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Dubuit

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[54] **TWO-COLOUR PRINTING MACHINES USING THE SILK-SCREEN PROCESS**

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[52] **U.S. Cl.** ..... **101/38 A,** 101/115, 101/124, 101/126, 118/220, 118/230

[51] **Int. Cl.** **B41f 17/22**

[58] **Field of Search** 101/38–40, 101/124, 126, 115, 35; 118/220, 230, 314, 319

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Assistant Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Young & Thompson

[57] **ABSTRACT**

A machine for printing in two colours by the silk-screen process, on objects such as tubes, cases, small flasks of synthetic material and the like, comprising a conveyor carrying, at uniformly-spaced intervals, an odd number of rotatable mandrels each adapted to receive an object to be printed, a drive for effecting a forward step-by-step movement of the conveyor with a step which is an even multiple of the interval, and two printing stations disposed along the conveyor and spaced apart from each other by a distance which is an odd multiple of the interval, each printing station comprising a silk-screen movable in translation and a squeegee, the conveyor comprising a star-plate rotatably mounted about a horizontal axis, the mandrels being also horizontal, and wherein the screens of the printing station are oblique with respect to each other.

16 Claims, 6 Drawing Figures

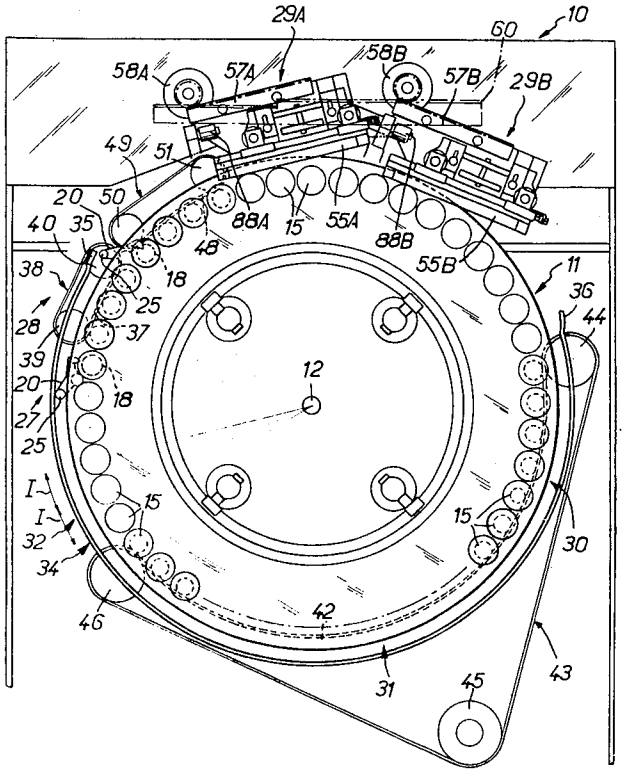


FIG. 1

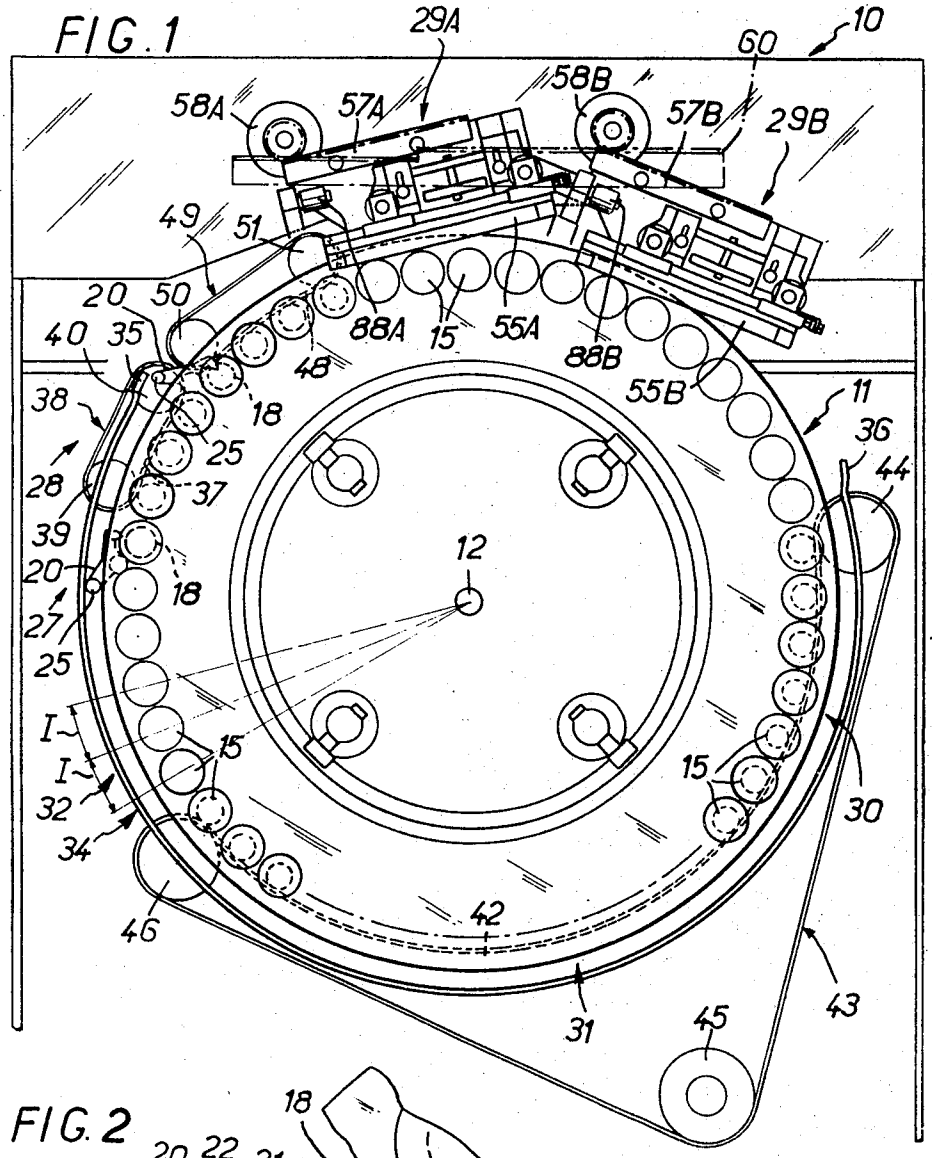

29A
10
60
58B
58A
57A
57B
29B
49
51
20
50
40
35
88A
15
55A
88B
55B
48
11
38
18
36
25
44
28
37
39
12
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18
27
25
I
I
15
15
32
30
34
42
46
31
45
43

FIG. 2

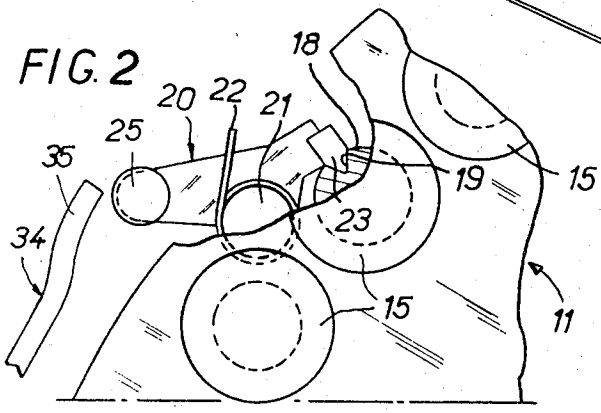

18
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22
21
25
35
19
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11

FIG. 3

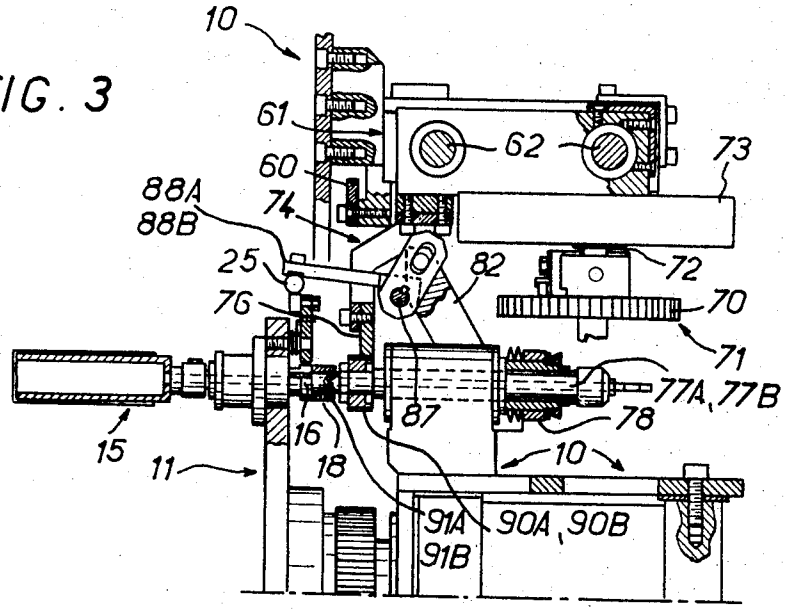

10
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62
73
60
88A
88B
74
25
82
72
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70
71
77A, 77B
87
78
15
16
18
11
10
91A
91B
90A, 90B

