Feb. 12, 1957 F. NAGELS 2,780,973

APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

Filed May 10, 1954 5 Sheets-Sheet 1

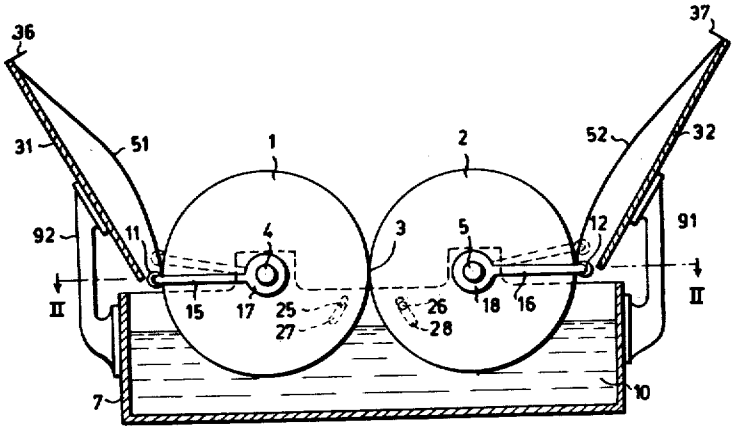


Fig. 1.

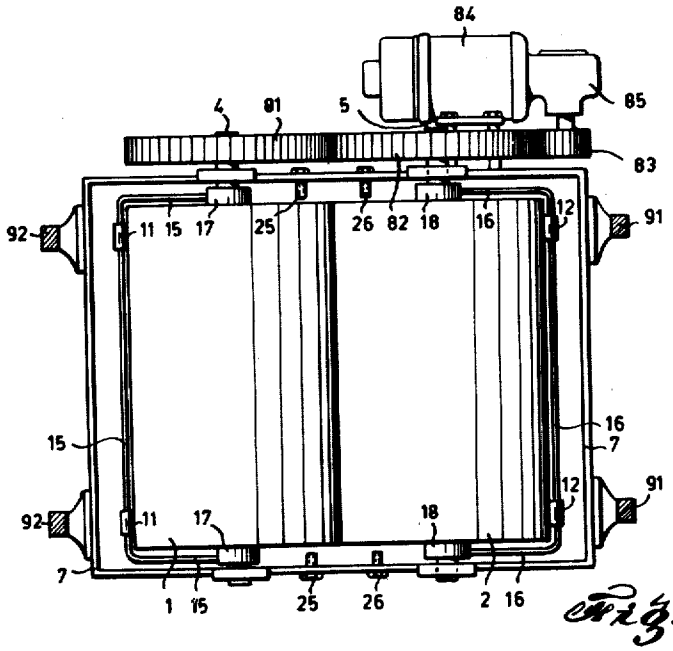


Fig. 2.

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APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

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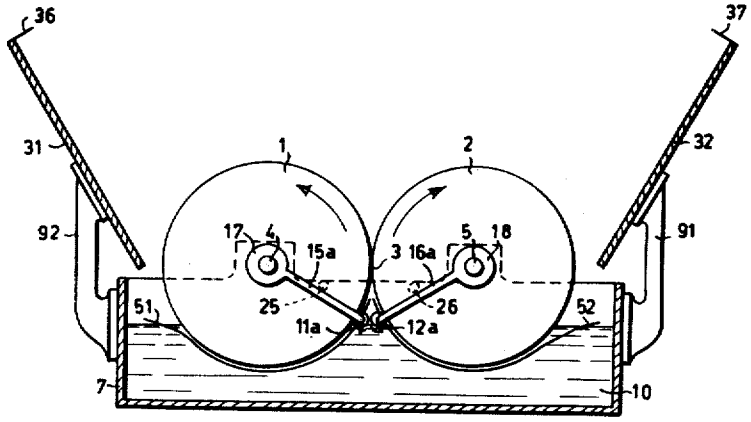


Fig. 3.

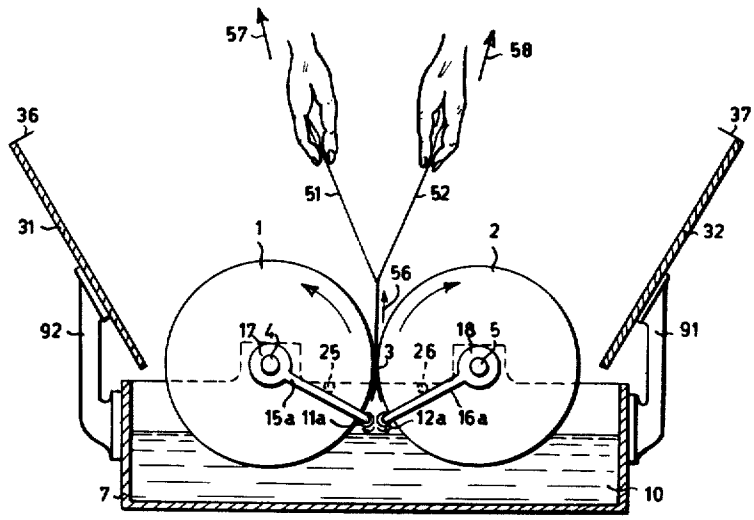


Fig. 4.

