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(54) TRANSFER DEVICE FOR PRINTING MACHINES

(71) We, HEIDELBERGER DRUCKMASCHINEN AKTIENGESELLSCHAFT, a body corporate organised under the laws of Germany, of 69, Heidelberg, Alte Eppelheimer Strasse 15—21, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a transfer device for a perfection printing press.

In both recto-(one-sided) and perfection (two-sided) printing presses, it is essential that transfer of sheets to be printed be achieved in correct register from one printing unit to another. For this reason, the sheets are handled by only a single gripping mechanism at each cylinder so that, at each cylinder, the sheet is picked up and released only once. Only tongs-type gripping mechanisms can be conveniently used for this purpose.

In previously-proposed printing presses, (e.g. the presses described in German Patent Specification No. 536,453, and German Offenlegungsschriften Nos. 1,810,589 and 2,224,218) the arrangement of the gripper tongs often has several shortcomings. In particular they may be subject to extensive wear and may adversely affect the delivery of sheets in accurate register at high printing speeds, for example as a result of bending the gripped edges of the sheets.

According to the invention there is provided a transfer device for printing machine comprising a rotatable transfer cylinder; gripper tongs mounted on the transfer cylinder for pivotal movement about a pivot axis extending parallel to the axis of rotation of the transfer cylinder, the gripper tongs comprising two cooperating gripper elements each of which is independently rotatable about the pivot axis; and individual drives each for controlling the rotation of a respective one of the gripper elements about the pivot axis, each drive comprising

a rotatable drive gear mounted coaxially with the pivot axis.

The two gripper elements are controlled individually and consequently can be adjusted independently of one another into position to effect pick-up of a sheet by its edge during transfer. The front edge of the sheet consequently cannot be folded over or damaged, which would result in inaccurate registry. Furthermore, separate control ensures the best possible utilisation of kinematic conditions, so that because of only slight load fluctuations a control cycle consuming little power can be achieved.

Preferably the pivot axis of the gripper tongs is located in or near the peripheral surface of the transfer cylinder, inwardly of the tangent to the peripheral surface at the point of intersection of the gripper elements with the peripheral surface.

By disposing the axis of rotation of the gripper tongs at a point below this tangent to the peripheral line of the transfer cylinder, the axis of rotation may be disposed in a position where not only adequate stability of all mounting and control parts of the tongs grippers but also adequately reliable holding force of the grippers can be achieved without it being possible for the edge of the sheet to be bent in a manner detrimental to accuracy of register.

The bending of the edge of the sheet gripped by the tongs gripper may not only cause delivery of the sheet out of register, but may cause permanent deformation of the sheet. As a result, during subsequent transfers of the sheet the grippers tongs may strike against the bent-over sheet edge and either damage or at least further deform the latter, so that the errors will in register accumulate.

Additionally, if the gripper shaft is so mounted that its axis of rotation does not substantially go beyond the peripheral line of the transfer cylinder, the grippers do not penetrate excessively deep into the gaps of the adjacent cylinders. The best possible spacial use can therefore be made of the

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periphery of the cylinder, because of the small dimensions of the cylinder gaps. The angle through which the grippers are swivelled is also relatively small.

5 Advantageously, one gripper element is mounted on a rotatable tubular member, and the other gripper element is mounted on a rotatable shaft coaxial with the tubular member and the pivot axis. The construction of the gripper tong in this form results in a compact, space saving, stable construction which is less susceptible to vibrations.

10 In practice the gripper tongs will normally comprise a plurality of sets of individual tongs arranged for simultaneous actuations. Desirably, each of the individual tongs is individually adjustable and spring-biased into its closed position. In this way the same closing force can be applied to all the gripper elements, thereby improving the control of the register. Preferably in each of the gripper tongs one of the gripper elements—conveniently the outer element when the grippers are arranged for recto printing—is mounted rigidly on the rotatable shaft, and the other element is mounted on a casing rotatably mounted on the rotatable tubular member, and a spring acting between the tubular member and the casing biases the casing in the closing direction of the gripping elements into engagement with an adjustable stop, for example an adjusting screw, on the tubular member.

15 This construction of the gripper tongs permits individual adjustment of the tongs, since the adjusting screw can be provided in a readily accessible manner on the gripper casing. The opening and closing of the tongs grippers can consequently be so adjusted that opening and closing is effected simultaneously. Furthermore, because of their arrangement both gripping elements of each tongs gripper can easily be replaced.