FIG. 4

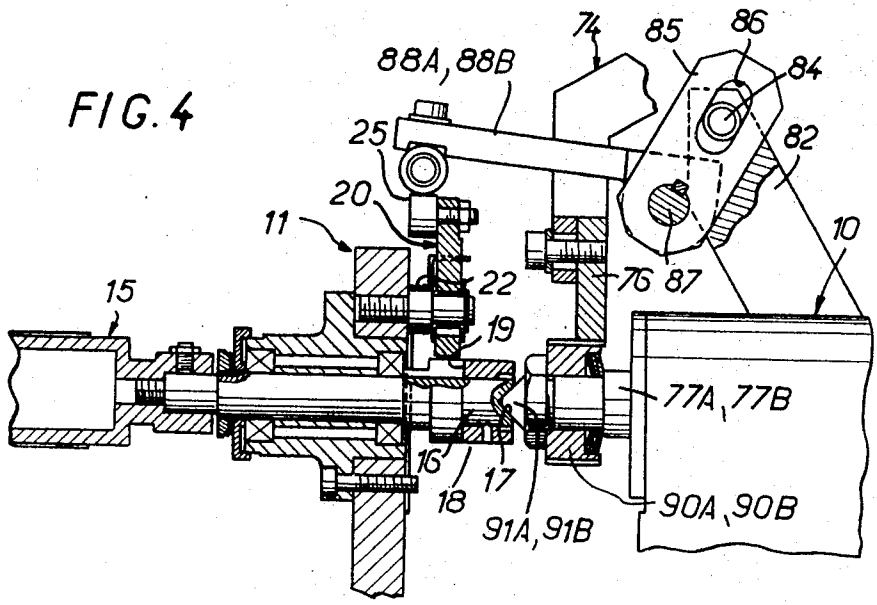

74
85
86
84
88A, 88B
82
25
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76 87
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77A, 77B
16
17
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90A, 90B
91A, 91B

FIG. 5

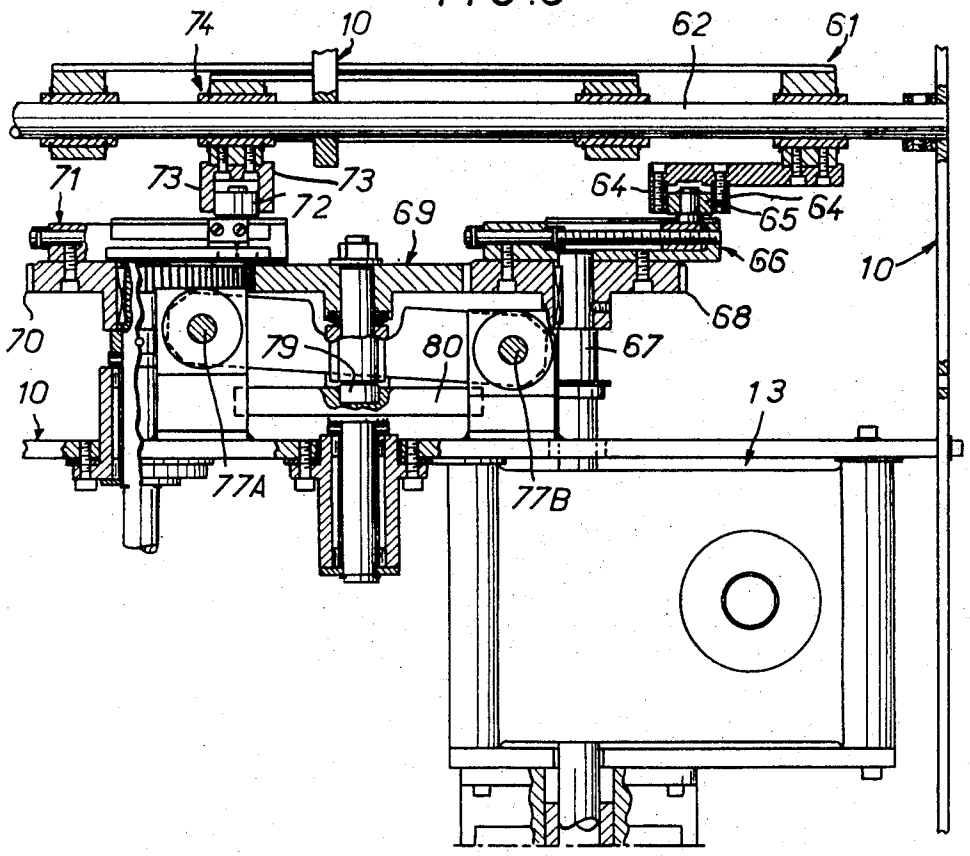
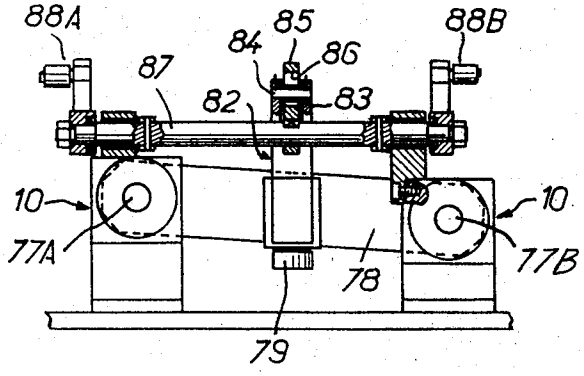

