the plate over, so that both top and bottom of the plate may be painted or treated within the horizontal plane.



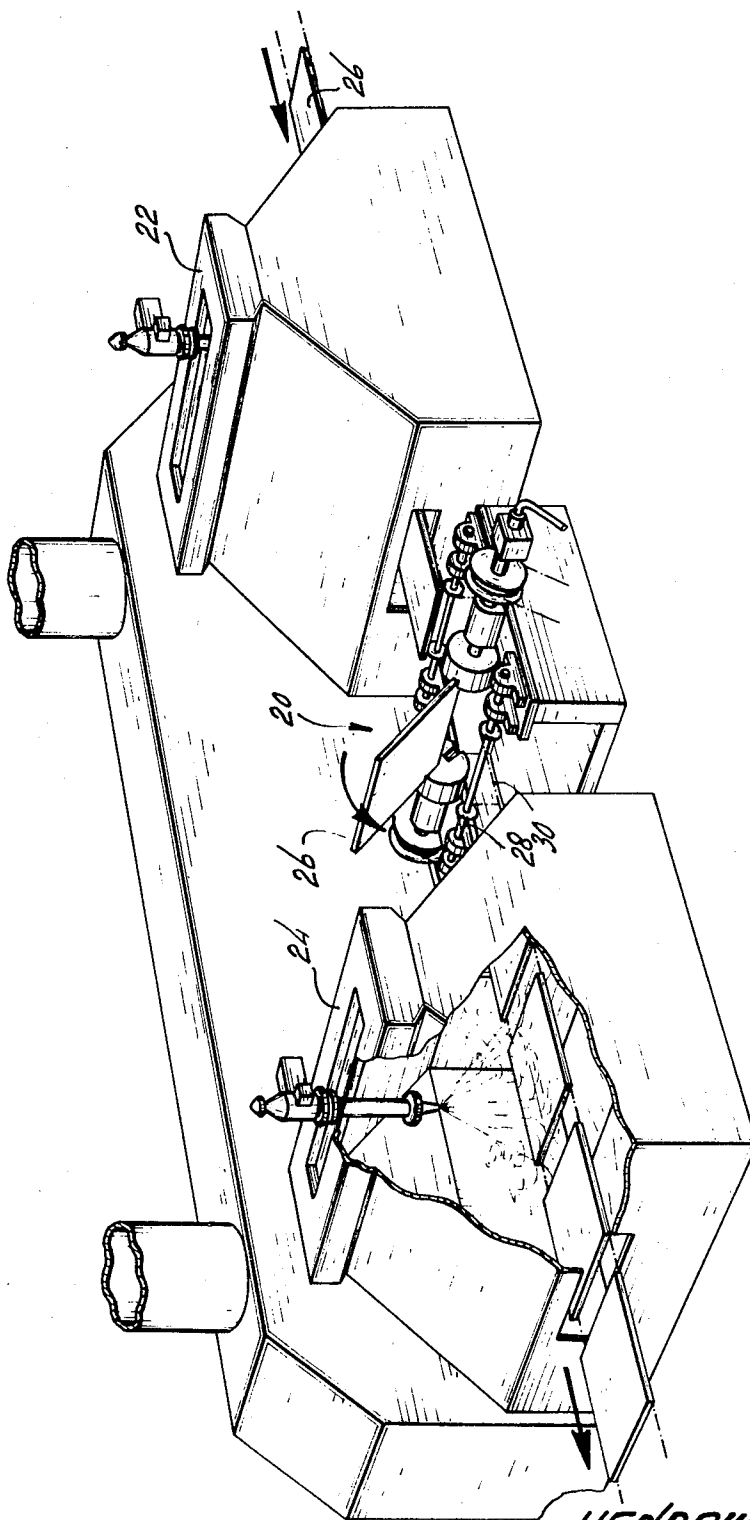


FIG. 1

INVENTOR

HENDRIK F. BOK

BY

Semmes and Semmes

ATTORNEYS

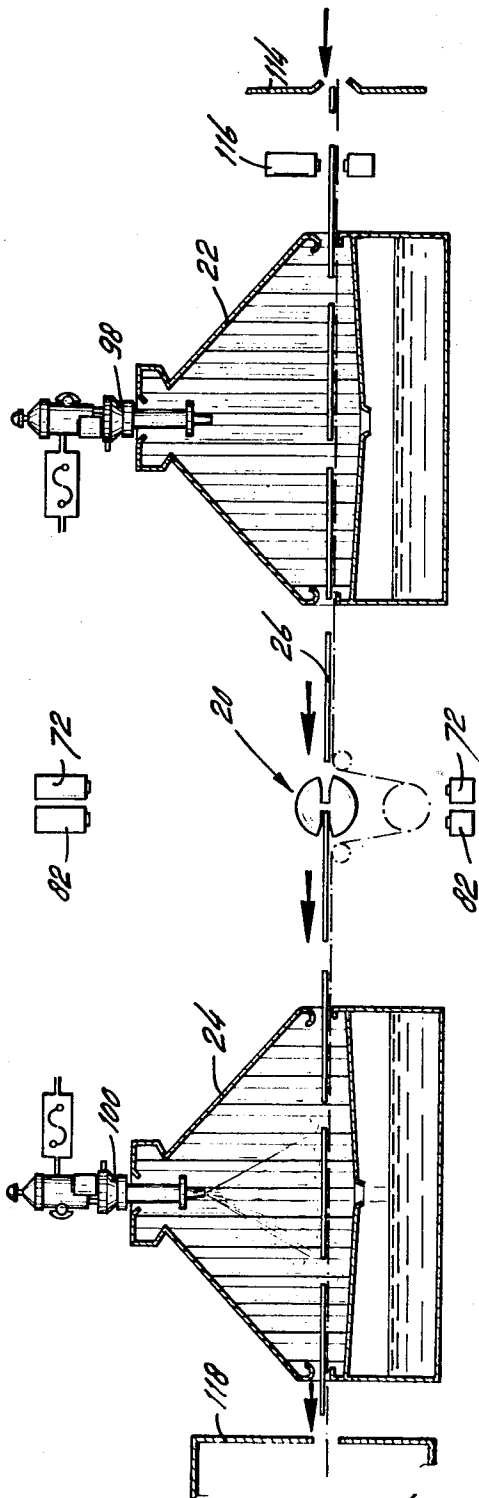


FIG. 2

INVENTOR
HENDRIK F. BOK

BY **Semmes and Semmes**
ATTORNEYS

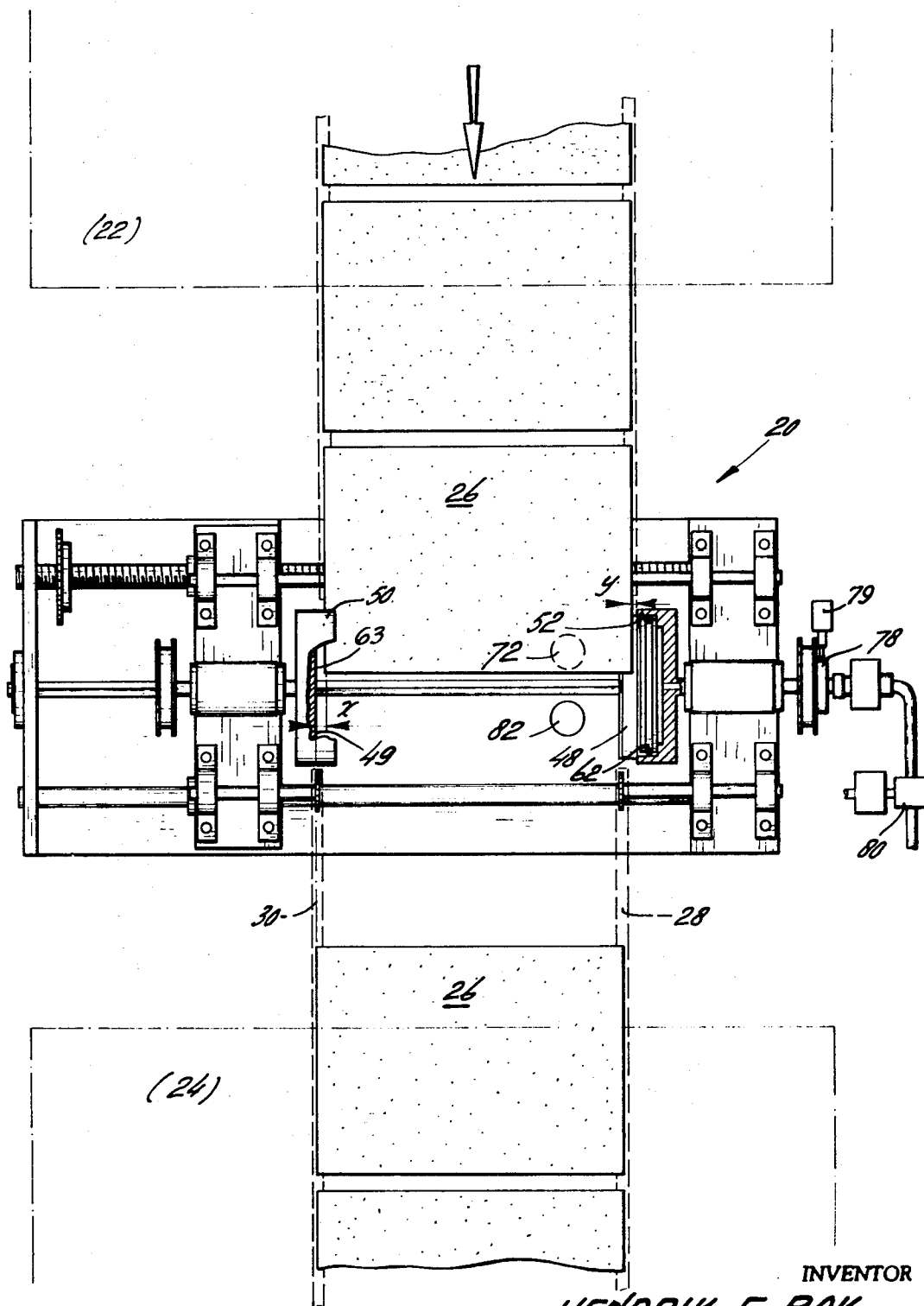


FIG. 3

INVENTOR
HENDRIK F. BOK

BY **Semmes and Semmes**