20 The individual drives for the gripper elements are conveniently located on respective ends of the transfer cylinder. This symmetrical distribution of the drives can be accommodated in a smaller space than other arrangements.

25 Preferably, the gripper element mounted on the rotatable shaft projects through cut-outs in the tubular member and the casing, engagement of the gripper element with the cutout in the casing restraining the casing from axial involvement on the tubular member. This arrangement is particularly simple and space-saving.

30 Desirably, each drive comprises a drive element mounted for pivotal movement relative to the transfer cylinder and carrying a toothed segment for operating the gripper element, the drive element being biased into engagement with a cam which effects the pivotal movement of the drive element. This constrained positive control of the closing

movement of the grippers facilitates the smooth running of the device even at high printing speeds, together with reliable closure of the grippers even for the recto-printing sheet-movement.

35 If, in accordance with an alternative embodiment of the invention, it is desired to convert the transfer device from recto-(single-side) printing to perfection printing, each drive may be provided with two control cams side by side on respective ends of the transfer cylinder coaxial with the axis of rotation of the transfer cylinder, each drive element carrying an axially-slidable roller which can be selectively applied against one of the two control cams.

40 In the preferred embodiment of the invention, in the position for single-sided printing, the clamping plane of one of the gripper elements always lies at the same height in relation to the peripheral line of the delivery cylinder from which the sheet is delivered to the transfer cylinder, irrespective of the thickness of the sheet transported.

45 A device for adjusting one of the gripping elements of each tongs gripper to the thickness of the sheets which are to be printed is not therefore necessary. Furthermore, it is an advantage that during delivery between the gripper system the sheet must lie straight and is not curved. It is well known that even a slight curvature of the front edge of the delivered sheet appreciably impairs the accuracy of register of the impressions.

50 Desirably the clamping surface of at least one of the gripper elements is curved, by the curvature increasing with the deviation of the axis of rotation of the gripper tongs from the tangent to the surface of the transfer cylinder at the point of intersection of the gripper element with the peripheral surface.

55 Since it may not be possible to obtain sufficient holding force by means of curved clamp surfaces with some types of paper, for example smooth, heavy sheets or cardboard which is smooth on both sides, when the axis of rotation of the gripper shaft is located in the region of the peripheral line of the transfer cylinder the invention, at least one of the clamping surfaces may be flat and in the form of friction surfaces, i.e. surfaces giving a good grip. For this purpose the clamp surfaces may for example be grooved or coated with corundum or with diamond. When flat clamp surfaces are used, detrimental bending of the edge of the sheet can largely be avoided by taking an average of the deviation of the clamp plane from the tangent, both in the recto printing and in the verso printing position, in accordance with the various requirements in respect of accuracy of register of the two sheet transfer positions.

60 In order that the invention may be better

understood, a preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings in which:

5 Figure 1 is a view of the operating side of the transfer device in the recto printing position, viewed from the operating side.

10 Figure 2 shows the drive side of the transfer device in the same operating position and viewed from the operating side.

Figure 3 shows the transfer device of the invention in the "verso printing" transfer position.

15 Figure 4 shows the three cylinders of a printing machine incorporating the transfer device during the delivery of the sheet between one transfer cylinder and the impression cylinder.

20 Figure 5 is a partial section through the two transfer cylinders and the impression cylinder of the printing machine of Figure 4.

Figure 6 shows control means for the gripping elements of the tongs grippers on the drive side of the transfer device.

25 Figure 7 shows corresponding control means for the coating gripping elements of the tongs grippers on the operating side of the printing machine.

30 Figure 8 is a section through a tongs gripper in the verso printing position.

Figure 9 is a section through the same tongs gripper in the recto printing position, and

35 Figure 10 is a plan view of a tongs gripper in the verso printing position.

40 As Figure 4 shows, a printing machine incorporating the turning device according to the invention comprises a first transfer cylinder 1 and a second transfer cylinder, referred to as the turning cylinder, 2, the latter being disposed between the transfer cylinder 1, and the following printing cylinder 3. The second transfer cylinder 2 embodies the turning device of the invention. The other cylinders of the printing unit between which the turning device is provided are not shown. Similarly, for the sake of clarity the drawing does not show another delivery cylinder which must lie between the preceding printing mechanism and the first transfer cylinder 1.

