

Oct. 13, 1959

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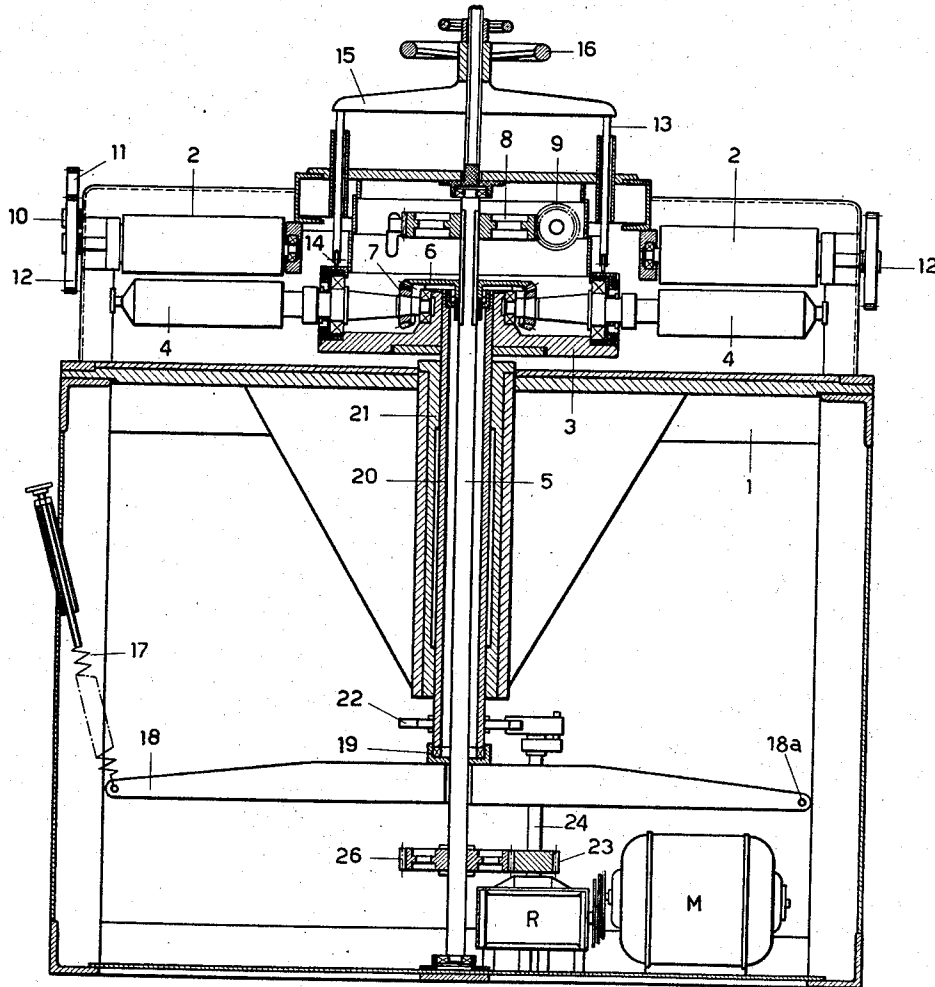
2,908,218