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80
67
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77A
77B

FIG. 6


88A
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88B
87
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83
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77A
77B
78
79

TWO-COLOUR PRINTING MACHINES USING THE SILK-SCREEN PROCESS

The present invention relates generally to printing in two colours on various objects, such as tubes, cases, small flasks of synthetic material or the like, by the so-called serigraphic or silk-screen process.

A machine of this kind must comply with certain essential conditions.

The first condition refers to the necessity of ensuring the drying of the first colour before the application of the second in order to avoid smearing of this first colour.

In order to ensure sufficient drying time between these two impressions, it has already been proposed to arrange the objects to be printed on rotating mandrels carried in odd numbers at regular intervals by conveying means with a vertical shaft, in co-operation with operating means intended to effect a forward step-by-step movement of the said conveyor means with a step which is an even multiple of the said interval on the one hand, and on the other hand with two printing stations arranged along the said conveyor means and distant from each other by a distance which is an odd multiple of the said interval.

Thus, the distance of the printing stations and the forward step of the conveyor means forming between them prime numbers, an object which has just been printed at a first printing station passes first of all to this second printing station without receiving any impression, and only receives such a second impression upon its second passage over the second printing station, so that sufficient drying time has elapsed between these two impressions.

However, the arrangement of the said conveying means on a vertical axis lends itself badly to the positioning on these means of the objects to be printed and renders difficult the equipment of the printing stations with screens of the usual type.

Another essential condition to be observed for a machine of this type tends to ensure a reference marking of the impression of the second colour with respect to the impression of the first.

The present invention has for its object a machine for printing on various objects in two colours by the silk-screen process, complying in a simple and satisfactory manner with these various essential conditions, and which is free from the drawbacks briefly referred to above.

The machine according to the invention is of the kind comprising conveyor means carrying at regular intervals an odd number of rotatable mandrels, each capable of recciving an object to be printed, control means intended to effect a forward step-by-step movement of said conveyor means with a step which is an even multiple of the said interval, and two printing stations arranged along the said conveyor means and separated from each other by a distance which is an odd multiple of the said interval, each printing station comprising a silk screen movable in translation and a squeegee, and is characterized in that the said conveyor means are constituted by a plate, known as a "star" rotatably mounted about a horizontal axis, the mandrels being also horizontal, and in that the screens of the printing stations are oblique with reference to each other and form a slight angle with the horizontal plane.

The arrangement on a horizontal axis of the said star facilitates the placing in position of the objects to be printed on the mandrels carried by the star and enables the printing stations to be equipped with flat screens of the usual type, the positioning of these screens being further facilitated by their obliquity with respect to each other.

In addition, each mandrel is freely mounted on the star, in combination on the one hand with indexing means intended to give the said mandrels a definite angular position with respect to the said star, and on the other hand with means for driving in rotation intended to ensure their rotation in synchronism with the translation movement of the screens.

The angular indexing means associated with the mandrels comprise, for each mandrel, a locking pawl pivotally mounted on the plate and urged by a spring for the application of one of its extremities against the corresponding mandrel, the said mandrel having a notch in which there may be engaged the said extremity of its locking pawl, in co-operation on the one hand on the upstream side of the printing stations, with a fixed ramp or curved belt bearing against the mandrels over part of the periphery of the plate, for rotation of the said mandrels during the rotation of the said plate, and on the other hand, at each printing station, a release lever pivotally-mounted and intended to act on the locking pawl of the mandrel present at the printing station considered, for the liberation of this mandrel in rotation.

