United States Patent [19]

Aiko et al.

[11] **3,777,661**

[45] **Dec. 11, 1973**

[54] **METHOD AND DEVICE FOR MARKING SHEETS THROUGH STENCILS**

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[22] Filed: **June 28, 1971**

[21] Appl. No.: **157,107**

[30] **Foreign Application Priority Data**

June 29, 1970 Japan 45/56775
July 29, 1970 Japan 45/66755
Oct. 21, 1970 Japan 45/92511

[52] **U.S. Cl.** **101/114**, 101/128.2, 101/129, 101/48

[51] **Int. Cl.** **B41f 15/08**, B41n 1/24

[58] **Field of Search** 101/129, 128.2, 48, 101/114

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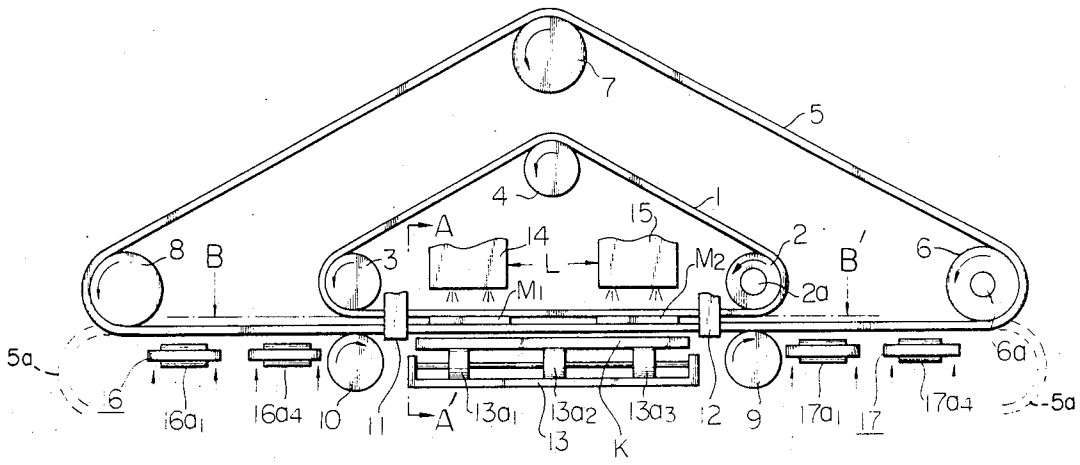
[57] **ABSTRACT**

A sheet to be marked is delivered to a marking station in succession by a second conveyor. Stencils for desired marks are prepared at a punching station and forwarded by a first conveyor to the marking station and registered on the sheet to be marked. Pigment sprayer means in the marking station directs pigment jets onto the stencils for urging the stencils to the sheet, so as to print the marks carried by the stencils onto the sheet by the pigment jets.