45 The first transfer cylinder 1 has two sheet guide surfaces 4 and 5. The latter are separated from one another by two diametrically opposite cylinder gaps 6 and 7. The grippers are disposed on one wall of each cylinder gap 6 or 7. A suction rod 9 extends over the entire width of the cylinder on the opposite cylinder gap wall. On the sheet guide surface 4 of the transfer cylinder 1 is disposed a sheet 10 which has been printed on one side and the front edge of which is held by the grippers 8, while its rear end is held by the suction rod 9.

Since the turning cylinder 2 has a diameter equal to only half the diameter of the transfer cylinder 1, it also has only one cylinder gap 11, in which the bearings 12 for the tongs grippers 13 are mounted. Grippers 15 are likewise provided in the single gap 14 in the impression cylinder 3.

70 As Figure 5 shows, the cylinders 1 to 3 of the machine are mounted in the side walls 16 and 17 of the printing machine, the turning cylinder 2 by means of journals 18 and 19 and the impression cylinder 3 by means of journals 20 and 21. The turning cylinder 2 is driven by the drive gear 22 fastened on the shaft (not shown) of the first transfer cylinder 1. This gear meshes with the spur gear 23 mounted adjustably on the journal 18, while a drive gear 24 of equal size is mounted at the side of the gear 23 on the same journal 18 of the turning cylinder 2. The gear 24 in turn meshes with a spur gear 25 which is keyed on the journal 20 of the impression cylinder 3.

80 Between one end wall 26 of the turning cylinder 2 and the side wall 16 on the drive side is disposed a drive element 27 for the tongs grippers 13. It is mounted for rotation on a pin 28 which is screwed into the end wall 20. On the operating side a corresponding drive element 30 for the tongs grippers 13 is disposed between the other end wall 29 of the turning cylinder 2 and the side wall 17. The drive element 30 is likewise mounted pivotally on a pin 28 screwed into the end wall 29. The two drive elements 27 embrace the journals 18 and 19 of the turning cylinder 2 respectively.

90 Details of the construction of the drive elements 27 and 30 can be seen in Figures 1 to 3. At the opposite end to that where the pin 28 is disposed, each of the drive elements 27 and 30 has a toothed segment 31 and 32 respectively.

105 According to Figure 2, a split bearing eye 33 is provided in the drive element 27 below the pin 28 and receives a pin 34 which can be clamped fast by means of a clamp bolt 35. On this pin 34 is rotatably mounted a roller 36, as can be seen in detail in Figure 6. Through the axial displacement of the pin 34 in the bearing eye this roller 36 can cooperate selectively with two control cams 37 and 38. These two control cams 37, 38 are fastened coaxially to the turning drum on the inside of the side wall 16. A circlip 39 provided on the bearing pin 34 limits the axial sliding motion of the pin 34 in one direction, and the roller 36 itself limits the axial movement in the opposite direction. When the cam roller 36 is on the control cam 38, the end of the bearing pin 34 which is provided with the circlip 39 projects into a recess 40 provided in the end wall 26 in the turning cylinder 2.

120 Identical control means are provided on 130

the operating side. The split bearing eye 33 for the pin 34 of the roller 36 is however here disposed not below but above the pin because the drive element 27 is mounted on the other side of the cylinder. Between the side wall 17 and the drive element 30, two control cams 41 and 42 are likewise fastened on the side wall 17, coaxially to the turning cylinder 2. Through axial displacement in the bearing eye 33 after the clamp bolt 35 has been slackened, the cam roller 36 can be applied against one of the two control cams 41 and 42. The circlip 39 then limits the axial movement of the bearing pin 34 in one direction. A recess 40 in the end wall 29 of the turning cylinder 2 serves once again to receive the end, provided with the circlip 39, of the pin 34 on which the roller 36 is mounted.

Respective compression springs 43 act on the drive elements 27 and 30 in such a manner that their roller 36 is always pressed against the control cams 37 or 38 and 41 or 42 respectively. The compression spring 43 is pushed by means of a spring rod 44 and is supported at one end way of the eye of the spring rod 44 against a pin 45 which is screwed into the end wall 26 or 29 of the turning cylinder 2, while the other end of the compression spring 43 bears against an abutment 46 which is fastened on the drive element 27 or 30.