These indexing means with individual locking pawls make it possible to ensure, in a very simple and very reliable manner, the desired angular reference position for the mandrels, without it being necessary to provide any reference mark on the objects carried by the said mandrels, and acting on the first printing station and then on the second, they provide accurate reference marking of the second colour with respect to the first.

With regard to the means for driving the mandrel in rotation, these preferably comprise dog-clutch shafts mounted axially movable in translation at the printing stations, for co-operation with a dog-clutch tail provided for that purpose on each mandrel, and driven in rotation in synchronism with the translation of the screens.

Each dog-clutch shaft preferably carries, for its rotational drive, a pinion which engages with a toothed rack common to the two dog-clutch shafts, the said toothed rack being rigidly fixed on a trolley movable mounted for translation in synchronism with the translation movement of the screens.

Such a drive by pinion and toothed rack is capable of ensuring the desired rotation of the dog-clutch shaft with great accuracy and great fidelity, without any irregular taking-up of play in one direction or in the other.

The trolley carrying the toothed rack effecting the rotation of the dog-clutch shaft is preferably mounted movably on the same slides as those on which the trolley effecting the translation of the screens is also movably mounted.

This results in simplification of the construction of the machine.

Also, these slides preferably form conjointly a horizontal plane, each of the trolleys being driven in lateral movement by a plate crank with a vertical axis of rotation.

These plate-cranks being thus horizontal, it is advantageously easy to adjust the lateral travel which they are to effect.

The objects of the invention, their characteristic features and their advantages will furthermore be brought out in the description which follows below by way of example, reference being made to the accompanying diagrammatic drawings, in which:

FIG. 1 is a partial view in front elevation of a machine according to the invention, after the elimination of certain parts of the machine;

FIG. 2 shows to a larger scale a part of FIG. 1 with portions broken away;

FIG. 3 is a partial view in transverse section of the machine according to the invention, an external view being given of certain elements of this machine;

FIG. 4 shows a view in partial cross-section and to a larger scale of the machine according to the invention, showing a detail of FIG. 3;

FIG. 5 is a partial view in rear elevation of the machine according to the invention, with parts broken away locally and with local sections;

FIG. 6 is a partial rear view in elevation of the machine according to the invention, illustrating a detail of this machine which is not shown in FIG. 5.

The machine according to the invention comprises a frame, of which only certain parts can be seen on the figures, in which they have all been given the same reference number, namely the reference **10.**

On this frame **10** is rotatably mounted a plate **11** keyed on a horizontal shaft **12,** this shaft being controlled in step-by-step rotation from a so-called indexing device **13,** shown in FIG. 5; a plate of this kind is commonly known as a star.

Close to its periphery, the plate or star **11** carries at regular angular intervals I an odd number of mandrels **15,** these angular intervals I being half the angular forward step P applied to the shaft **12** by the indexing device **13.**

The mandrels **15** are horizontal and are mounted freely rotatable on the plate **11;** behind this plate, they are extended by a dog-clutch tail **16** (FIG. 3), the extremity of which is provided with a slot **17** shown in FIG. **4.**

According to one aspect of the present invention, this dog-clutch tail **16** carries a cylindrical hub **18** provided locally with a notch **19** shown in FIGS. **2** and **4.**

Conjointly, with each mandrel **15** is associated an individual locking pawl **20** pivotally mounted about a shaft **21** carried by a plate **11,** and urged by a torsion spring **22** so as to be applied by one of its extremities **23** against the hub **18** carried by the dog-clutch tail **16** of the mandrel **15** considered.

At its other extremity, the locking pawl **20** carries a roller **25.**

Each locking pawl **20** is arranged in such manner that its extremity **23** can be engaged in the notch **19** of the hub **18** of the dog-clutch tail **16** of the corresponding mandrel **15,** as has been shown in FIG. 1 for one of these mandrels and which can be seen from FIG. **2.**

Around the plate **11,** on the front face of the machine, are successively arranged: a supply station **27** for placing the objects to be printed in position on the mandrels **15;** a flaming station **28;** a first printing station **29A;** a second printing station **29B;** one or more drying stations **30;** a cooling zone **31;** and an ejection station **32** for removing the printed objects.

All round the plate **11,** from the flaming station **28** to the drying station **30,** passing through the lower part of the said plate, and therefore excluding the stations **29A, 29B,** runs a fixed ramp **34** against which the roller **25** of each locking pawl **20** can come into contact.

This fixed ramp **34** is arranged in such manner as to force such a locking pawl **20** to leave free for rotation the corresponding mandrel **15,** as has been shown in FIG. **1** in connection with one of these mandrels.