ATTORNEYS

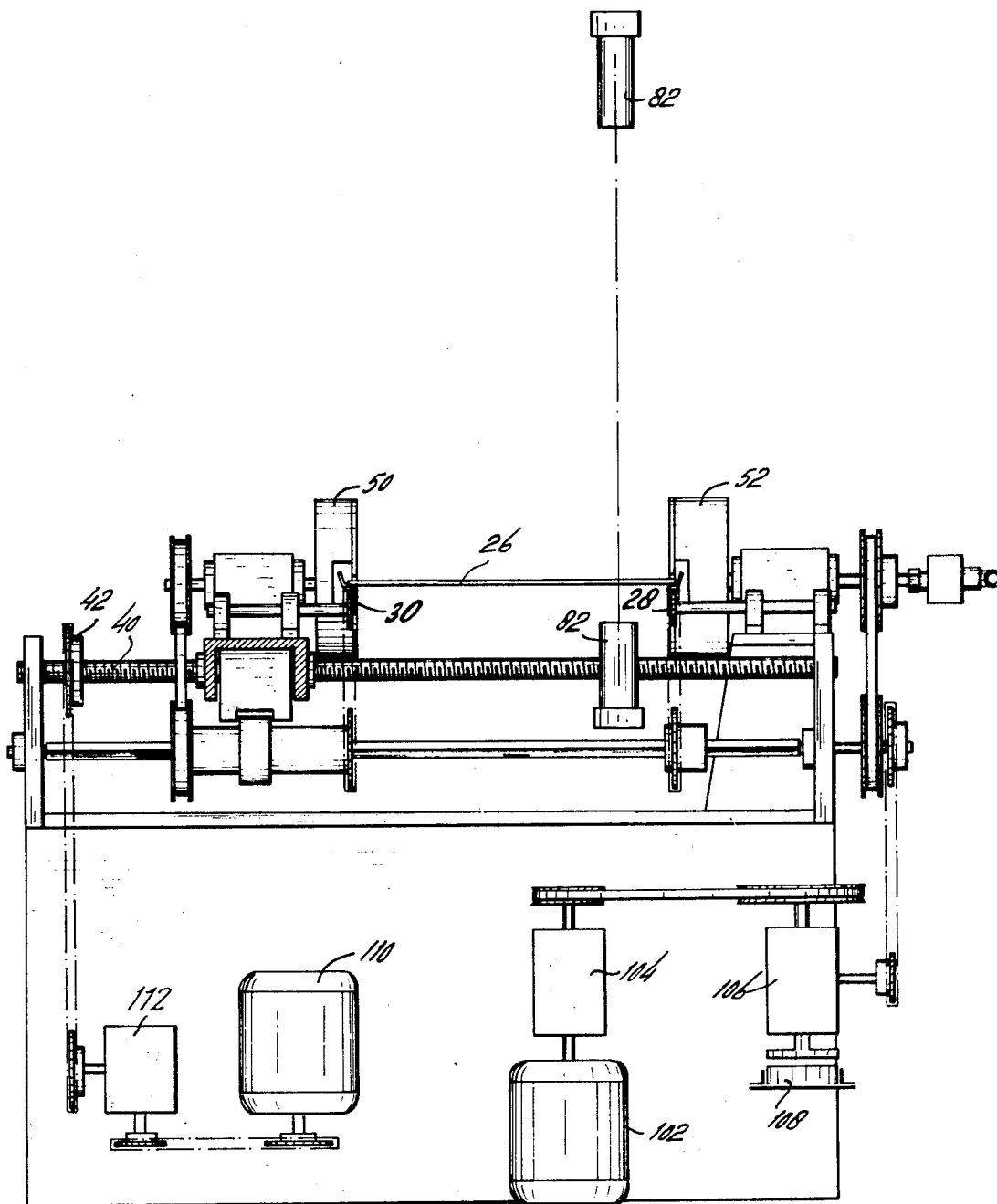


FIG. 4

INVENTOR

HENDRIK F. BOK

BY **Semmes and Semmes**

ATTORNEYS

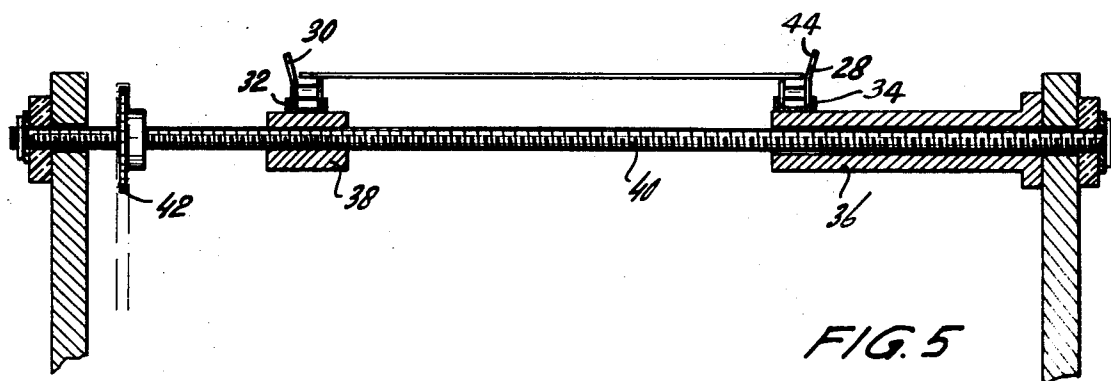


FIG. 5

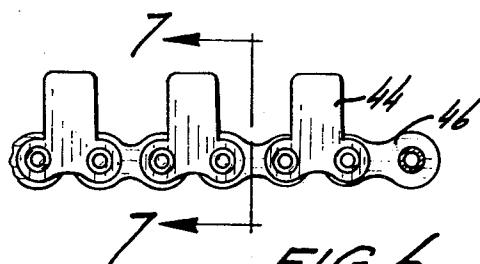


FIG. 6

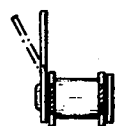


FIG. 7

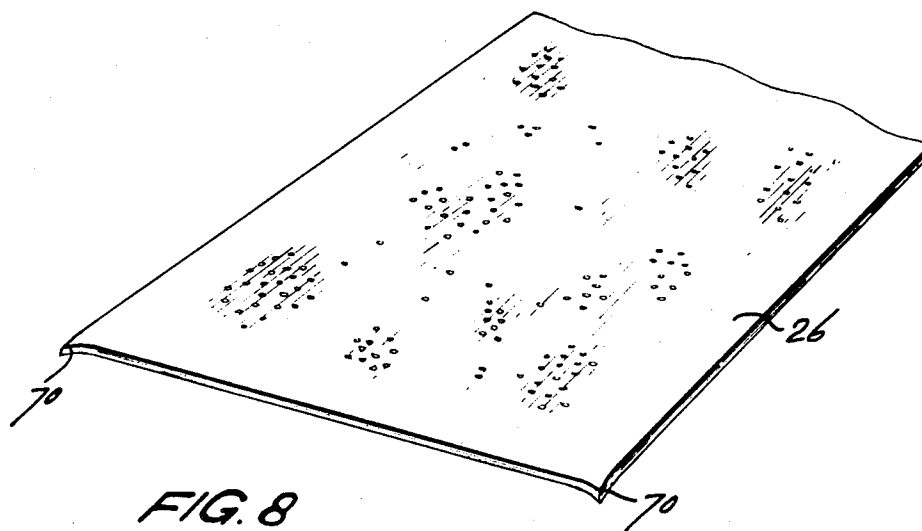


FIG. 8

INVENTOR

HENDRIK F. BOK

BY **Semmes and Semmes**

ATTORNEYS

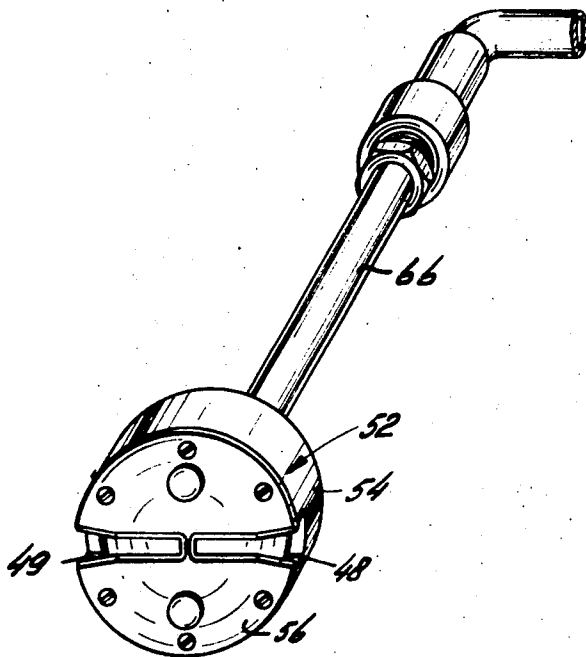


