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(54) **Kinematic mechanism for moving the pad in a pad printing machine**

(57) A description is given of a kinematic mechanism for moving the pad (26) in a pad printing machine (10) with mobile cliché (20), wherein the cliché (20) is carried by a carriage (16) mobile in a horizontal guide (14) of the frame (12) of the machine and the pad (26) is carried by a rod (24) mobile in a vertical guide (22) to be moved between a high position (L) of cycle start, an intermediate position (L1) of taking of the image from the cliché (20) and a low position (L2) of depositing of the image on the object to be printed, the kinematic mechanism comprising a mobile gear (60) rotating around a fixed gear (58), being hinged eccentric in (62) on the mobile gear (60) a connecting rod (64) whose other end is hinged to the pad-carrying rod (24), the kinematic mechanism being such that the connecting rod pivot (62) occupies the same angular positions every two turns of the mobile gear (60) in relation to the fixed gear (58) with ratio between mobile and fixed gear of 2:1.

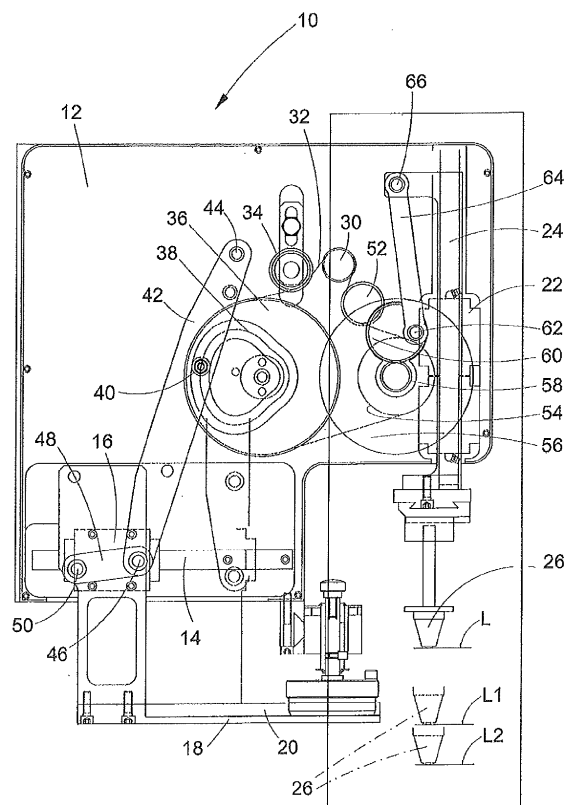


FIG. 1

Description

[0001] The present invention relates to the field of machines or apparatuses for printing images on surfaces, more particularly of objects, by means of a pad or so-called "pad printing" process. According to this process a cliché is inked by means of an inker and then the excess ink is removed with a scraper. A pad in generally relatively soft and elastic material is lowered onto the cliché to take the image and is then raised and applied on the object to be printed. These steps are repeated several times in printing with several colours, taking the images from different clichés inked with different inks.

[0002] Pad printing machines are divided into two major categories: with fixed cliché and with mobile cliché.

[0003] The machines with fixed cliché provide for a vertical movement of the pad for taking the image from the cliché previously inked and scraped, a horizontal movement for the transfer of the pad from the vertical of the cliché to the vertical of the object and a movement of depositing of the image on the object with a vertical movement of the pad. The cycle is therefore composed of six separate movements, therefore in six points of each cycle the speed of the pad will be zero, therefore with somewhat long cycle times, of the order of 2-6 seconds.

[0004] The terms "vertical" and "horizontal" are used in this context only to simplify the description, it being clear that the machine can also work when tilted, with the sole condition that there is orthogonality between the two movements.

[0005] The machines with mobile cliché differ from those with fixed cliché by the fact that the cliché is provided with reciprocating movement, freeing at each cycle the print area and therefore subjecting the pad to only vertical movements.

[0006] This type of machines with mobile cliché work with lower cycle times compared to machines with fixed cliché in that the pad, not being subjected to horizontal movements, can better withstand the accelerations and decelerations during the movement, which would otherwise induce oscillations on the same.

[0007] The present invention relates to this second type of pad printing machine, with mobile cliché and pad with vertical movement.

[0008] The known systems for imparting the vertical movement of the pad provide for example for the use of double-acting pneumatic pistons or motors with double direction of rotation which drive the movements of descent and of ascent of the pad directly by means of cams.

[0009] These known systems, almost all of which provide for the inversion of the motion of the driving means, while allowing higher working speeds compared to pad printing machines with fixed cliché, have limits at the maximum speeds which can be reached, due mainly to the dead times of inversion of the motion of the driving means.

[0010] The speeds which can currently be reached with these known systems are of the order of 5-7,000

cycles/hour.

[0011] A system of this type with inversion of motion is described for example in the Italian patent application MI94A 000841 in the name of the same Applicant, where a rotating means of oscillating rotary motion is provided for transmitting a reciprocating rectilinear movement to the pad.

[0012] EP 0680825 A2 describes a complicated kinematic mechanism with articulated levers for transmitting by means of a connecting rod/crank mechanism a reciprocating rectilinear motion to the pad.