In order to facilitate the entrance of the locking pawls **20** on the fixed ramp **34,** the latter is provided with flared extremities **35, 36.**

At the flaming station **28** there are provided means intended to ensure the rotation of the mandrels **15.**

In the example of construction shown, these means are constituted by one of the sides **37** of a belt **38** passed in an endless loop over two pulleys **39, 40,** one of which is driven in rotation, the said side **37** being applied against the hubs **18** carried by the dog-clutch tails **16** of the mandrels **15** located at the flaming station **28** (see FIG. **1**) and in practice against at least two of these hubs.

According to a similar arrangement, one of the sides **42** of a belt **43** passed in an endless loop over three pulleys **44, 45** and **46** which are arranged in a triangle and one of which is driven in rotation, is applied against the hubs **18** of the dog-clutch tails **16** of the mandrels **15** located at the drying stations **30** and in the cooling zone **31** (see FIG. **1**).

Between the flaming station **28** and the first printing station **29A** extends a curved ramp bearing against the hubs **18** of the dog-clutch tails **16** of the mandrels **15** located on the corresponding portion of the periphery of the plate **11.**

In the example shown, this curved ramp is constituted by one of the sides **48** of a belt **49** passed in an endless loop over two fixed pulleys **50, 51,** neither of which is driven in rotation; due to its flexibility, this side **48** is applied in an advantageously reliable manner against the hubs **18** of the mandrels **15** concerned, and by friction is able to ensure rotation of these mandrels with respect to the plate **11** during the rotation of this latter.

Each printing station **29A, 29B** comprises a silk screen **55A, 55B** oblique to the horizontal; these screens **55A, 55B** are thus oblique with respect to each other and are rigidly fixed to toothed racks **57A, 57B** which each engage with a driving pinion **58A, 58B,** as shown in FIG. **1.**

These driving pinions **58A, 58B** are keyed for rotation on pinions which are not shown in the drawings and which are both engaged with the same toothed rack **60** common to the two screens **55A, 55B,** the latter being carried by a trolley **61** movably mounted for translation on two slides **62** belonging to the frame of the machine.

According to a particular arrangement of the invention, these slides **62** form conjointly a horizontal plane as shown in FIG. **3.**

In known manner, with each screen **55A, 55B** is associated a squeegee (not shown in the drawings) carried for example by a pneumatic device (also not shown) capable of permitting its alternating movement with respect to the corresponding screen, substantially perpendicularly with respect to the said screen.

As can be seen from FIG. **5,** the trolley **61** which controls the screens **55A, 55B** carries two horizontal slides

64 forming a groove in which is engaged a roller 65 mounted radially adjustable in position on a crank-plate 66 keyed on a driving shaft 67 driven in rotation in synchronism with the plate 11.

According to one aspect of the invention, this crank-plate 66 is rigidly fixed to a pinion 68 which engages with an intermediate pinion 69 and this latter engages in turn with the pinion 70 of a second crank-plate 71.

As previously, this crank-plate 71 carries a roller 72 mounted radially adjustable in position on the crank-plate 71, and this roller 72 is engaged in two slides 73 forming a groove and carried horizontally by a second trolley 74 which, like the trolley 61, is slidably mounted on the slides 62 and which effects the rotation of the mandrels 15 at the printing stations.

The crank-plates 66 and 71 have their axes vertical, and the planes of the trolleys 61 and 74 are therefore horizontal.

This arrangement advantageously facilitates the adjustment of the radial position of the rollers 65 and 72 on these crank-plates; this adjustment may be indicated by an index which moves opposite a fixed scale carried by the corresponding crank-plate.

As is clearly shown in FIG. 3, the trolley 74 carries a toothed rack 76 parallel to the toothed-rack 60 carried by the trolley 61.

In addition, two horizontal dog-clutch shafts 77A, 77B are mounted movable for rotation and movable axially in the frame 10, behind the plate 11, at the printing stations 29A, 29B corresponding (see FIG. 3).

These dog-clutch shafts 77A, 77B are keyed axially on a common cross-member 78 (FIGS. 3 and 6) and this common cross-member 78 carries a roller 79 engaged in the track of a dog-clutch cam 80 (FIG. 5), this dog-clutch cam 80 being keyed for rotation in synchronism with the crank-plates 66, 71 through the intermediary of the pinion 69.

The cross-member 78 common to the dog-clutch shafts 77A, 77B carries in its central portion a bracket 82, the free extremity of which forms a fork 83 and carries transversely a shaft 84 (FIG. 6).

This shaft 84 serves to operate a crank-pin 85 which is engaged for that purpose between the arms of the fork 83, and has an elongated slot 86 through which passes the shaft 84 (see FIG. 6).