The toothed segment 31 of the drive element 27 meshes with a gear 50 which is fastened by means of a tapered pin 52 to a gripper shaft 51. This gripper shaft 51 extends coaxially through a gripper tube 53 and is mounted rotatably in the latter by means of a plurality of bearings 54, as can be seen in detail in Figure 6 and 7. The gripper tube 53 extends along the gap 11 of the turning cylinder 2 and is mounted for rotation in the previously-mentioned bearings 12. On the operating side a gear 55 is disposed on the free end of the gripper tube 53, this gear meshing with the toother segment 32 of the drive element and entirely corresponding in respect of pitch circle diameter and a number of teeth with the gear 50 previously mentioned. It is fastened to the gripper tube 53 by means of a fitting key 56 and a threaded pin 57. The axial guiding of the gripper shaft 51 in the gripper tube 53 is effected by the gear 50 at one end of the gripper shaft and by a circlip 58 in conjunction with a washer 59. The tooth clearance between the toothed segment 31 or 32 and the gear 50 or 55 can be adjusted by disposing various shims 47 under the bearings 12.

Figures 8 to 10 show details of the construction of the tongs grippers 13. Each tongs gripper 13 consists of a gripping element 60 and a coacting gripping element 61;

this distinction between gripping elements and coacting gripping elements is not intended to indicate different functions or the necessary association of the tongs gripper parts with the gripper shaft or gripper tube. The inner gripping element is referred to as the "coacting gripping element" solely to distinguish the gripping element which is in the outer position in the verso printing position from that which is in the inner position.

The gripping element 60 is fastened on the gripper shaft 51 by means of a bolt 62, while the coacting gripping element is fastened by two bolts 63 to a gripper casing 64 which is mounted for rotation on the gripper tube 53. Both the gripping element 60 and the coacting gripping element 61 are therefore pivotable about the common axis of rotation 48 of the gripper shaft 51 and gripper tube 53. On the side of the gripper casing 64 remote from the coacting gripper 61 is provided a supporting arm 65, which has a hole 66 in which is supported a compression spring 67 the other end of which bears against an abutment 68. The side of the supporting arm 65 which is remote from the hole 66 serves as a stop surface 69 for an adjusting screw 70 which can be clamped fast by means of a lock nut 71 in a threaded hole 72 in the abutment 68. As Figure 10 shows, the abutment 68 is clamped fast on the gripper tube 53 by means of a clamp screw 73. The gripping elements 60 fastened to the gripper shaft 51 project in each case through a cutout 74 in the gripper tube 53 and through another cutout 49 in the gripper casing 64. The rotatably mounted gripper casing is thus guided laterally by the fixed gripping elements 60 with the assistance of the side edges of the cutout 49.

The adjusting screw 70 is brought to a clearly defined adjustment, that is to say its end facing the stop surface 69 is adjusted to a clearly defined distance from the latter so that all the tongs grippers 13 will open at the same time. The compression springs 67 and their bearings are all of the same construction, so that by means of the rotatably mounted bearing casing 64 they apply an identical holding force to all the clamp surfaces 75 of the gripping elements 60 and coacting gripping element 61. As Figure 8 shows, the tongs grippers 13 can be swivelled through an angle 76 from the verso printing position shown in Figure 8 to the recto printing position shown in Figure 9. The clamp line 77 of the clamp surfaces 75 describes for this purpose the path 78 shown in dot-and-dash lines. The clamp surfaces 75 are rounded. The axis of rotation 48 of the gripper shaft 51 and gripper tubes 53 lies inwardly of the tangent to the peripheral line 79 of the turning cylinder 2 at the point of intersection of the clamp surfaces 75 of the gripper elements and the peripheral line, exactly on the peri-

peral line 79 of the turning cylinder 2. With this configuration the rounding need be only slight, in order to avoid the bending-over of the gripped sheet. The clamp surface 75, the fastening of the gripping element 60, the mounting of the gripper casing 64, and also the stop surface 69 and compression spring 67 lie symmetrically to the longitudinal axis 84 of the tongs gripper 13.

In the verso printing position of the tongs grippers 13, the clamp surfaces 75 of all the gripping elements lie exactly at the height of the peripheral line 79 of the turning cylinder 2. The sprung coacting gripping element 61 on the other hand adapts itself through its resiliency to the thickness of the delivered sheet 10. On the other hand, in the recto printing position of the tongs gripping element 13, as shown in Figure 9, the clamp surfaces 75 of the fixed grippers 60 lie exactly at the height of the peripheral line of the transfer cylinder 1. The delivery of the front edge of the sheet in a curved state is thereby prevented. In this position also the sprung coacting gripping element 61 adapts itself to the thickness 80 of the delivered sheet 10. It is thus unnecessary to adjust the fixed gripper 60 to the various sheet thicknesses.