[0013] The pad-carrying rod is connected to one end of an elongated lever, extending approximately perpendicularly thereto, whose other end is moved by the aforementioned connecting rod/crank mechanism. The complexity of the kinematic mechanism and the high inertial masses involved do not allow high cycle speeds to be obtained,

[0014] The main object of the invention is that of increasing the production speed of pad printing machines with mobile cliché.

[0015] Another object of the present invention is that of providing a kinematic mechanism for moving the pad for these pad printing machines with mobile cliché which is simple to manufacture and with reliable functioning in time.

[0016] The aforesaid objects are achieved by the invention which has the features listed in the annexed independent claim 1.

[0017] Advantageous embodiments of the invention are disclosed by the dependent claims.

[0018] Substantially, the kinematic mechanism for moving the pad in a pad printing machine with mobile cliché according to the invention comprises a gear which is mobile circularly around a fixed gear, in such a way that each point of the mobile gear returns to the starting position every two turns around the fixed gear. Hinged to the fixed gear is a connecting rod whose other end is hinged to a lever restrained to move in a vertical direction and carrying below a pad.

[0019] The kinematic mechanism is regulated in such a way that the connecting rod pivot, which is eccentric in relation to the mobile gear, is positioned, at each turn, respectively in the higher part and in the lower part when it is in the lower part of the fixed gear. In this way the pad-carrying lever descends from the high position, wherein the mobile gear is in the upper part of the fixed gear, to positions lowered to two different levels, with reciprocating turns of the mobile gear, for taking the image from the cliché and depositing of the same on the object to be printed respectively.

[0020] Conveniently the gear ratio between the mobile gear and the fixed gear is 2:1 and the eccentricity of the connecting rod pivot determines the difference between the two levels of lowering of the pad-carrying lever, this eccentricity being equal to half of the difference of the vertical stroke of the pad-carrying lever in two successive cycles of taking and depositing of the image.

[0021] The mobile gear is conveniently carried by a disk coaxial to the fixed gear and rotating around the latter, driven by an appropriate motor.

[0022] Conveniently the motor for driving the disk carrying the mobile gear actuates, by means of a cam, a linkage suitable for imparting the reciprocating rectilinear movement to the cliché.

[0023] Further features of the invention will be made clearer by the following detailed description, referred to one of its embodiments purely by way of a non-limiting example illustrated in the accompanying drawings, in which:

- Figure 1 is an elevated schematic view of a pad printing machine incorporating the kinematic mechanism for moving the pad according to the invention, the machine being illustrated in a typical condition of printing cycle start, with the cliché in backward position and the pad raised;

Figures 2a-i illustrate the various working phases of the machine, in particular the various positions of the pad during a complete printing cycle.

[0024] Referring for now to Figure 1, the pad printing machine according to the invention is denoted as a whole by reference numeral 10. It comprises a fixed frame 12, whereon the various parts of the machine are mounted.

[0025] More particularly, a fixed horizontal track 14 is provided for the sliding of a cliché-carrying carriage 16 which has a lower arm 18 wherein a cliché 20 is arranged in a removable manner, prepared with the image to be reproduced.

[0026] On the frame 12 a guide 22 for vertical sliding (or in any case orthogonal to the track or guide 14) is likewise provided wherein a pad-carrying rod 24 is housed in a vertically sliding manner, which carries at the lower end a pad 26 of any type in itself known, normally in soft material, for the transfer of the image from the cliché 20 to an object to be printed, which is not illustrated in the accompanying drawings.

[0027] According to the embodiment illustrated in Figure 1, the movement is imparted to the pad-carrying rod 24 and to the cliché-carrying carriage 16 by a single motor 30, which by means of a transmission with belt and cogged wheels sets the abovementioned parts in motion.

[0028] More particularly, the motor 30 drives a transmission belt 32 which passes through a belt tightener 34 and actuates in rotation a cogged wheel 36 whereon a cam profile 38 is formed, wherein a cam follower 40 slides, carried by a lever 42 hinged above in 44 to the frame 12 and in proximity of its lower part in 46 to a second lever 48 in turn hinged in 50 to the aforesaid cliché-carrying carriage 16.

[0029] The profile of the cam 38 is such as to make the cliché-carrying carriage 16 perform a reciprocating rectilinear movement to bring it from the backward position shown in Figure 1 to an advanced position at the vertical of the pad 26, providing rest times in the ad-

vanced and backward positions to allow the taking of the image from the cliché 20 and the transfer of the same onto the object, respectively, as will be described in greater detail herein below.

[0030] A complete turn of 360° of the cogged wheel 36 carrying the cam 38 corresponds to a work cycle of the machine.

[0031] The aforementioned transmission belt 32 passes through an additional belt tightener 52 and goes to actuate a cogged pulley 54 keyed onto a disk 56 mounted coaxial to a fixed gear 58. On the disk 56 a gear 60 is mounted, meshed with the fixed gear 58 with a gear ratio of 2:1. On the gear 60, which is referred to as mobile, in that carried by the rotating disk 56 and rolling on the fixed gear 58, a connecting rod 64 is hinged in 62, whose other end is hinged to the pad-carrying rod 24.