6 Claims, 6 Drawing Figures



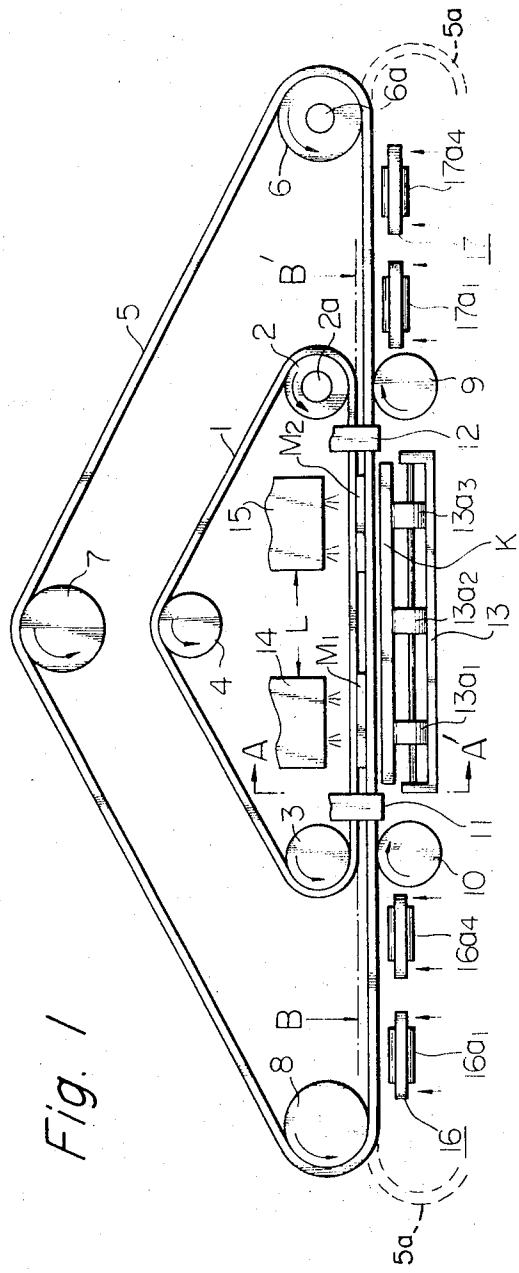


Fig. 1

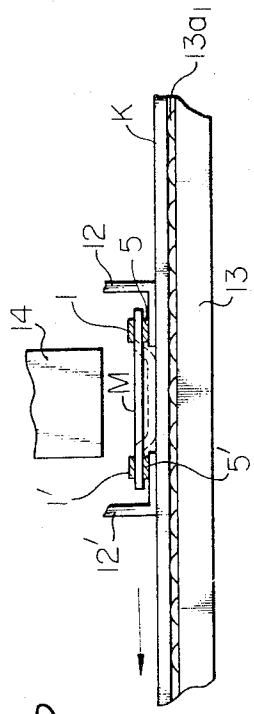


Fig. 2

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Fig. 3

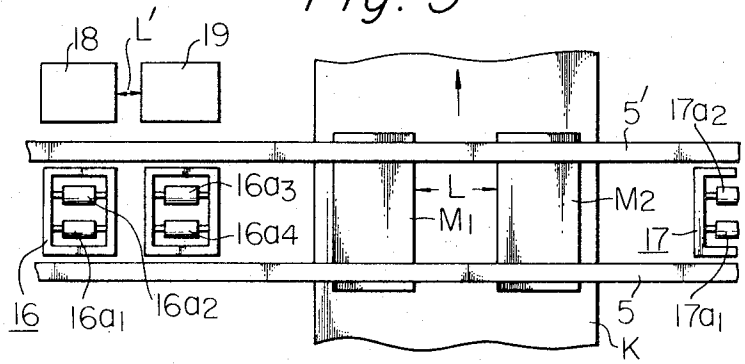


Fig. 4

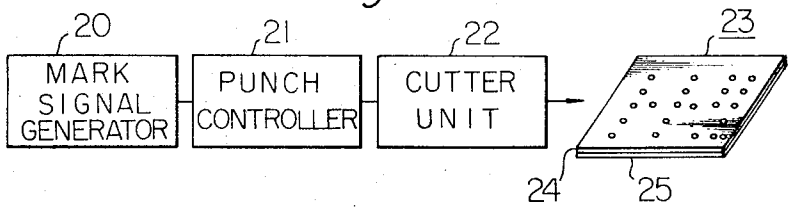


Fig. 5

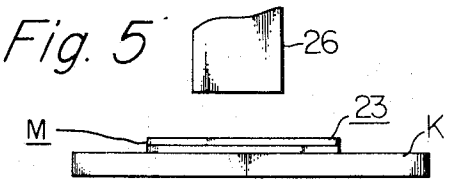
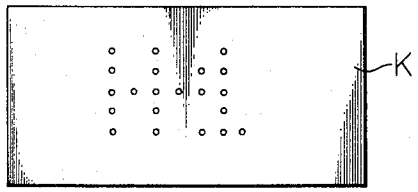


Fig. 6



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METHOD AND DEVICE FOR MARKING SHEETS THROUGH STENCILS

BACKGROUND OF THE INVENTION

This invention relates to a method and a device for marking a sheet through stencils, and more particularly to an improved method and a device for automatically delivering a sheet to be printed and one or more stencils toward a marking station wherein pigment jets are directed to the sheet through the stencils for marking the sheet through the tencils.