FIG. 9

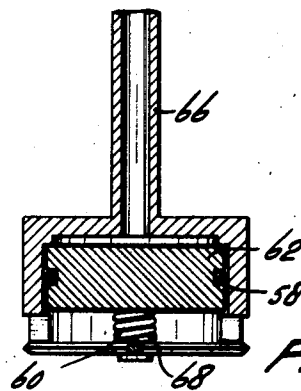


FIG. 10

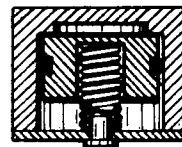


FIG. 11

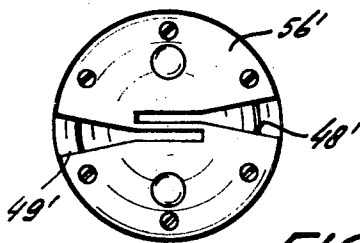


FIG. 13

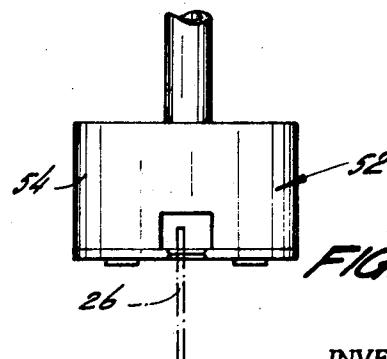


FIG. 12

INVENTOR

HENDRIK F. BOK

BY **Semmes and Semmes**
ATTORNEYS

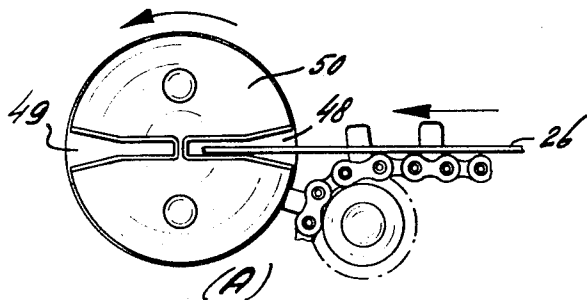


FIG. 14

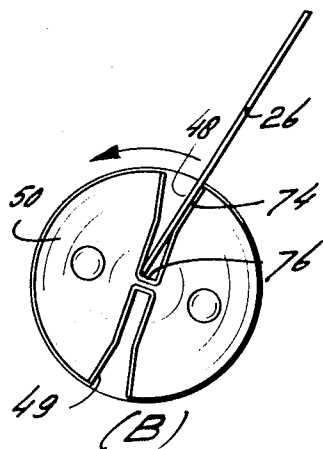


FIG. 15

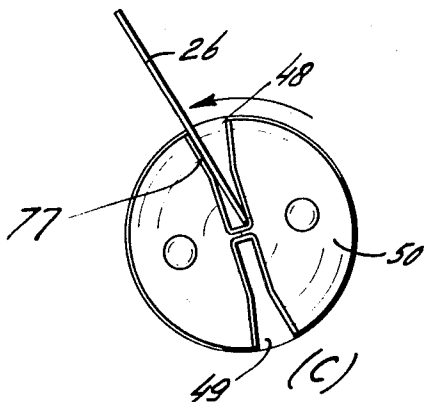