The crank-pin 85 is keyed on a horizontal shaft 87 which pivots laterally and on each side of the frame 10.

On the extremities of this shaft 87 are fixed and keyed two release levers 88A, 88B, the extremities of which extend in such manner as to be able to act, at the corresponding printing stations 29A, 29B, on the rollers 25 of the locking pawls 20 associated with the mandrels 15 located at these printing stations.

The dog-clutch shafts 77A, 77B furthermore each carry a pinion 90A, 90B which engages with the toothed-rack 76 carried by the trolley 74 and terminate in a nipple 91A, 91B, capable of penetrating into the slot 17 of the dog-clutch tail 16 of a mandrel, as shown in FIGS. 3 and 4.

The objects to be printed are placed in position on the mandrels 15 at the supply station 27 while the mandrels are free for rotation due to the action of the cam 34 on their locking pawls 20.

After flaming at the flaming station 28, with rotation by the side 31 of the driven belt 38, the objects to be printed arrive step-by-step at the first printing station 29A.

On the corresponding travel, the side 48 of the fixed belt 49 causes the mandrels 15 to rotate with respect to the plate 11, due to the forward movement of this plate 11.

During the course of the rotation of these mandrels with respect to the plate 11, the notch 19 of their hub 18 comes facing the extremity 23 of their locking pawl 20 and, due to the action of the spring 22 which urges this latter, the said extremity 23 is engaged in the said notch 19.

The mandrels 15 are from thence locked for rotation and are therefore indexed, that is to say angularly set with reference to the plate or star 11 on which they are carried, and therefore with respect to the other parts of the machine.

In practice, the objects to be printed do not at first receive any impression at the printing station 29A. They then arrive at the second printing station 29B.

Due to the rotation of the dog-clutch cam 80 with which is engaged the roller 79 carried by the cross-member 78 common to the dog-clutch shafts 77A, 77B, these shafts are operated in axial sliding, in the direction of the plate 11 which is then indexed in position, and in particular the nipple 91B of the dog-clutch shaft 77B passes into the slot 17 of the dog-clutch tail 16 of the mandrel 15 located at the printing station 29B.

Conjointly, the bracket 82 rigidly fixed on this common cross-member 78 controls the downward movement of the release lever 88B and this latter, acting on the locking pawl 20 associated with the mandrel 15 located at the printing station 29B, liberates this mandrel for roation.

The crank-plates 66, 71 then cause the corresponding trolleys 61, 74 to slide in the same direction, and these latter, through the intermediary of the toothed-racks 60, 76, effect on the one hand the lateral movement of the silk screen 65B of the printing station 29B, and on the other hand the synchronous rotation of the mandrel 15 present at this printing station.

The object carried by this mandrel thus receives a first impression. After this impression, the dog-clutch shafts 77A, 77B are brought back to their initial position which frees the mandrel concerned and enables the star 11 to continue its step-by-step forward movement.

The objects having received a first impression then pass to the drying station 30 and then to the cooling station 31, with rotation by the driven belt 43.

After a fresh angular setting by the fixed belt 49, the objects to be printed are again presented at the printing station 29A, at which they then receive a second impression.

The objects which have thus been given two impressions are then removed from the star 11 at the ejection station 32.

In practice, after a first complete revolution of the star 11, an object receives its second impression at the station 29A, while another object is receiving its first impression at the station 29B.

As will have been understood, the adjustment of the rollers 65, 73 on the crank-plates 66, 71 permits regulation of the travel of the corresponding trolleys 61, 74, which travels must be identical. It will of course be understood that the present invention is not limited to the

form of embodiment described and shown, but includes any alternative form of construction.

In particular, the belt **49** which ensures the indexing of the mandrels may be mobile; it may also be replaced by a fixed ramp.

Similarly, the flaming station may be replaced by any desired treatment station.

In addition, according to an alternative form (not shown) the indexing means for the mandrels and the rotational driving means of the mandrels comprise a toothed ring common to all the mandrels, the said ring being driven in rotation in synchronism with the lateral movement of the screens and engaging with pinions each respectively keyed on the mandrels.

According to another alternative form (not shown) the mandrels may each be provided with a bore for the penetration of one extremity of the objects to be printed.

In the case for example of the printing of flasks having a neck, this bore preferably has a diameter slightly less than that of this neck for the forcible penetration of this neck into the bore.

According to another alternative form (not shown) there is provided at each printing station a rotatable base movably mounted for translation parallel to the axis of the star, under the control for example of a pneumatic jack, such a base being intended to come on top of the corresponding extremity of an object to be printed in order to ensure better behaviour during its printing.