Preparation of stencils for marking a sheet or sheets, such as iron sheets, is carried out by a puncher, for instance by an automatic puncher controlled by an electronic computer. The stencil thus prepared is overlaid on the sheet, so as to print the mark carried by the stencil onto the sheet by spraying pigment through the stencil. The marking process of the aforesaid type is effected on a sheet or sheets of primary industrial products, e.g., iron sheets, and the marking should preferably be effected immediately after the sheets are produced, e.g., iron sheets as hot rolled, for optimizing the overall efficiency of the iron sheet production. In the case of marking hot iron sheets, stencils made of conventional material (such as cardboard) are likely to be burned during the marking process. To avoid such burning, the marking is usually carried out after the iron sheets are cooled, but the handling of the cooled iron sheets is time-consuming and tends to jeopardize the efficiency. One may think of making the stencils with heat-resistive metal so as to make the stencils heat-resistive, but such metallic stencils will require a comparatively large punching machine for accurately stamping marks thereon, which makes the overall marking device costly.

Therefore, an object of the present invention is to obviate the aforesaid difficulties of conventional marking process and device, by providing an improved method and a device for marking through stencils in a simple and effective manner.

It is another object of the present invention to provide a special stencil which is particularly suitable for marking directly onto hot iron sheets as hot-rolled.

SUMMARY OF THE INVENTION

According to one feature of the present invention, there is provided a method for marking a sheet through a stencil which comprises steps of punching a stencil by boring holes representing marks to be printed; feeding the stencil to a marking station along a first path; feeding a sheet to be marked to the marking station through a second path perpendicular to the first path so as to place a certain spot of the sheet below the stencil at the marking station; and directing pigment jets to the stencil from the above for urging the stencil toward the sheet and imprinting the mark on the sheet at the certain spot by the pigment jets.

Further, according to another feature of the present invention, a device for marking a sheet through a stencil is provided which comprises a punching station having means for punching stencil holes representing marks to be imprinted; a first conveyor means for holding and carrying the stencil to a marking station; a stencil-feeding means transferring the stencil from the punching station to the first conveyor means; a second conveyor means carrying a sheet to be marked to the marking station; a stencil-removing means removing the stencil away from the first conveyor means; a pigment sprayer means disposed in the marking station and producing pigment jets; a control means holding the first and second conveyor means so as to keep the stencil in registration with the sheet in the marking station, means for directing said jets toward the stencil while holding the two conveyor means for marking the sheet through the stencil by the pigment jets, restarting the two conveyor means upon marking, loading the first and second conveyor means with a fresh stencil and a fresh sheet, respectively, and removing the used stencil out of the first conveyor means.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and a more complete understanding of the present invention may be had by referring to the following description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a schematic elevational view, illustrating a marking device according to the present invention:

FIG. 2 is a sectional view, taken along the line A–A′ of FIG. 1;

FIG. 3 is a partial plan view of the marking device, taken from the direction of the arrows B–B′ of FIG. 1;

FIG. 4 is a diagrammatic illustration of a process for preparing stencils according to the present invention; and

FIGS. 5 and 6 are schematic views, showing the process at the instant of marking through a stencil.

Like parts are designated by like numerals and symbols throughout the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 to 3, first and second inner conveyors 1 and 1′ are disposed substantially in parallel with each other, while keeping a suitable spacing therebetween. As shown in FIG. 2, the spacing between the two inner conveyors 1 and 1′ is slightly shorter than the width of a stencil M to be moved by the conveyors, which width is taken at right angles to the travelling direction of the stencil M under the guidance of the conveyors 1 and 1′. Accordingly, the conveyors 1 and 1′ engage the stencil M at positions slightly inside of the opposing edges of the stencil. The first inner conveyor 1 is driven by a motor 2*a* through a driving roll 2 and it is guided by driven rolls 3 and 4 in a counter-clockwise direction, as seen in FIG. 1. The second inner conveyor 1′ is guided and driven by similar rolls and motor (not shown).