[0032] The connecting rod pivot 62 is arranged eccentric on the gear 60 so as to determine differentiated vertical strokes of the pad-carrying rod 24, as will be explained in greater detail herein below. More particularly the eccentricity e of the connecting rod pivot 62 (see in particular Figures 2a) and 2e corresponds to half of the difference between the vertical stroke of the pad-carrying rod 24 for the taking of the image from the cliché and the corresponding stroke for the depositing of the image on the object.

[0033] A description is now given of the functioning of the kinematic mechanism for moving the pad-carrying rod 24, with reference to the series of Figures 2a)-i).

[0034] The machine cycle starts from the position illustrated in Figure 1g, with the pad 26 situated substantially in the higher position denoted by L, to pass to the position of taking L1 of Figure 2a, then once again to the high position L of Figure 2c, then to the lower position of printing L2 of Figure 2e, and to return finally to the high position of cycle start of Figure 2g.

[0035] However, in order to explain better the functioning of the kinematic mechanism, the pad-carrying rod 24 is initially in the position of taking of the image from the cliché 20 shown in Figure 2a. In this position the mobile gear 60 is positioned below the fixed gear 58 on the vertical passing through its centre, and the connecting rod pivot 62 is in the high part of the gear 60, on the same vertical.

[0036] Since the gear ratio between the mobile gear 60 and the fixed gear 58 is 2:1, each angle α of movement (rolling) of the mobile gear on the fixed gear 58 will correspond to an angular movement $\alpha/2$ of each point on the mobile gear 60. Thus, when the disk 56 rotates through 90° around the fixed gear, the connecting rod pivot 62 rotates through 45°, taking itself into the position illustrated in Figure 2b. A successive angular rotation through 90° of the disk 56 takes the connecting rod pivot 62 into the position of Figure 2c rotated through 90° in relation to the starting position of Figure 2a. In this context, for simplicity, it is supposed that the condition of Figure 2c represents the higher position of the pad-carrying rod 24 (in actual fact the higher position is reached

after some other degrees of rotation of the disk 56, but this has no influence for the purpose of the invention). A further rotation through 90° of the disk 56 takes the connecting rod pivot 62 into the position of Figure 2d, rotated through a further 45°, and therefore into the starting position of Figure 2e, when the disk 56 has performed a complete turn. In the position of Figure 2e the connecting rod pivot 62 is in the lower position on the vertical passing through the centres of the gears 60 and 58, at 180° in relation to the starting position of Figure 2a. In this position the pad 26 is also in the lower position (level L2) of depositing of the image on the object to be printed.

[0037] In the subsequent turn of the disk 56 the connecting rod pivot 62 passes through the positions of Figures 2f, 2g, which is assumed to be the higher position like 2c (in actual fact the higher position occurs with a few degrees of advance compared to what is shown in Figure 2g), 2h and 2i which corresponds to the starting position 2a of taking of the image.

[0038] It is pointed out that in every angular position of the disk 56, and therefore of the gear 60, the connecting rod pivot 62 is in diametrically opposed positions (at 180°) at each subsequent turn of the disk.

[0039] The kinematic mechanism according to the invention achieves the objects set in that, by rotating the disk 56 always in the same direction in the working phase, it is possible to move the pad-carrying rod 24 at very high speeds, up to about 20000 cycles/hour, versus the 5-7000 cycles/hour which can be reached with the mechanisms currently in use, as mentioned previously, the movements of the cliché-carrying carriage 16 and of the pad-carrying rod 24 are synchronised one with the other so that the cliché 20 is in an advanced position, on the vertical of the pad 26, when the latter has to take the image (positions of Figures 2g to 2i), while it is in backward position when the pad has to perform the printing (positions of Figures 2c to 2e).

[0040] The object to be printed, in a manner in itself known, can be carried by a rotary table or by any other support which positions the object to be printed at level L2 to receive the image carried by the pad 26 when the latter descends into the lower position shown in Figure 2e.

[0041] According to the embodiment shown in the accompanying drawings a single motor 30 imparts by means of a cogged belt transmission the reciprocating rectilinear movement horizontal to the cliché-carrying carriage 16 by means of the cam 38 and corresponding to the linkage 42-48, and the vertical movement with differentiated stroke to the pad-carrying rod 24, by means of the connecting rod mechanism 62-64.

[0042] It is however clear that the invention can provide separate motor drives for the kinematic mechanisms for moving the pad 26 and the cliché 20.

[0043] It is likewise clear that the movement of the pad 26 can be obtained with staggered positions in relation to those shown in Figures 2a-i, bearing in mind what was said at the beginning about the horizontal and vertical

slidings, of the cliché 20 and of the pad 26 respectively.

[0044] Naturally the invention is not limited to the particular embodiment previously described and illustrated in the accompanying drawings, but instead numerous detail changes can be made thereto, within reach of the person skilled in the art, without thereby departing from the scope of the same invention as defined in the annexed claims.