Finally, according to another alternative (not shown) the indexing device **13** is replaced by a Maltese cross.

What we claim is:

1. A machine for printing in two colours by the silk-screen process on objects such as tubes, cases, small flasks of synthetic material and the like, comprising, conveying means carrying at uniformly-spaced intervals an odd number of rotatable mandrels each adapted to receive an object to be printed, driving means for effecting a forward step-by-step movement of said conveying means with a step which is an even multiple of said interval, and two printing stations disposed along said conveying means and spaced apart from each other by a distance which is an odd multiple of said interval, each printing station comprising a silk screen movable in translation and a squeegee, where said conveying means comprises a star-plate rotatably mounted about a horizontal axis, said mandrels extending horizontally from said star-plate, and wherein the screens of said printing station are oblique with respect to each other.

2. A machine as claimed in claim **1,** in which the screens of said printing station are both oblique with respect to the horizontal.

3. A machine as claimed in claim **1,** in which each said screen is mounted fast with a toothed rack with which engages a driving pinion, said driving pinion being keyed for rotation on another pinion, said other pinion engaging with an operating toothed rack for the two screens, said operating rack being movable longitudinally in translation, alternately in one direction and in the other, in synchronism with the driving means of said star-plate.

4. A machine as claimed in claim **1,** in which each said mandrel is mounted freely rotatable on said star-plate, indexing means for determining for said mandrel a definite angular position with respect to said star-plate before printing, and rotational driving means for insuring the rotation of said indexed mandrel in synchronism with the translation movement of said screens.

5. A machine as claimed in claim **4,** in which, for each printing station, the rotational driving means of said mandrels comprise a dog-clutch shaft driven in rotation in synchronism with the translation of said screen, said dog-clutch shaft being also movable axially in translation so as to co-operate with a dog-clutch tail on each said mandrel.

6. A machine as claimed in claim **5,** in which for its rotational drive, each said dog-clutch shaft carries a pinion which engages with a toothed rack common to the dog-clutch shaft of each screen, said toothed-rack being rigidly fixed to a trolley mounted movably in translation in synchronism with the translation movement of said screens.

7. A machine as claimed in claim **6,** in which the trolley carrying the toothed-rack which actuates said dog-clutch shafts is movably mounted on slides on which is also movably mounted a trolley carrying the toothed-rack effecting the translation movement of said screens.

8. A machine as claimed in claim **7,** in which said slides form conjointly a horizontal plane, each of said trolleys being driven in translation movement by a crank-plate having a vertical axis of rotation.

9. A machine as claimed in claim **8,** in which the two crank-plates are synchronous in rotation and ensure a movement in the same direction of the trolley effecting the translation movement of said screens and of the trolley effecting the rotational drive of said dog-clutch shafts.

10. A machine as claimed in claim **4,** in which the indexing means for said mandrels comprise, for each mandrel, a locking pawl pivotally mounted on said star-plate and urged by a spring into application on one of its extremities against a notch of the corresponding mandrel, a curved ramp on the upstream side of the printing stations bearing against said mandrels over a part of the periphery of said star-plate, for rotation of said mandrels by friction to align said notch with said pawl, a releasing lever at each respective printing station pivotally mounted and adapted to act on the locking pawl of the mandrel located at the respective printing station to remove said pawl from said notch, for the liberation in rotation of said mandrel.

11. A machine as claimed in claim **10,** in which said releasing levers are controlled for rocking movement in dependence on a cam driven in synchronism with the translation movement of the dog-clutch shafts for insuring the rotation of said mandrels after their liberation for rotation.

12. A machine as claimed in claim **10,** in which said curved ramp ensuring the frictional drive of said mandrels is constituted by one of the sides of a belt passed in an endless loop over at least two fixed pulleys.

13. A machine as claimed in claim **12,** in which said belt is fixed.

14. A machine as claimed in claim **12,** in which said belt is movable.

15. A machine as claimed in claim **10,** in which a fixed ramp runs over a part of the periphery of said star-plate, adjacent at least one of a treatment station before printing, and a drying station after printing; said

ramp acting on the locking pawl of the mandrels which are located opposite to it for maintaining said pawl out of contact with the notch of said mandrels, and means to ensure rotation of said mandrels at at least one of said stations.

16. A machine as claimed in claim **15,** in which for at least one of said treatment and drying stations, the means adapted to ensure rotation of the mandrels at such station are constituted by one of the sides of a belt passed in an endless loop over at least two pulleys of which one is driven in rotation, said side bearing against at least one of said mandrels.

* * * * *