First and second outer conveyors 5 and 5′ travel in parallel with the first and second inner conveyors 1 and 1′, respectively. At a certain portion of the travelling paths of the conveyors 1, 1′, 5, and 5′, the first pair of the inner and outer conveyors 1 and 5 act to hold the opposite surfaces of the stencil M along a first edge thereof, while the second pair of the inner and outer conveyors 1′ and 5′ act to hold the opposite surfaces of the stencil M along a second edge thereof, the second edge being in parallel with the first edge, as shown in FIG. 2. The first outer conveyor 5 is driven in a counter-clockwise direction by a motor 6*a* through a driving roll 6 and it is guided by driven rolls 7 to 10, as shown in FIG. 1. The second outer conveyor 5′ is supported and driven by similar rolls and motor (not shown).

Instead of using different driving motors, such as the motors 2*a* and 6*a*, it is possible to use a suitable trans-

mission for driving all the conveyors at the same linear speed by a single motor.

In the preferred embodiment, as shown in FIG. 1, the driven rolls 9 and 10 for the first outer conveyor roll 5 are disposed immediately below the driven rolls 2 and 3 for the first inner conveyor 1, for ensuring the parallel movement of the two conveyors in the section between the rolls 3, 10 to the rolls 2, 9. Similar arrangement is made for the corresponding driven rolls for the second pair of conveyors 1' and 5'.

In FIG. 1, the driving roll 6 and the driven rolls 7, 8 are disposed above a horizontal plane defined by the axes of the other driven rolls 9, 10, but it is also possible to dispose the rolls 6, 7, and 8 below such plane. In the latter case, the outer conveyor 5 travels below the inner conveyor 1 throughout its entire path, which is partially shown in FIG. 1 by dotted lines 5*a*.

Two pairs of metallic holders 11, 1' and 12, 12' act to slidably hold the lower surface of the outer conveyors 5, 5' in the section between the driven rolls 9 and 10, so as to prevent the outer conveyors 5, 5' from sagging. Thus, in this section, the inner and outer conveyors 1, 1', 5, 5' are held straight.

A sheet K to be marked, such as an iron sheet, is delivered to a position immediately below the conveyor section between the metallic holders 11, 11' and 12, 12', with a suitable spacing from the outer conveyors 5, 5', as shown in FIGS. 1 and 2. The delivery of the sheet K is effected by a sheet conveyor assembly 13, which may include rollers 13*a*1, 13*a*2, . . . driven by an electric motor (not shown). The sheet conveyor assembly 13 delivers the sheet K in a direction perpendicular to the travelling direction of the conveyors 1, 1', 5, and 5' for the stencils M.

First and second pigment sprayers 14 and 15 are disposed above the inner conveyors 1 and 1' in a section between the holders 11, 11' and the holders 12, 12', with a suitable vertical spacing from the conveyors. A distance L is provided between the two pigment sprayers 14 and 15, along the travelling direction of the inner and outer conveyors, as shown in FIG. 1.

That section of the device, which includes the sprayers 14, 15, the parallel straight portions of the inner and outer conveyors 1, 1', 5, 5' between the two pairs of the metallic holders 11, 11' and 12, 12', and a portion of the sheet conveyor assembly 13 immediately below the parallel straight portions of the former conveyors, constitutes a marking station.

A stencil-feeding station is formed on the outer conveyors 5, 5' at a position upstream of the marking station, by means of a stencil-feeding conveyor assembly 16. The assembly 16 may include rollers 16*a*1, 16*a*2, 16*a*3, and 16*a*4, which are driven by a suitable motor (not shown). The stencil-feeding conveyor assembly 16 is vertically reciprocable, for instance, by means of a suitable hydraulic cylinder (not shown), so that the top plane of the rollers 16*a*1 to 16*a*4 may be brought to a level flush with the plane of the upper surface of the first and second outer conveyors 5 and 5'.