Claims

1. A kinematic mechanism for actuating a pad (26) in a pad printing machine (10) provided with a mobile cliché (20), wherein said cliché (20) is carried by a carriage (16) which moves into a horizontal guide (14) of a machine frame (12) and said pad (26) is carried by a pad carrying rod (24) which moves into a vertical guide (22), or in any case orthogonal to said guide (14) of the cliché-carrying carriage (16), to be moved among an upper position (L), at which the cycle begins, an intermediate position (L1) at which the image is taken from the cliché (20) and a lower position (L2) at which the image is deposited on an object to be printed, **characterized in that** said kinematic mechanism comprises a mobile gear (60) meshing with and rotating around a fixed gear (58), a connecting rod (64) having one end eccentrically hinged on a pivot (62) on said mobile gear (60) and the other end (64) hinged to said pad-carrying rod (24), the kinematic mechanism being such that said pivot (62) of the connecting rod is placed in the same angular positions on said mobile gear (60) every two complete turns of the mobile gear (60) around the fixed gear (58).
2. A kinematic mechanism according to claim 1, wherein when the mobile gear (60) is positioned at the lower position on the vertical passing through the center of the fixed gear (58) said pivot (62) of the connecting rod is positioned on said vertical, alternatively at an upper position corresponding to the drawing of the image from the cliché and at a lower position corresponding to the printing of the image on the object, a eccentricity e of the pivot (62) of the connecting rod being equal to half of the difference between the vertical strokes of the pad-carrying rod (24) to take and deposit the image.
3. A kinematic mechanism according to claim 1, wherein the ratio between the mobile gear (60) and the fixed gear (58) is 2:1.
4. A kinematic mechanism according to any one of the preceding claims, **characterized in that** said mobile gear (60) is carried by a disk (56) rotatably mounted coaxially with respect to said fixed gear (58).

5. A kinematic mechanism according to claim 4, wherein said disk (56) is rotated by a motor (30) by means of a toothed belt (32) wound onto a pulley (54) fixed on the disk (56) or by means of a gear. 5
6. A kinematic mechanism according to claim 5, wherein said motor (30) drives, through said belt (32), a toothed wheel (36) in which a cam profile (38) is provided, which, through a linkage (42-48) or a gear gives to said cliché-carrying carriage (16) a reciprocating rectilinear motion. 10
7. A kinematic mechanism according to claim 4, wherein an angular rotation of $\alpha/2$ of said pivot (62) of the connecting rod corresponds to a rotation of an angle α of said disk (56), and thus of said mobile gear (60). 15
8. A pad printing machine (10) provided with a mobile cliché (20) comprising a fixed frame (12) in which are formed: a horizontal guide (14) for the sliding of a cliché-carrying carriage (16) and a vertical guide (22) for the sliding of a pad-carrying rod (24) suitable for moving the pad (26) between an upper position (L) at which the cycle begins, an intermediate position (L1) at which the image is taken from the cliché (20) and a lower position (L2) at which the image is deposited onto a object to be printed, **characterized in that** said pad-carrying rod (24) is moved by a kinematic mechanism according to any one of the preceding claims. 20 25 30

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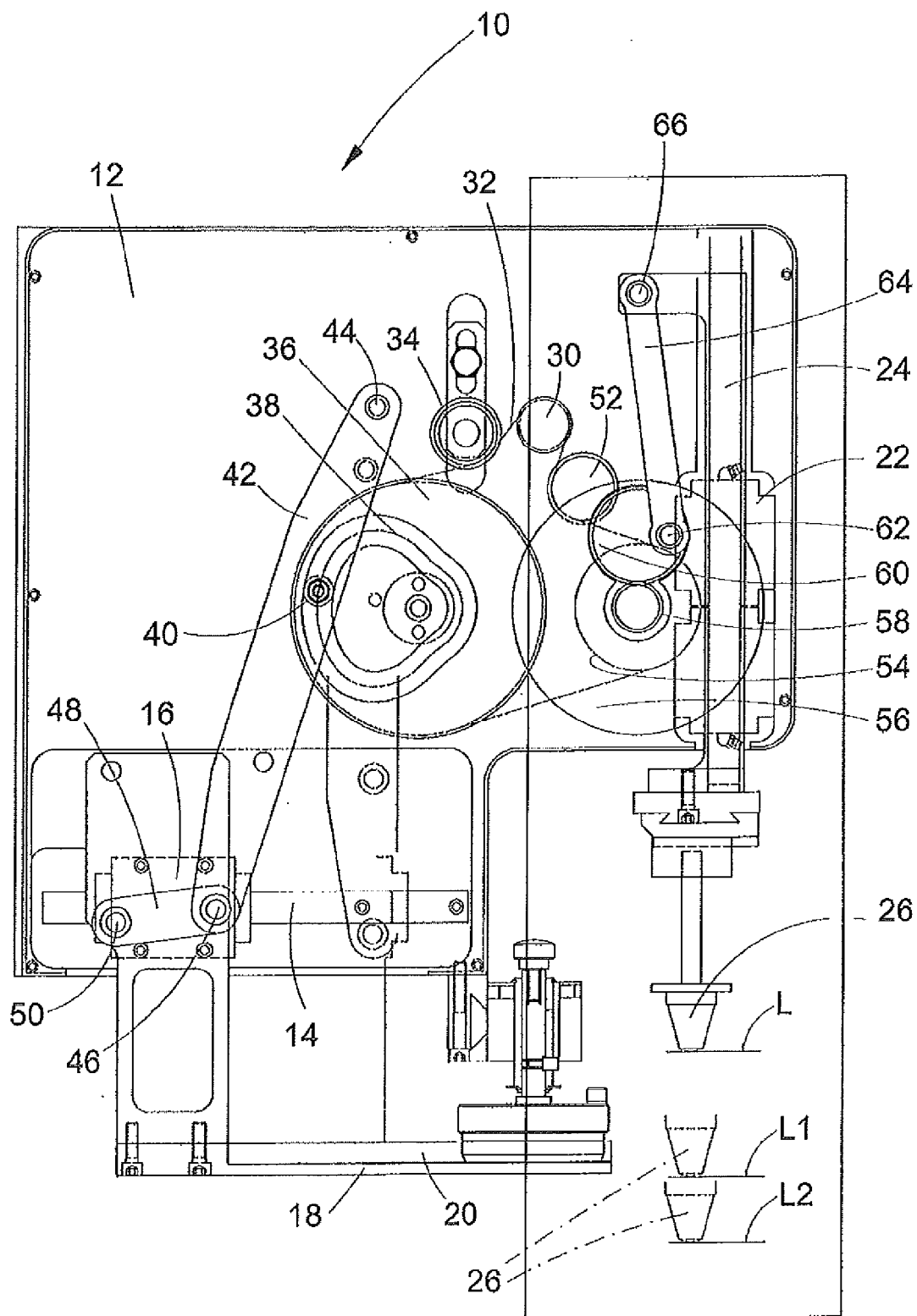