MACHINE FOR PRINTING ON ARTICLES IN THE SHAPE
OF DEVELOPABLE BODIES OF REVOLUTION

Filed July 6, 1956

2 Sheets-Sheet 1

Fig. 1



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2 Sheets-Sheet 2

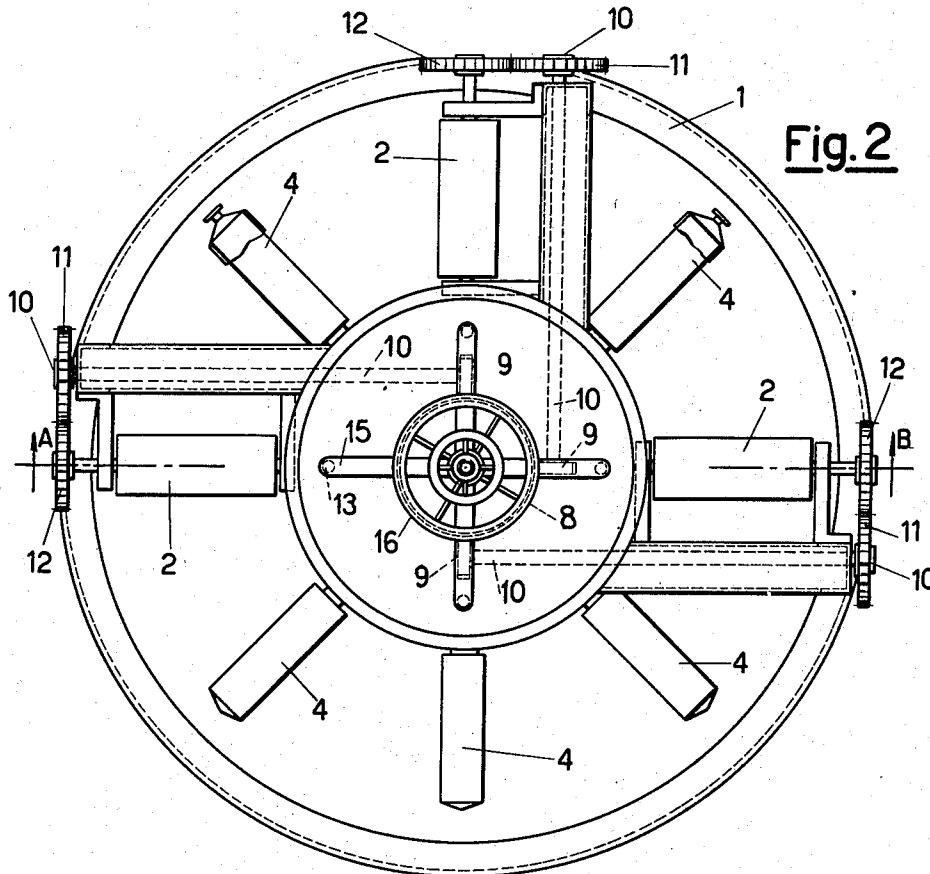


Fig. 2

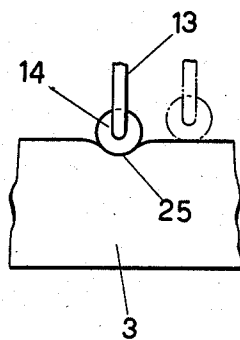


Fig. 3

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**MACHINE FOR PRINTING ON ARTICLES IN THE
SHAPE OF DEVELOPABLE BODIES OF REVOLU-
TION**

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6 Claims. (Cl. 101—38)

The printing on plastics requires a technique quite different from that used for printing on fabrics or on paper, owing to the fact that plastics have a very reduced porosity, so that printing takes place not by absorption, as in the case of paper, fabrics and the like, but by deposition on the surface. The colour or ink is not absorbed, but after evaporation of the solvent there is formed a film that can adhere to the plastics only if the liquid vehicle contains mordants for plastics.

On the other hand, the use of colours or inks based on mordants excludes the use of offset or screen printing machines because the colour dries too quickly and, moreover, it may damage the usual rubber rolls of such machines.

However, dyes based on mordants are extensively employed in an intaglio printing process using engraved copper rollers, for printing on calendered materials of vinyl resin. The solvents are sufficiently volatile and prints in several colours can be obtained with machines very similar to those adopted in the textile industry.

It is an object of the present invention to provide a machine suited for printing in several colours on cylindrical articles of plastics, for example, on tubes of plastics.

It is an object of the present invention to build a machine permitting printing in several colours, while eliminating the difficulty of registration, on articles having the shape of developable bodies or revolution.

In the existing process for printing with engraved rollers, the printing roller carries engraving corresponding to the profile of the picture or writing that is to be printed and is immersed in a basin containing the dye or ink.