A stencil-removing station is formed on the outer conveyors 5, 5' at a position downstream of the marking station, by means of a stencil-removing conveyor assembly 17. The assembly 17 may include rollers 17*a*1, 17*a*2, 17*a*3, and 17*a*4, which are driven by a suitable motor (not shown). The stencil-removing conveyor assembly 17 is vertically reciprocable, for instance, by means of a suitable hydraulic cyclinder (not shown), so that the top plane of the rollers 17*a*1 to 17*a*4 may be brought to a level flush with the plane of the upper surface of the first and the second outer conveyors 5 and 5'.

A stencil-punching station is formed at a position adjacent the stencil-feeding station but offset from the path of the outer conveyors 5 and 5'. The stencil-punching station may include a first puncher 18 and a second puncher 19, so as to punch two stencils M1 and M2 at a time. The marks to be punched on the two stencils M1 and M2 by the different punchers 18, 19 may be the same or may be different from each other, depending on the need of each application. The stencils punched by the punchers 18, 19 are fed onto the outer conveyors 5, 5'. It is preferable to provide the same distance L between the two punchers 18, 19 as the distance between the two pigment sprayers 14, 15.

The operation of the marking device of the present apparatus, as illustrated in the foregoing, will now be described. The inner and outer conveyors 1, 1', 5, 5', the metal sheet conveyor assembly 13, the stencil-feeding conveyor assembly 16, and the stencil-removing conveyor assembly 17 are actuated. The sheet K to be marked, e.g., an iron heet, is at first indexed in position at the marking station by means of the metal sheet conveyor assembly 13, and then the conveyor assembly 13 is de-energized. More particularly, that spot of the iron sheet K which is to be marked is brought underneath the outer conveyors 5, 5' at a position between the two pairs of the metallic holders 11, 11' and 12, 12'.

Two stencils M1 and M2, which have been punched by the punchers 18 and 19, respectively, are transferred onto the stencil-feeding conveyor assembly 16 then held at a raised position above its lower position shown in FIG. 1. The punching by the punchers 18 and 19 is, of course, to bore holes on the stencils M1 and M2, which holes represent marks to be imprinted on the iron sheet K. The rollers 16*a*1 to 16*a*4 are driven so as to bring the stencils M1 and M2 to the proper position wherein the stencils lie above thw two outer conveyors 5 and 5'. As the stencils arrive at the proper position, the rollers 16*a*1 to 16*a*4 are stopped, and a hydraulic cylinder (not shown) is actuated to lower the stencil-feeding conveyor assembly 16, so as to transfer the stencils M1 and M2 onto the outer conveyors 5 and 5'. After the transfer, the conveyor assembly 16 returns to its lower position, as shown in FIG. 1.

The outer conveyors 5 and 5' carry the stencils M1 and M2 to the right, as seen in FIG. 1, so as to hold the stencils M1 and M2 by the inner conveyors 1, 1' and the outer conveyors 5, 5'. When the two stencils M1 and M2 are brought to certain predetermined positions within the marking station, i.e., between the two pairs of the metallic holders 11, 11' and 12, 12', the inner and outer conveyors 1, 1', 5, 5' come to rest. At this moment, the two stencils M1 and M2 are located immediately below the two pigment sprayers 14 and 15, respectively, as shown in FIG. 1.

When the two sprayers 14 and 15 deliver pigment jets toward the stencils M1 and M2, the pressure of the pigment jets forces the stencils to bend toward the close proximity of the iron sheet K, as shown in FIG. 2. Consequently, clear and well-defined marks can be imprinted on the iron sheet K by the pigment jets from the sprayers 14 and 15 through the stencils.