FIG. 1

FIG. 2a

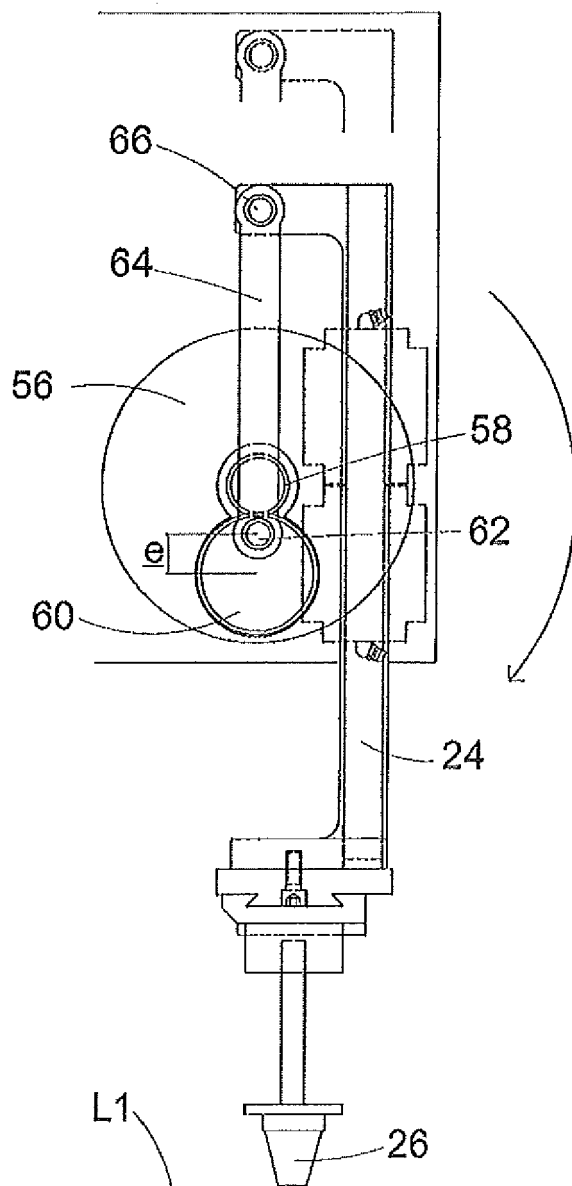


FIG. 2b

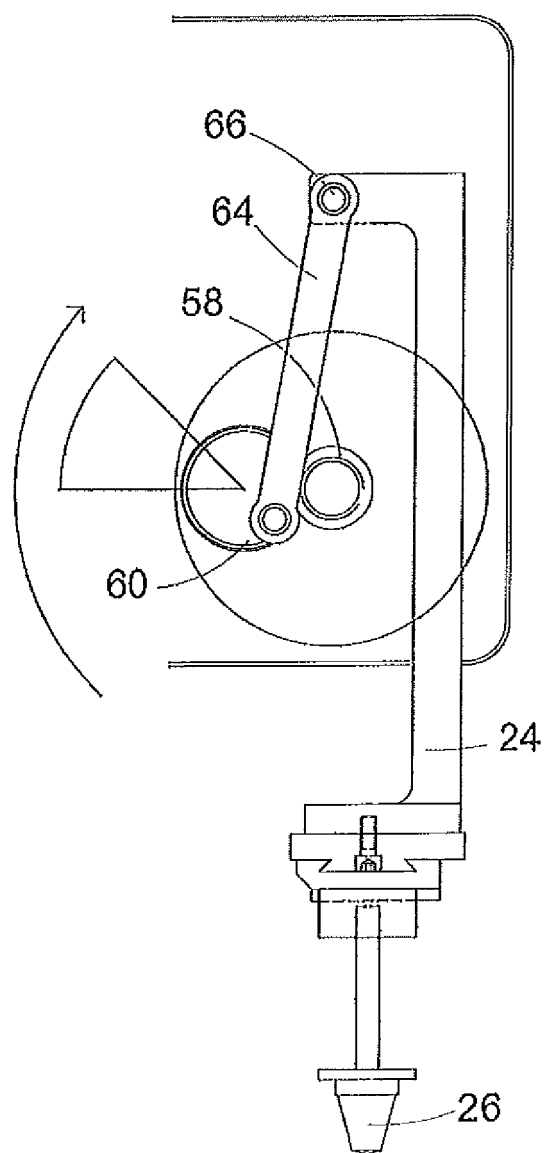


FIG. 2c

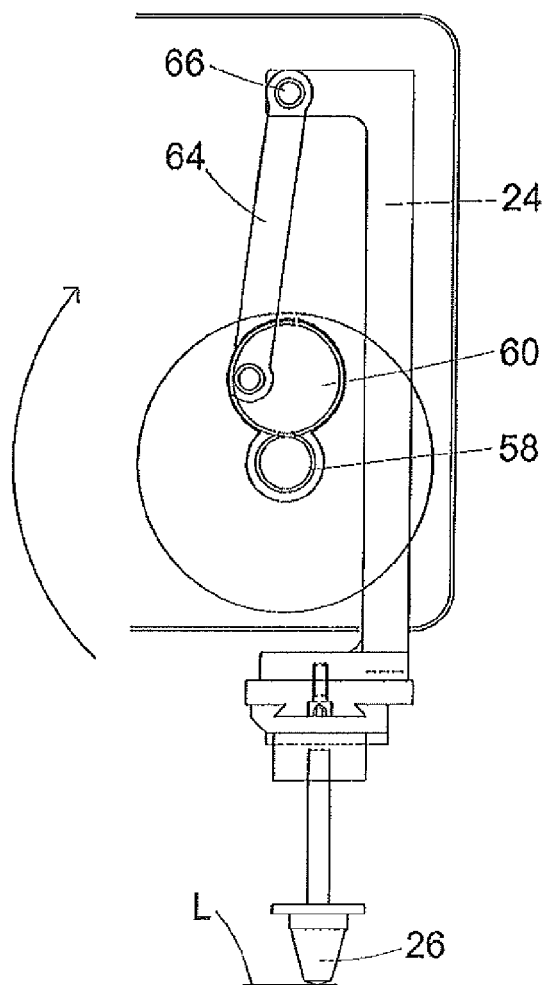


FIG. 2d

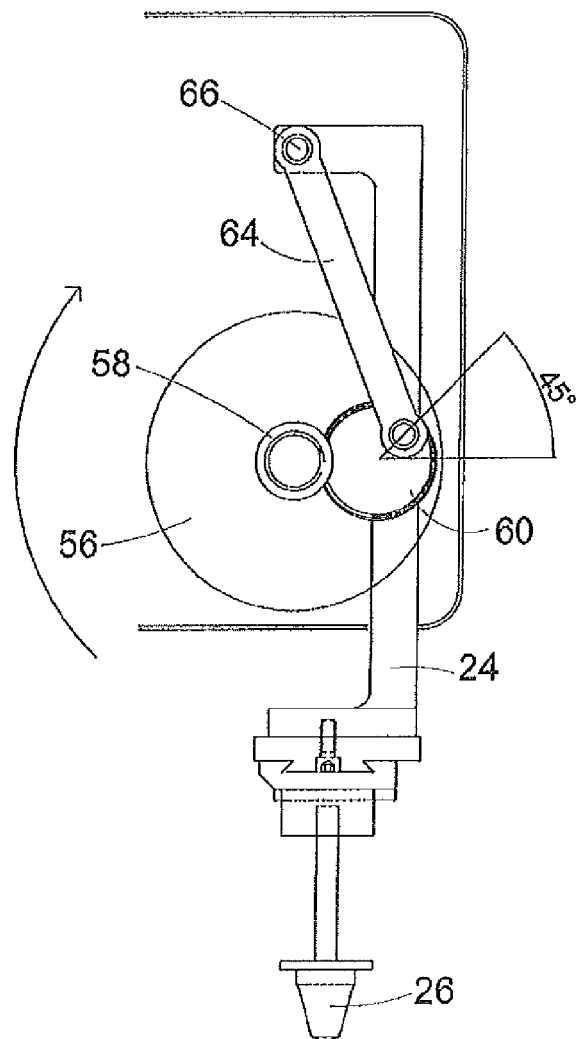


FIG. 2e

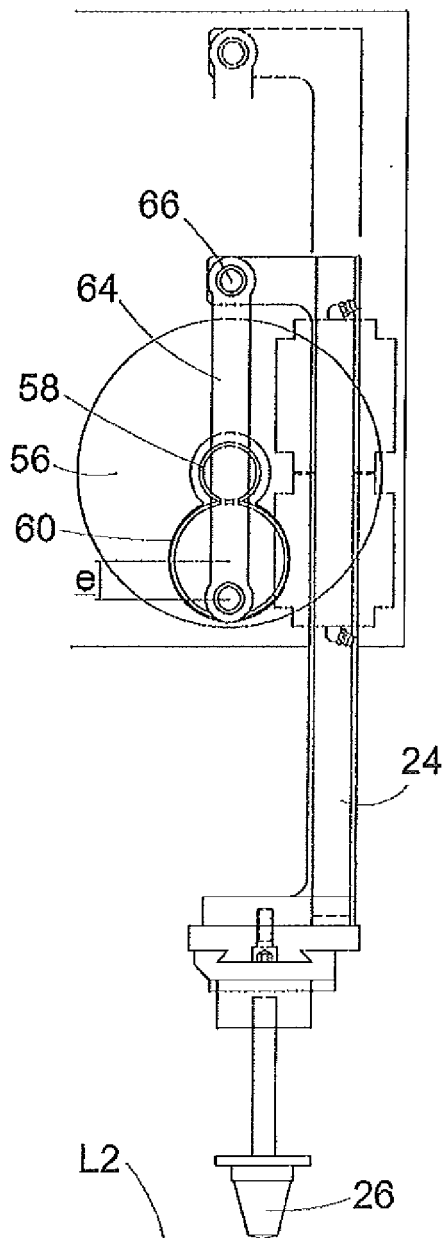


FIG. 2f

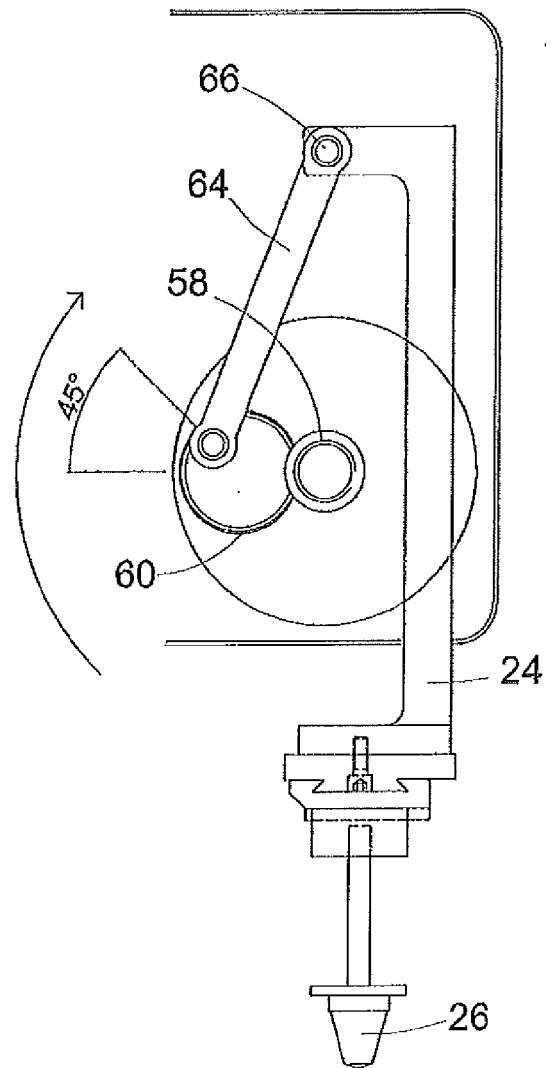


FIG. 2g

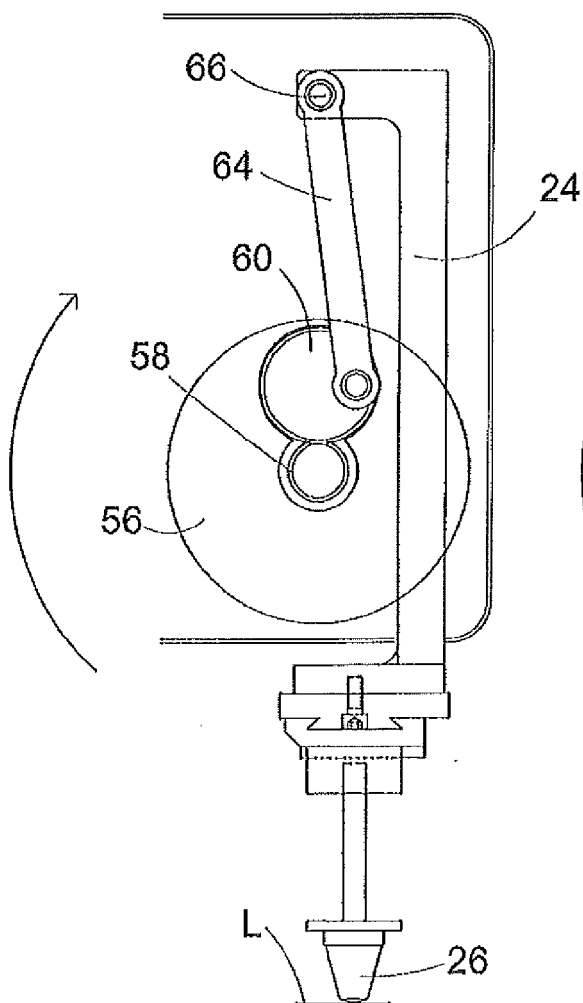