FIG. 16

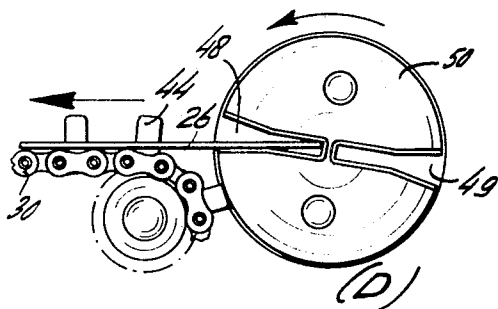


FIG. 17

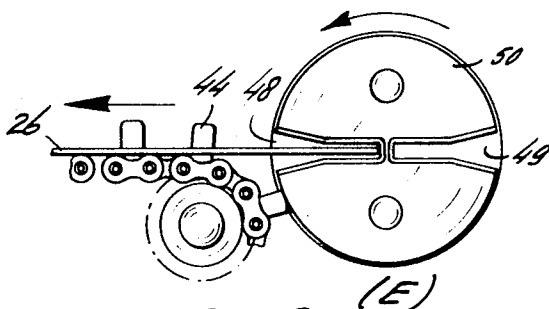


FIG. 18

INVENTOR

HENDRIK F. BOK

BY

Semmes and Semmes

ATTORNEYS

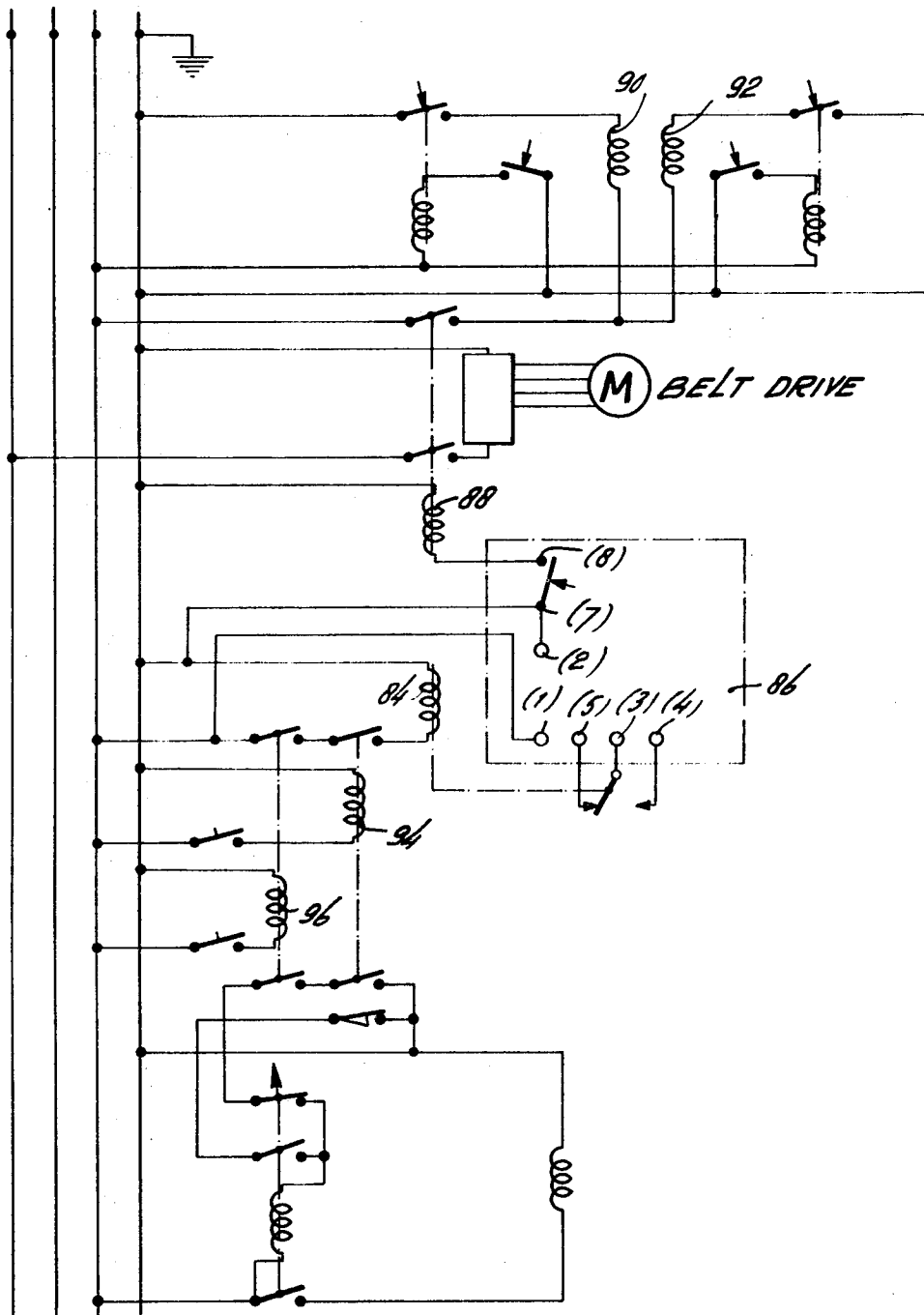


FIG. 19

INVENTOR

HENDRIK F. BOK

BY ***Semmes and Semmes***

ATTORNEYS

METHOD AND APPARATUS FOR TURNING OVER A PLATE

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

In spray painting operations, particularly in the painting of photoresist and like materials in the printed circuit industry, a major problem is flipping over a wet plate after it top has been coated, so that the bottom may be coated. Normally, the plates are advanced in a horizontal plane by an endless conveyor. After the plate leaves a first spray coating chamber where its top has been painted, a cul-de-sac or like device is used to flip over the plate for painting upon its bottom, and the plate is advanced into a second spray coating chamber. A principal shortcoming of conventional devices is the necessary handling of the wet plate surface with deleterious effects upon the spray coating, as well as the complexity of moving parts which contributes to jamming of the plates. The practical result has been that wet plates are, in most cases, flipped over by hand.