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APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

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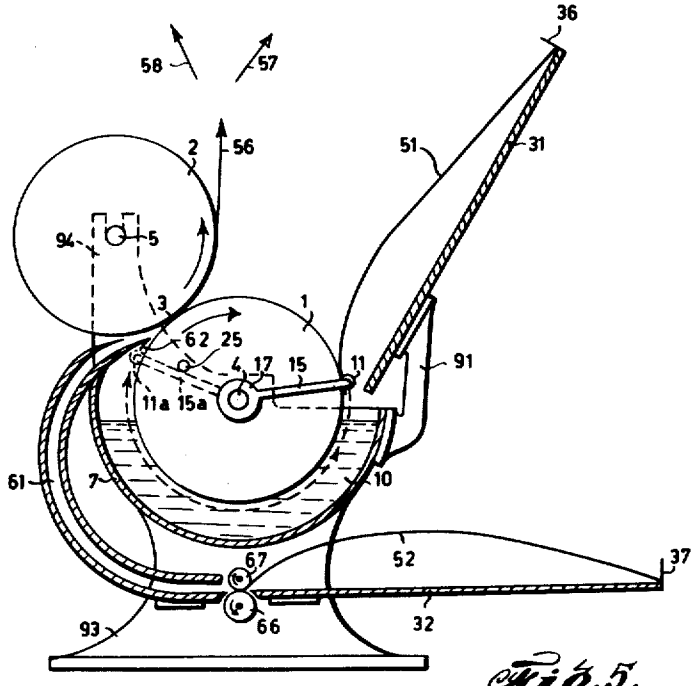


Fig. 5.

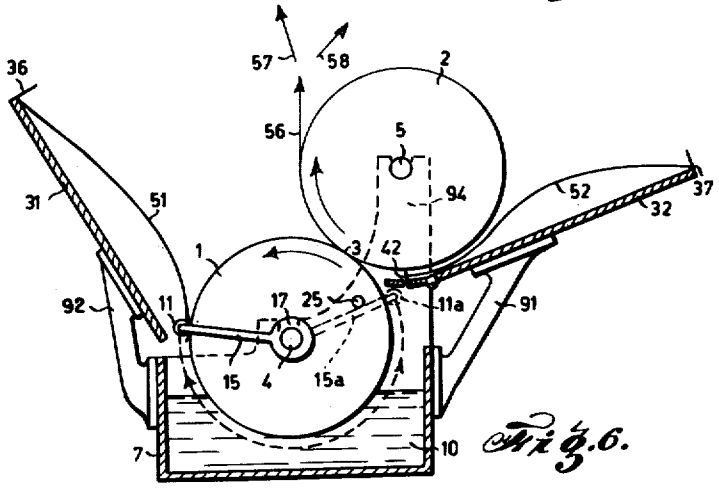


Fig. 6.

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APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

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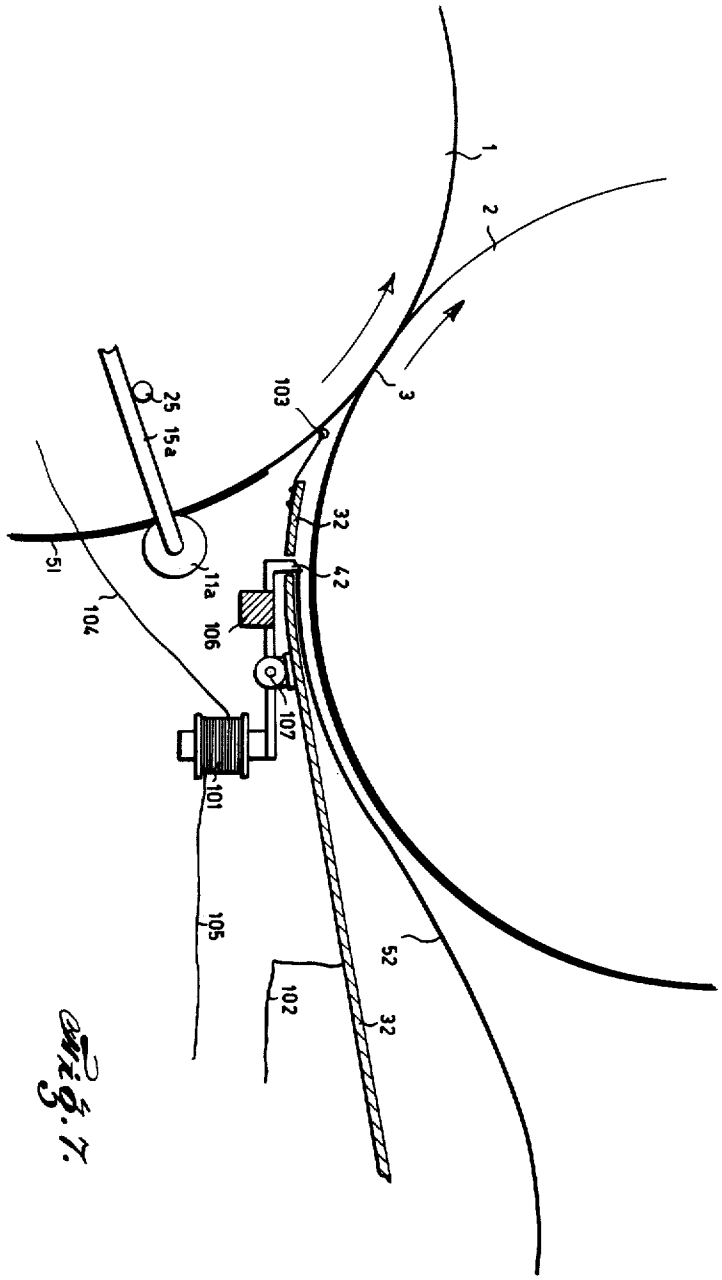