In the event of relatively heavy and extremely smooth sheets 10, or cardboard which is smooth on both sides having to be transported by the tongs grippers 13, it may be that greater clamping force is expedient in order to ensure delivery of the sheets in correct register. In this case either the fixed gripping element 60 or the sprung coacting gripping element 61 may be replaced by elements having a flat clamp surface 75 providing a good grip. In many cases it will be sufficient for only the fixed gripping element 60 or only the sprung clamp gripping element 61 to be changed. In serious cases however, it is also possible for both the fixed gripping elements and the sprung coacting gripping elements 61 to be provided with a flat surface giving a good grip, which for example is grooved or coated with corundum, because when the axis of rotation 78 is situated on the peripheral line 79 of the turning cylinder 2 the clamp surfaces may extend in such a manner, at least in the recto printing position, that the angle of bend of the sheet received is negligibly small. Although a slightly larger angle of bend must then be accepted when the tongs grippers 13 are in the verso printing position, nevertheless this does not have so detrimental an effect on the delivery of the sheets in correct register because, in the verso printing position, the rear edge of the sheet is gripped, but the sheet itself is held in correct register at its front edge until transfer has been effected.

The mode of operation of the turning de-

vice is as follows: in the case of recto printing sheet transport as shown in Figures 1 and 2 the sheet 10 is transported by the grippers 8 of the transfer cylinder 1 and at the tangent point between the transfer cylinder 1 and the turning cylinder 2 is transferred to the tongs grippers 13, which then remain in the position shown in Figure 1 until the sheet 10 is delivered to the grippers 15 of the impression cylinder. This delivery also usually takes place at the tangent point between the turning cylinder 2 and the impression cylinder 3. Directly after the delivery both the grippers 60 and the coacting grippers 61 are pivoted about the axis of rotation 48 so that the front edge of the sheet is freed. During the subsequent further rotation of the turning cylinder 2, the fixed gripping element 60 pivots in accordance with the radii 81 and is thus moved under the front edge of the new sheet 10 brought up by the transfer cylinder 1. At the time of the delivery of the sheet the clamp edges 75 of the fixed gripping element 60 are thus situated exactly at the height of the peripheral line of the transfer cylinder 1.

The combined pivoting, and closing movement of the tongs grippers 13 is effected conjointly by the control cams 37 and 41. On the drive side the gripping elements 60 fastened to the gripper shaft 51 are driven by way of the roller 36, drive elements 27, toothed segment 31, and gear 50. On the operating side the roller 36, drive elements 30 toothed segment 32, and gear 55 similarly control the coacting gripping element 61 mounted resiliently on the gripper tube 53. The force for opening the tongs grippers 13 is supplied by the compression springs 43 which, as already stated above, also serve the purpose of holding the rollers 36 in contact with the control cams 36, 37, 41, and 42.

If the apparatus of the invention is to be used for perfection printing, the rollers 36 have only to be moved axially on the drive and operating sides. For this purpose it is necessary to slacken the clamp screws 35 and on the drive side to move the roller 36 away from the control cam 36 and on to the control cam 38. Similarly, on the operating side the roller 36 is moved outwards away from the control cam 41 until it lies against the control cam 42. After this has been done the clamp screws 35 must be retightened. When the printing machine incorporating the turning device of the invention is now operated, the tongs grippers 13 move in accordance with the radii 82 and 83 shown in the periphery of the turning cylinder 2 in Figure 3.

The transfer cylinder 1 feeds the sheets 10 to the turning cylinder 2 once more. At least starting from the position of the transfer cylinder 1 shown in Figure 4, the sheets 10 are held by the grippers 8 at the front