Upon completion of the marking, the pigment jets from the sprayers **14** and **15** are stopped, and the inner and outer conveyors **1, 1', 5, 5'** are restarted, so as to move the two stencils M1 and M2 onto the stencil-removing conveyor assembly **17.** The assembly **17** is raised by a hydraulic cylinder (not shown) from its lower position, as shown by the arrows in FIG. **1,** so that the plane of the top surface of the rollers **17***a***1** to **17***a***4** of the assembly **17** is brought to a level flush with the upper surface of the outer conveyors **5, 5'** before the two stencils M1 and M2 are delivered onto the rollers **17***a***1** to **17***a***4.** When the two stencils are properly placed on the stencil-removing conveyor assembly **17,** the rollers **17***a***1** to **17***a***4** are actuated, while further raising the assembly **17** by the hydraulic cylinder (not shown). As a result, the two stencils M1 and M2 are removed from the path of the conveyors **5** and **5'** and out of the marking device. Then, the stencil-removing conveyor assembly **17** is returned to its lower position, as shown in FIG. **1.**

When the marking is completed, the rollers **13***a***1, 13***a***2,** . . . are actuated to move the iron sheet thus marked out of the marking device.

Thus, the marking device completes one marking cycle, and becomes ready for next marking cycle.

In the foregoing description, it was assumed that the distance between the two punchers **18** and **19** is identical with the distance between the two sprayers **14** and **15,** but it was not required to keep the aforesaid two distances identical with each other. If the distance L' between the punchers **18** and **19,** as shown in FIG. **3,** is different from the distance L between the two sprayers **14** and **15,** such difference may easily be compensated. For instance, the stencil-feeding conveyor assembly **16** may be formed into two parts, one part having rollers **16***a***1** and **16***a***2** and another part having rollers **16***a***3** and **16***a***4,** so that the two parts are vertically reciprocated in a completely independent fashion. For instance, if the distance L' is shorter than the other distance L, the part having the roller **16***a***3** and **16***a***4** may be lowered before the other part of the stencil-feeding conveyor assembly **16,** so that the stencil M2 may be transferred onto the conveyors **5** and **5'** before the other stencil M1. When the conveyors **5** and **5'** carry the stencil M2 away from the stencil M1 until the distance between the two stencils M1 and M2 becomes identical with the distance L between the two sprayers **14** and **15,** the other part of the stencil-feeding conveyor assembly **16** may instantly be lowered to cause the stencil M1 to be forwarded by the conveyors **5** and **5'** with a lagging distance L from the stencil M2. Similar modification can easily be effected for the case when the distance L' is longer than the distance L.

Furthermore, the number of the stencils, the punchers, and the sprayers is not limited in number to two, as shown in the illustrated embodiment. Any suitable number of such parts can be used, so as to meet the specific need of each practical application.

As described in the foregoing, the stencils M1 and M2 are forwarded to the marking station while being held by the two pairs of the inner and outer conveyors **1, 5** and **1', 5'** under the guidance of the two pairs of metallic holders **11, 11'** and **12, 12',** so that the tension of the conveyors **1, 1', 5,** and **5'** keeps the stencils M1 and M2 away from the sheet K with a suitable distance therefrom. As a result, even if the sheet K is a hot iron sheet, the stencils M1 and M2 can be kept intact by being protected from the heat from such hot iron sheet. When the sheet K is at a very high temperature, the outer conveyors **5** and **5'** should preferably be made of steel and the stencils M1 and M2 should preferably be made by superposing a metal foil, e.g., aluminum foil on a cardboard at the surface facing the sheet K. More particularly, the stencil M may be formed by bonding a metal foil **25** onto a cardboard **24,** as shown in FIG. **4.**

Referring to the block diagram of FIG. **4,** the stencil M may be automatically punched by a computerized mechanism. In the figure, a mark signal generator **20,** such as a computer console or a typewriter, may manually be actuated for generating mark-carrying signals. The signals are applied to a punch controller **21,** e.g., a computerized converter, where punch control signals are generated in response to the mark-carrying signals from the signal generator **20.** A cutter unit **22** acts to automatically punch the stencil M, so as to bore holes representing the mark ordered by the signal generator **20.** In the example FIG. **4,** a mark "H–1" is punched.