FIG. 2h

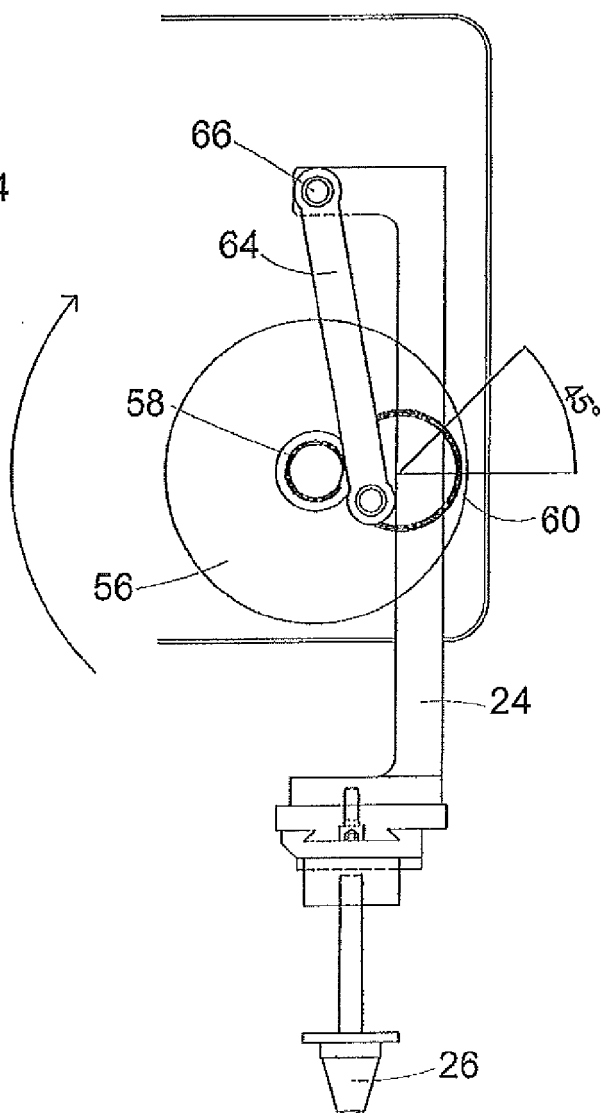
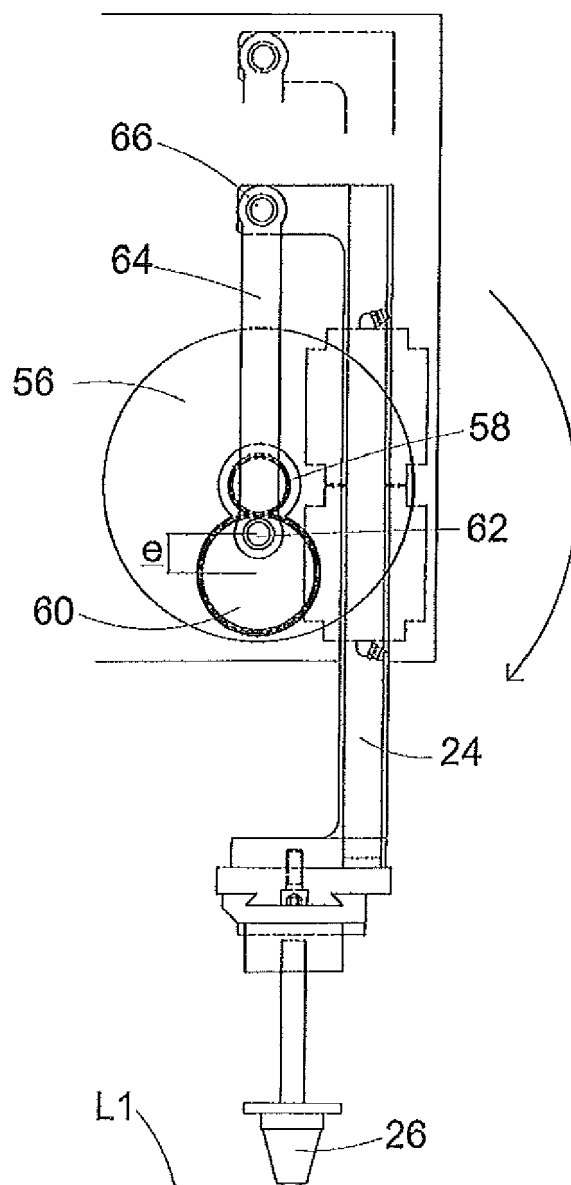


FIG. 2i





EUROPEAN SEARCH REPORT

Application Number
EP 12 15 0951

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 680 825 A2 (VOLDER LAURENT DE [BE]) 8 November 1995 (1995-11-08) * abstract * * column 2, lines 6-45 * * column 3, line 25 - column 4, line 46 * * figures 1-3 *	1-8	INV. B41F17/00
X	IT MI 940 841 A (TOSH S.R.L.) 30 October 1995 (1995-10-30) * pages 9-11 * * figure 1 *	1-8	
A	US 5 921 177 A (SHIN KYU IL [KR]) 13 July 1999 (1999-07-13) * the whole document *	1-8	
A	DE 536 084 C (ADOLF MEDER) 20 October 1931 (1931-10-20) * the whole document *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
			B41F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 March 2012	Examiner Bellofiore, Vincenzo
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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 12 15 0951

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12-03-2012

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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