SUMMARY OF THE INVENTION

According to the present method, a turnover device may be positioned intermediate a first spray coating chamber and a second spray coating chamber. The turnover device includes two slotted heads mounted on either side of an advancing conveyor so that the slots are aligned with the leading edge of an advancing plate 180°. As the leading edge of the plate enters the slots, both slotted heads are pivoted 180°; so as to flip over the plate upon a discharge conveyor which pulls the plate from the slots and advances the plate into the second spray coating chamber. A major control feature consists in a reciprocable piston mounted in one of the heads, so as to extend within the slot and engage a first side of the plate, while pushing a second side of the plate against the slot side in the opposed head, thus firmly locking plate in clasped position while the plate is rotated 180°. As the rotation is completed, the reciprocable piston is released and the discharge conveyor is enabled to advance the plate to the second spray coating chamber for painting of its bottom.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a turnover device supported intermediate first and second spray coating chambers;

FIG. 2 is a vertical sectional view of a proposed installation according to FIG. 1;

FIG. 3 is a top plan of the turnover device, showing the leading edge of an advancing plate, the ends of the slots in either head;

FIG. 4 is a transverse sectional view of the turnover device, showing the plate supported in head slot, as in FIG. 3;

FIG. 5 is a fragmentary sectional view, showing the means for varying the lateral distance of one chain conveyor from the other, so as to accommodate plates of different widths;

FIG. 6 is a fragmentary elevation of the chain links showing the special vertical tabs which laterally confine and align the advancing plates;

FIG. 7 is a transverse sectional view, taken along section line 7—7 of FIG. 6;

FIG. 8 is a fragmentary perspective of a printed circuit board or plate of the type which can be turned over according to the present invention;

FIG. 9 is a fragmentary perspective of a slotted head having a reciprocable piston mounted inwardly thereof;

FIG. 10 is a fragmentary sectional view of the cylinder and piston shown in FIG. 9;

FIG. 11 is a transverse section of the cylinder illustrated in FIGS. 9 and 10;

FIG. 12 is a side elevation showing the plate edge supported in the slot;

FIG. 13 is front elevation of a modified head having radially overlapping slots, so as to foreshorten the distance required for pivoting flip over the plates; and

FIGS. 14—18 illustrate the turnover cycle as the plate leading edge advances into the head slot, is abutted, and the head is rotated 180° for flip over of the plate, from top to bottom.

FIG. 19 illustrates the schematic diagram of the electrical system for the turnover device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, a panel flipover device 20 is shown between two spray coating stations 22 and 24, allowing the spray operation in both stations to be directed downwards. The flipover device 20 turns the panel 26 180° and places the panel accurately onto the chain conveyor 28—30 for transport to the second spray station 24.

The chain conveyor consists of chain tracks 28 and 30, track 28 being stationary and track 30 being laterally adjustable to allow transport of panels with different widths (FIG. 3). The chain tracks are supported in U-shaped channels 32 and 34, made of low-friction material. The channel 34 supporting the chain 28 is attached to a flange 36, being part of the equipment frame while channel 32 is attached to a threaded nut 38. When threaded rod 40 is turned by means of sprocket 42, the threaded nut 38 will move left or right depending upon the direction of turning sprocket 42. The panel 26 is placed onto the chain and in between the upward direction tabs 44 of the individual connecting links 46, as illustrated in FIGS. 5 and 6.

After spraying the top surface of panel 26 in the first spray station 22, the panels are carried into the flipover area and placed into the receiving slots 48 of the two flipper heads 50 and 52, illustrated in FIG. 3. As illustrated in FIG. 9, flipper head 52 has a thin plate 56 provided with two slots 48 and 49 attached to flipper head cylinder 54. Within this cylinder 54 is placed a piston 62 with O-ring 58. Two springs 60 are placed between slotted plate 56 and top of piston 62. In rest position, shown in FIGS. 10 and 11 there is approximately 0.75 clearance between plate 56 and piston 62. When air pressure is applied via swivel joint 64 and through the hollow shaft 66 of cylinder 54, the piston moves against the spring pressure of springs 60 and the distance between plates 56 and piston 62 decreases until a stop, provided by stud 68 has been reached, allowing approximately 1/2 inch of piston travel.

Flipper head 50 has the same double slotted plate as flipper head 52, however, the flipper head housing has recessed slot, instead of a piston. This recessed slot is Teflon coated.

After a flipover operation has been completed, the slots 48 and 49 are horizontal and in-line with the conveyor tracks, ready to receive the panels.

As can be seen from FIG. 3, a panel 26 is first placed into the slots by the conveyor. At this point there is ample clearance between piston 63 and edge of panel 26. Also flipper head 50 with its recessed slot shows adequate clearance. These clearances between the sides of the panel and the flipper heads are necessary to allow unobstructed entrance of panel particularly since the panels 26, used in the fabrication of printed circuits may have copper plated tip 70 at the corners of the panel as a result of the higher current densities during the copper plating process necessary prior to coating the surfaces of the panel. With tight spacing between flipper heads 50 and 52 and edges of the panel, improper feed-in and consequent jam ups could easily occur. Plate 26 having copper tips 70 is illustrated in FIG. 8.