Against the printing roller there is pressed a scraper knife for removing the excess dye or ink, so that the colouring matter remains only in the cavity or engraving.

The scraper knife is usually subjected to a slow longitudinal movement that avoids continuous contact between the same portions of the surfaces of the knife and the printing roller.

In existing intaglio printing machines, the printing roller is ordinarily pressed with a certain pressure against a roller, called the pressure roller, that is disposed under the printing roller and is made to turn by the printing roller, and the plastics in the shape of a continuous sheet or tape is fed between the two rollers.

The machine according to the present invention permits, as mentioned above, printing by the intaglio process with several colours on articles of flexible plastics having the shape of bodies of revolution, and includes a turret having rotatable mandrels extending radially therefrom for carrying the articles to be printed, the turret being rotatable about a vertical central axis and movable vertically along that axis, a series of printing rollers extending radially from the vertical central axis in fixed positions in a horizontal plane above the mandrels, a drive mechanism operative to effect the step-by-step rotation of the turret so that the mandrels are brought successively under the

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printing rollers while the printing rollers and mandrels are continuously rotated, and means operative to displace the turret downwardly relative to the printing rollers during turning of the turret, so that the mandrels are then spaced from the printing rollers, and to move the turret upwardly when the mandrels are positioned below related printing rollers, so that articles on the mandrels are then urged into printing contact with the printing rollers.

A machine embodying this invention is represented in the accompanying drawings, wherein:

Fig. 1 is a vertical sectional view of the machine taken along the line A—B in Fig. 2;

Fig. 2 is a plan view of the machine; and

Fig. 3 is an enlarged detail view of cooperating elements included in the machine of Figs. 1 and 2.

Referring to Figs. 1 and 2 in detail, it will be seen that the various members of the machine are supported by a sturdy frame 1, e.g. of steel spars, and include printing rollers 2 arranged with their axes all lying on the same horizontal plane and extending radially from the vertical central axis of the machine. The usual devices for feeding the dye to the printing rollers 2 are neither illustrated in the drawings nor described herein, as such devices may be of conventional construction. A mandrel carrying turret 3 having mandrels 4, mounted radially thereon is subjected to two movements: that is, an intermittent rotation about the vertical central axis of the machine and a vertical movement along said axis which is also intermittent.

The intermittent rotation has the purpose of successively disposing the axes of the mandrels 4 in the same vertical radial planes as the axes of the printing rollers 2, while the vertical movement has the function of approaching or removing the mandrels to and from the printing rollers.

As can be seen in Fig. 1, the turret 3 is fitted on a hollow shaft 20 which is mounted within a support sleeve 21 so that the hollow shaft can slide vertically within its support sleeve. A lever 18 which is pivoted at one end, as at 18a, has its other end connected to an adjustable spring 17, and serves to support the hollow shaft 20 by engaging a thrust ball bearing 19 at its lower end. A downward pressure is exerted by a plate 15, the position of which is adjusted by a handwheel 16, and by extensions 13, each of which has a small wheel 14 at its lower end for rolling contact with the upper surface of the turret 3. On the surface of the turret there are provided grooves 25 (Fig. 3) which extend radially so that, as soon as a small wheel 14 enters a groove 25, the turret 3 pushed upwards by the lever 18, can rise by an amount equal to the depth of the groove and in that way the mandrel comes into contact with the overlying printing roller.

A shaft 5 extends axially through hollow shaft 20 and has a grooved portion near the turret 3 on which a bevel gear 6 is slidably mounted to rest on the turret 3 so that, when the turret is lifted or lowered, the bevel gear 6 is also lifted or lowered equally to remain in engagement with bevel pinions 7 coaxial with the respective mandrels. The transmission of rotary movement to the printing rollers 2 is achieved in the following manner: the shaft 5 carries, at the height of the printing rollers, a helical gear 8 having the same number of teeth as the bevel gear 6. The helical gear 8 meshes with wheels 9 which also have helical teeth equal in number to the teeth on the bevel gears 7. The wheels 9 are carried by shafts 10, each of which also carries a toothed wheel 11 with straight teeth meshing with a related wheel 12 which also has straight teeth and which is coaxial with a printing roller. The ratio between the number of teeth on the gears 11 and 12 is equal to the ratio between the diameter of the printing rollers and the external diameter of the round