Referring to FIG. **5,** if the sheet K is not very hot, the stencil M may be brought into direct contact with the sheet K at the moment of printing, and the spraying of pigment from the sprayer **26** will print a clear mark, such as "H–1," on the sheet K, as shown in FIG. **6.** If the sheet K is very hot, the stencil M should preferably be spaced from the sheet K, as shown in FIG. **2.**

In the foregoing disclosure, the marking is done at two location of the sheet K by using two stencils M1 and M2. However, it is also possible to mark at only one location or at three or more location at a time by slightly modifying the construction and operation of the device of FIGS. **1** to **3.** Instead of marking only once for each sheet, two or more marking operations can also be effected for each sheet while changing the stencils for each marking operation.

It is another feature of the invention that the holding of the sheet K, such as a hot iron sheet, at a position below the sprayers **14** and **15** for the marking can also be used for sizing the sheet. As a result, the marking and sizing can simultaneously be effected, and the overall efficiency of the manufacture of the sheets can be improved.

Although the present invention has been described with a certain degree of particularlity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

We claim:

1. A method of marking a sheet by use of a resilient discrete stencil having a pattern of punched holes representative of a mark to be printed on the sheet, said method comprising the steps of feeding said resilient stencil having punched holes representing a mark to be printed on the sheet to a marking station along a first path by a first pair of spaced parallel conveyors; holding the stencil stationary in the marking station by a second pair of spaced parallel conveyors in cooperation with said first pair of conveyors, said conveyors holding the stencil in a horiziontal plane along one edge of the stencil by pinching between one conveyor of said first pair and the corresponding one of the second pair, and by pinching an opposite other edge between the

other conveyor of said first pair and the correspnding other of said second pair; feeding the sheet to be marked to the marking station along a second path perpendicular, under and without contact with said first path in the marking station; holding the sheet stationary in the marking station so that a portion of the sheet to be printed faces the flexible stencil being held in said horizontal plane with a spacing therebetween; effecting marking of the sheet by spraying pigment onto the stencil and through said punched holes and onto the sheet, impact of the pigment causing the stencil to flex to contact the sheet being held stationary in the marking station; terminating spraying and thereby terminating contact of said stencil with said sheet; and removing the stencil and the sheet from the marking station for preparation of the next marking process by means of said conveyors.

2. The method of claim **1** wherein two stencils are simultaneously transferred for marking a sheet of hot steel.

3. A device for marking a sheet at a marking station by use of a resilient discrete stencil having a pattern of punched holes, said device comprising in combination, said resilient discrete stencil; a first pair of spaced parallel conveyors adapted to receive said stencil for moving the stencil toward and then away from a marking station along a first path; a second pair of spaced parallel conveyors adapted for holding the stencil stationary in horizontal plane in cooperation with said first pair of conveyors, said holding of the stencil being by pinching one edge of the stencil between one conveyor of said first pair and the corresponding conveyor of said second pair, with an opposite edge of the stencil being pinched between the other conveyor of said first pair and the corresponding other conveyor of said second pair; feed means for moving the sheet to be marked along a second path toward the marking station; means for holding the sheet to be marked stationary in the marking station and spaced from the stencil; means for marking said sheet by spraying pigment against the stencil and through said pattern of holes, the resilient stencil being flexed into contact with the surface of the sheet by pigment impacting said stencil, means for terminating pigment spraying and thereby terminating contact of the stencil with the sheet; and means for moving the sheet away from the marking station after marking; said first and second paths being mutually perpendicular, the second path being disposed under and without contact with the first path at the marking station.

4. The device of claim **3** wherein the conveyors of said first pair are made of steel.

5. The device of claim **3** wherein the spacing between the stencil and the sheet in the marking station is selected so that a substantial area of the surface of the stencil comes into contact with the sheet at the time of printing.

6. The device of claim **3** including further means for removing the stencil from said first pair of conveyors after transfer from the marking station.

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