edge and also by the suction rod 9 at the end of the sheet. The front edge of the sheet 10 is moved past the turning cylinder 2 by the grippers 8 until the gap 6 or 7 in the transfer cylinder 1 and the gap 11 in the turning cylinder 2 lie opposite one another. As can be seen in Figure 3, in this position of the cylinder 1 and 2 the tongs grippers 13 grip the rear end of the sheet 10 directly behind the suction bar 9. This delivery position can also be seen on a larger scale in Figure 8. After the rear edge of the sheet has been taken over by the tongs grippers 13, the suction rod first frees the sheet, and only then do the grippers 8 of the transfer cylinder 1 open. During the further rotation of the turning cylinder 2 which then takes place the tongs grippers 13 pivot about the axis of rotation 48 in accordance with the radii 82, until, at the tangent point between the turning cylinder 2 and the impression cylinder 3, they encounter the grippers 15. Shortly before this position is reached, the tongs grippers 13 are once again exactly in the recto printing position. They deliver the sheet 10 in correct register to the grippers 15 of the impression cylinder 3. After the delivery the tongs grippers 13 pivot about the axis of rotation 48 in accordance with the radii 83 until they once again reach the verso printing position and grip the rear edge of the next sheet 10 brought up by the transfer cylinder 1.

Through the control of the tongs grippers 13 which has already been explained with reference to the movement of the sheet for recto printing, the closure of the grippers is also maintained by constraint during the turning of the sheet so that in all phases of the turning device a uniform holding force of the tongs grippers is ensured.

WHAT WE CLAIM IS:—

1. A transfer device for a printing machine comprising a rotatable transfer cylinder; gripper tongs mounted on the transfer cylinder for pivotal movement about a pivot axis extending parallel to the axis of rotation of the transfer cylinder, the gripper tongs comprising two cooperating gripper elements each of which is independently rotatable about the pivot axis; and individual drives each for controlling the rotation of a respective one of the gripper elements about the pivot axis, each drive comprising a rotatable drive gear mounted coaxially with the pivot axis.

2. A transfer device for a printing machine comprising a rotatable transfer cylinder; gripper tongs mounted on the transfer cylinder for pivotal movement about a pivot axis extending parallel to the axis of rotation of the turning cylinder, the gripper tongs comprising two cooperating gripper elements each of which is independently ro-

tatable about the pivot axis located inwardly of the tangent to the peripheral surface of the transfer cylinder at the point of intersection of the gripper elements and the peripheral surface; and individual drives each for controlling the rotation of a respective one of the gripper elements about the pivot axis, each drive comprising a rotatable drive gear mounted coaxially with the pivot axis.

3. A transfer device according to claim 1 or claim 2 wherein the pivot axis is located in or near the peripheral surface of the transfer cylinder.

4. A transfer device according to any one of claims 1 to 3 wherein one gripper element is mounted on a rotatable tubular member and the other gripper element is mounted on a rotatable shaft which is coaxial with the tubular member and with the pivot axis.

5. A transfer device according to claim 4 wherein one gripper element is mounted rigidly on the rotatable shaft and the other gripper element is mounted on a casing rotatably mounted on the rotatable tubular member, and a spring acting between the tubular member biases the casing in the closing direction of the gripping element into engagement with an adjustable stop mounted on the tubular member.

6. A transfer device according to Claim 5 wherein the gripper element mounted on the rotatable shaft projects through cutouts in the tubular member and the casing, engagement of the gripper element with the cutout in the casing restraining the casing from axial movement on the tubular member.

7. A transfer device according to any one of Claims 1 to 6 wherein the individual drives for the gripper elements are located on respective ends of the transfer cylinder.

8. A transfer device according to any one of Claims 1 to 7 wherein each drive comprises a drive element mounted for pivotal movement relative to the transfer cylinder and carrying a toothed segment for operating the gripper element, the drive element being biased into contact with a cam which effects the pivotal movement of the drive element.

9. A transfer device according to Claim 8 wherein each drive comprises two control cams which are provided side by side on a respective side of the transfer cylinder coaxial with the axis of rotation of the transfer cylinder, and each drive element carries an axially slidable roller which can be selectively applied against each of the two control cams.

10. A transfer device according to any one of Claims 1 to 9, wherein, in its verso printing position, the clamp plane of one gripper element is always situated at the same height in relation to the peripheral