After panel 26 has been placed in the slots of the flipper heads 50 and 52 for at least 85 percent of the slot depth, electric eye 72 triggers the flipover movement, turning the flipper heads 180°. Rate of turn is approximately 180° per second. FIGS. 13—17 show the flipper head 50 in 5 positions A through E. During the movement of the flipper head from position A (feed-in position) to position B, the panel 26 is supported by edge 74 of slot 48 and because of the weight of the panel, it slides down until it reaches the bottom 76 of both slots 48.

During transition from position B to position C, the panel will tilt over and lean against the edge 77 of the slot, as shown in FIG. 16.

Attached to flipper head 52 of FIG. 3 is a cam 78 which controls a pilot valve or switch 79, which in turn controls the air valve 80. When the pilot valve or switch 79 is activated by cam 78, the air valve 80 is opened and piston 62 pushes the panel 26 towards flipper head 50 until the panel is held tight between both flipper heads. The pilot valve 79 is activated just after reaching position C, illustrated in FIG. 16. This piston force is maintained during the movement of from position C to position D. As illustrated in FIG. 3, the conveyor chain tracks 28 and 30 at the exit side of the flipover device have the same width as the feed-in track side. Tracks 28 and 30 are aligned with the recessed slot in flipper head 50 in such a way that the panel edge falls inside the chain extension tabs 44, as shown in FIGS. 5 and 6. Up to the point where the panel 26 is placed onto the conveyor chain tracks, piston 62 holds the panel tight between the flipper head (position D), illustrated in FIG. 17. However, immediately after passing through position D, the pilot valve or switch 79 is released by cam 78, causing the piston 62 to instantly retract to its rest position. At arrival at position E (FIG. 18), the panel is dragged out of the flipper slots 48, thus releasing electric eye 82 which has the function of preventing another flipover cycle from starting while panel 26 still occupies the slots at the exit side. In addition, this electric eye 82 stops the conveyor belt and prevents the spray gun from spraying, if for one reason or another, panel 26 is not dragged out of the slots within a reasonable time. Electric eye or photoswitch activates relay 84, shown in FIG. 19 and after a preset delay time of timer 86, the circuits of the conveyor drive and spray guns are opened by relay 88, FIG. 2 and solenoids 90 and 92 direct the two spray guns 98 and 100. Electric eye 82 activates relay 94, FIG. 19, to start the flipper operation. Electric eye or photo switch regulates safety relay 96 for operation of the flipper, belt drive and spray gun.

Although the two flipper heads 50 and 52 require synchronous movements the drive, as illustrated in FIG. 4 can be electro mechanical by using an electromotor 102, clutch 104, gear reducer 106, and brake 108, or by using a rotary cam action operated by either air or hydraulic, with or without gear reduction. It is important that the flipper slots after cycling are always perfectly aligned with the incoming panel.

The distance between the flipper heads 50 and 52 can be adjusted by using motor drive 110, clutch 112, sprocket 42, and threaded rod 40 in the same manner as shown in FIG. 2.

The slots 48' and 49' in the flipper head plates can be placed staggered as shown in FIG. 13 which will save the

required flipover space as it reduces the turn radius of the panel.

A static air knife 114, FIG. 2, may be employed to clean dust from the surface of panels 26 prior to spray coating and a photo switch 116 may be used to actuate the spray gun 98, as a panel enters chamber 22. An infrared drying oven 118 may be positioned adjacent spray chamber 24 exit.

I Claim:

1. A plate turnover device for flat plates having a uniform rectilinear edge comprising:
 - A. a feeding conveyor supporting a plurality of sequential horizontally aligned plates;
 - B. a turnover station extending inwardly of the sides of said feeding conveyor and including:
 - i. first and second plate turnover heads rotatably mounted at opposite sides of said conveyor;
 - ii. said heads having each at least one radial plate-receiving slot with a plate leading edge engaging face therein, said slots being alignable with the leading edge of an advancing plate;
 - iii. at least one said head including a hollow cylinder and a reciprocable piston mounted therein inwardly of said slot resilient means normally retracting said piston within said cylinder and away from said conveyor to open a said slot therein for reception of a plate therein and fluid pressure means for moving said piston in said cylinder toward said conveyor to extend through said slot and into edge engagement with a plate in said slot and to laterally pressure plate between said piston and the other said head within its slot;
 - C. rotating means connected to said heads, so as to rotate said heads 180° as the leading edge of a plate engages in said slots and the plate is laterally pressure engaged and supported by and between said heads with said leading edge engaged and supported by said engaging face; and
 - D. a discharge conveyor aligned with said slots so as to remove the plate from said slots, as rotation of said heads is completed, said fluid pressure means selectively operable for engaging said piston for movement against pressure of said resilient means into plate edge pressure engagement as the heads are rotated and release thereof for removal of the plate following turnover.
2. A plate turnover device as claimed in claim 1, said hollow cylinder in said one said head being inwardly open toward said conveyor, a plate closing said cylinder and having a said slot therein, springs interposed between said plate and said cylinder and normally resiliently retracting said piston to slot opening position.