articles on which printing has to be performed, so that the round articles to be printed and the printing roller have the same peripheral speed and, in that way the printing roller and the article, supported by the mandrel, roll without sliding upon one another and the registration of the various coloured zones, indispensable for multi-colour printing on a single article, is obtained easily. In order further to simplify the mechanism and to avoid transmission or disengaging members, the printing rollers are continuously rotated and, hence they keep rotating even during the inactive phase (inactive as to printing), of intermittent rotation of the turret 3 about the vertical central axis of the machine. Thus, a portion of the surface of the printing roller, having a certain angular extent, corresponds to the angular displacement of the turret 3 and that portion of the printing roller should be free of engravings and of course the angular extent of that portion has to be taken into account in determining the diameter of said printing roller.

The drive for producing the desired movements is derived from a motor M coupled to a speed reducer R having an output shaft 24 whereon there is mounted a toothed wheel 23 meshing with a toothed wheel 26 on the shaft 5 for continuously rotating the latter and, as already mentioned, for causing the continuous rotation of all of the printing rollers 2 as well as of the mandrels 4 through the gear systems described above. The ratio between the gears 23—26 and 6—7 is established in such a way as to ensure one complete revolution of each mandrel 4 during the period when it is in rolling contact with a printing roller 2. At the upper end of the shaft 24 and at the corresponding level on the hollow shaft 20 there are secured the cooperating elements of a mechanism 22, which may be a detent mechanism, Maltese cross or the like suited for effecting the intermittent rotary movement of the hollow shaft 20 and, consequently, of the turret 3 secured to the latter.

The simple operation of the apparatus therefore can be summarized as follows: As already set forth, all of the printing rollers are in continuous rotation irrespective of their position relative to the mandrels. After a short period, the mechanism 22 turns the hollow shaft 20 through a certain angle and the turret 3 turns with shaft 20. The turret rotates until the small wheels 14 enter the grooves 25 (Fig. 3); and, when this occurs, the lever 18, urged by the spring 17, pushes the hollow shaft 20 and the turret 3 upwards, so that the mandrels with the articles fitted thereon are lifted and the articles come into contact with the printing rollers. The printing rollers have as already mentioned a continuous movement of rotation about their own axes, said movement being derived from the shaft 5, the gears 3 and 9, the shaft 10, the gears 11 and 12, while the mandrels also rotate, with a movement derived from the shaft 5, through the pair of bevel gears 6 and 7. When printing with one colour has taken place, the turret is again angularly displaced so that the small wheels 14 disengage from the grooves 25 causing the lowering of the turret 3 and consequently of the mandrels 4 so that the contact of the articles to be printed with the printing rollers ceases.

It should be noted that the mandrels are angularly spaced apart by an angle which is a sub-multiple of the angle formed by the axes of two consecutive printing rollers for providing one or more intermediate rest positions between two subsequent printing operations, which may be useful to facilitate drying of the volatile part of the dye or ink.

When the mandrels have moved past the rest positions, they are again disposed under printing rollers which are immediately subsequent to the rollers that had previously printed the colour on the article, and the cycle recommences.

In addition to the simplicity of construction and operation, whereby the synchronization of the movements of the mandrels and of the printing rollers takes place auto-

matically without requiring continual checking of registration, there is afforded the further advantage that the mandrels, the printing rollers and also the gears can be easily replaced if the dimensions of the articles to be printed change.

Although the above described machine is intended for printing with a number of colours on cylindrical articles, it is obvious that the machine can print articles having the shape of bodies of revolution with developable surface, for example, conical articles. In the latter case, the mandrels and the printing rollers will have to be conical, and there can be provided an adjustment of the angle between the axes of the rolls 2 and of the mandrels 4 by means of eccentric supporting bushes or other equivalent means.