edge and also by the suction rod 9 at the end of the sheet. The front edge of the sheet 10 is moved past the turning cylinder 2 by the grippers 8 until the gap 6 or 7 in the transfer cylinder 1 and the gap 11 in the turning cylinder 2 lie opposite one another. As can be seen in Figure 3, in this position of the cylinder 1 and 2 the tongs grippers 13 grip the rear end of the sheet 10 directly behind the suction bar 9. This delivery position can also be seen on a larger scale in Figure 8. After the rear edge of the sheet has been taken over by the tongs grippers 13, the suction rod first frees the sheet, and only then do the grippers 8 of the transfer cylinder 1 open. During the further rotation of the turning cylinder 2 which then takes place the tongs grippers 13 pivot about the axis of rotation 48 in accordance with the radii 82, until, at the tangent point between the turning cylinder 2 and the impression cylinder 3, they encounter the grippers 15. Shortly before this position is reached, the tongs grippers 13 are once again exactly in the recto printing position. They deliver the sheet 10 in correct register to the grippers 15 of the impression cylinder 3. After the delivery the tongs grippers 13 pivot about the axis of rotation 48 in accordance with the radii 83 until they once again reach the verso printing position and grip the rear edge of the next sheet 10 brought up by the transfer cylinder 1.

Through the control of the tongs grippers 13 which has already been explained with reference to the movement of the sheet for recto printing, the closure of the grippers is also maintained by constraint during the turning of the sheet so that in all phases of the turning device a uniform holding force of the tongs grippers is ensured.

WHAT WE CLAIM IS:—

1. A transfer device for a printing machine comprising a rotatable transfer cylinder; gripper tongs mounted on the transfer cylinder for pivotal movement about a pivot axis extending parallel to the axis of rotation of the transfer cylinder, the gripper tongs comprising two cooperating gripper elements each of which is independently rotatable about the pivot axis; and individual drives each for controlling the rotation of a respective one of the gripper elements about the pivot axis, each drive comprising a rotatable drive gear mounted coaxially with the pivot axis.

2. A transfer device for a printing machine comprising a rotatable transfer cylinder; gripper tongs mounted on the transfer cylinder for pivotal movement about a pivot axis extending parallel to the axis of rotation of the turning cylinder, the gripper tongs comprising two cooperating gripper elements each of which is independently ro-

tatable about the pivot axis located inwardly of the tangent to the peripheral surface of the transfer cylinder at the point of intersection of the gripper elements and the peripheral surface; and individual drives each for controlling the rotation of a respective one of the gripper elements about the pivot axis, each drive comprising a rotatable drive gear mounted coaxially with the pivot axis.

3. A transfer device according to claim 1 or claim 2 wherein the pivot axis is located in or near the peripheral surface of the transfer cylinder.

4. A transfer device according to any one of claims 1 to 3 wherein one gripper element is mounted on a rotatable tubular member and the other gripper element is mounted on a rotatable shaft which is coaxial with the tubular member and with the pivot axis.

5. A transfer device according to claim 4 wherein one gripper element is mounted rigidly on the rotatable shaft and the other gripper element is mounted on a casing rotatably mounted on the rotatable tubular member, and a spring acting between the tubular member biases the casing in the closing direction of the gripping element into engagement with an adjustable stop mounted on the tubular member.

6. A transfer device according to Claim 5 wherein the gripper element mounted on the rotatable shaft projects through cutouts in the tubular member and the casing, engagement of the gripper element with the cutout in the casing restraining the casing from axial movement on the tubular member.

7. A transfer device according to any one of Claims 1 to 6 wherein the individual drives for the gripper elements are located on respective ends of the transfer cylinder.

8. A transfer device according to any one of Claims 1 to 7 wherein each drive comprises a drive element mounted for pivotal movement relative to the transfer cylinder and carrying a toothed segment for operating the gripper element, the drive element being biased into contact with a cam which effects the pivotal movement of the drive element.

9. A transfer device according to Claim 8 wherein each drive comprises two control cams which are provided side by side on a respective side of the transfer cylinder coaxial with the axis of rotation of the transfer cylinder, and each drive element carries an axially slidable roller which can be selectively applied against each of the two control cams.

10. A transfer device according to any one of Claims 1 to 9, wherein, in its verso printing position, the clamp plane of one gripper element is always situated at the same height in relation to the peripheral



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surface of an adjacent cylinder from which the sheet is fed to the transfer cylinder irrespective of the thickness of the transported sheets.

- 5 11. A transfer device according to any one of Claims 1 to 10 wherein the clamping surface of at least one of the gripper elements is curved.

- 10 12. A transfer device according to Claim 11 wherein at least one of the clamping surfaces of the gripper elements is flat and in the form of a friction surface.

13. A transfer device for a printing machine substantially as hereinbefore described with reference to the accompanying drawings. 15

14. A printing machine comprising a transfer device according to any one of the preceding claims.

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