What I claim is:

1. A machine for printing with several colors on articles of non-porous material having the shape of bodies of revolution with developable surfaces; comprising a turret having a hollow shaft depending centrally from the latter, a vertical sleeve in which said hollow shaft is rotatable and vertically slidable, thereby to support the turret for rotation about a vertical, central axis and for vertically upward and downward movement, a series of rotatable article carrying mandrels carried by said turret to move with the latter and arranged with their axes of rotation extending radially from said central axis and with equal angular spacing therebetween, a plurality of printing units each including a rotatable printing roller arranged with its axis of rotation extending radially from said central axis, the printing rollers of said units being disposed at a fixed elevation and having their axes of rotation spaced angularly apart by a whole multiple of the angular spacing between said axes of the mandrels, means continuously rotating said printing rollers and mandrels at substantially the same peripheral speeds, means intermittently turning said turret so that said mandrels are moved successively to working positions wherein the axes of rotation of the mandrels lie in vertical planes containing the axes of rotation of said printing rollers, a pivoted lever supporting said hollow shaft, spring means acting on said lever to urge the latter to pivot in the direction for moving said turret and mandrels vertically upward toward said printing rollers, and means permitting said spring means to move the turret vertically upward when said mandrels are at said working positions so that articles on said mandrels are brought into rolling contact with said printing rollers and being operative to move said turret in the opposite vertical direction in response to turning of the turret so that an article on each of the mandrels is moved out of contact with the printing rollers during displacement of the related mandrel between successive working positions of the latter.

2. A machine as in claim 1; further comprising a single drive means for said means rotating the printing rollers and mandrels and said means intermittently turning the turret so that the rotational movements of the printing rollers and mandrels are synchronized with the turning of the turret to automatically ensure proper registration of the impressions received by an article on each mandrel at each of said working positions.

3. A machine as in claim 2; wherein said means operative to move the turret in the opposite vertical direction includes a vertically adjustable assembly disposed above said turret and having rotatable wheels rolling on an upper surface of said turret to hold the latter downwardly against the action of said spring means in a position where articles on said mandrels are spaced from the printing rollers, said upper surface of the turret having upwardly opening recesses positioned to receive said wheels when said mandrels are disposed at said working positions so that said turret can then be moved upwardly by said spring means for contacting articles on the mandrels with the printing rollers at the related working positions.

4. A machine as in claim 2; wherein said means continuously rotating said printing rollers and mandrels in-

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cludes a rotatable drive shaft extending vertically through said hollow shaft, a bevel gear slidable on said drive shaft above said turret to rotate with said drive shaft while moving vertically with the turret, bevel gears on said mandrels meshing with said bevel gear on the drive shaft to transmit rotation of the latter to said mandrels, a gear on said drive shaft, and gear transmission means meshing with the last mentioned gear on the drive shaft and driving said printing rollers.

5. A machine as in claim 1; wherein said means operative to move the turret in the opposite vertical direction includes a vertically adjustable assembly disposed above said turret and having rotatable wheels rolling on an upper surface of said turret to hold the latter downwardly against the action of said spring means in a position where articles on said mandrels are spaced from the printing rollers, said upper surface of the turret having upwardly opening recesses positioned to receive said wheels when said mandrels are disposed at said working positions so that said turret can then be moved upwardly by said spring means for contacting articles on the mandrels with the printing rollers at the related working positions.

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6. A machine as in claim 1; wherein said means continuously rotating said printing rollers and mandrels includes a rotatable drive shaft extending vertically through said hollow shaft, a bevel gear slidable on said drive shaft above said turret to rotate with said drive shaft while moving vertically with the turret, bevel gears on said mandrels meshing with said bevel gear on the drive shaft to transmit rotation of the latter to said mandrels, a gear on said drive shaft, and gear transmission means meshing with the last mentioned gear on the drive shaft and driving said printing rollers.

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