Fig. 7.

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APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

Filed May 10, 1954 5 Sheets-Sheet 5

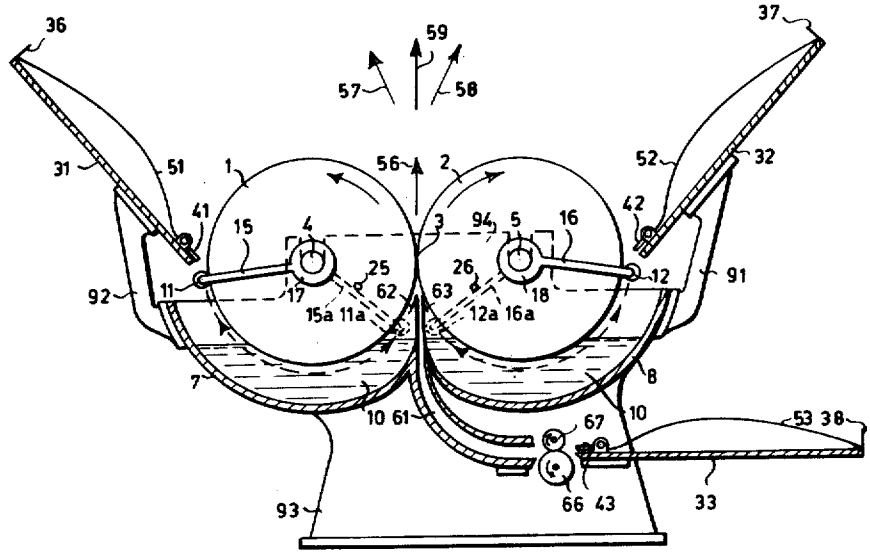


Fig. 8.

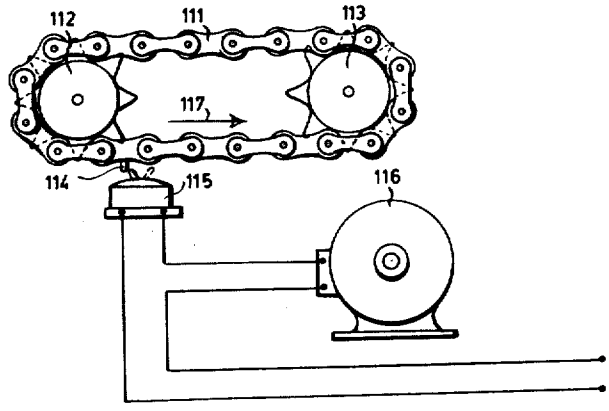


Fig. 9.

By- Frederik Nagels
Pollard, Johnston, Smythe & Robertson

United States Patent Office 2,780,973 Patented Feb. 12, 1957

2,780,973

APPARATUS FOR CARRYING OUT A TRANSFER PROCESS

Frederik Nagels, Venlo, Netherlands, assignor to Chemische Fabriek L. van der Grinten N. V., Venlo, Netherlands, a company of the Netherlands

Application May 10, 1954, Serial No. 428,570

Claims priority, application Netherlands May 8, 1953

11 Claims. (Cl. 95—89)

The invention is concerned with apparatus for carrying out a transfer process, in which with the co-operation of a liquid for enabling the transfer, sheet-shaped imagewise-exposed light-sensitive material is pressed against receiving support material by means of co-operating press rollers. Apparatus of that kind comprises a pair of press rollers, a liquid reservoir, and means for conveying at least one of the materials through said liquid reservoir.

An apparatus of this kind is described in British patent specification No. 672,844. The apparatus there described has the disadvantage that the sheet material to be used in the transfer process has to be relatively stiff to enable it to be pushed into and through the guideways of the apparatus so as to reach the pressing zone between the press rollers. This involves difficulties, since when the sheet passes through the liquid, its stiffness is usually unimpaired. A further disadvantage of the known apparatus is that the manual insertion of the sheets cannot take place sufficiently accurately, in particular with respect to the length of time during which the leading parts of the sheets are in contact with the liquid. Not until the sheets are in the grip of the press rollers of the apparatus according to British patent specification No. 672,844 will their further transport and moistening take place at constant speed (the speed of the press rollers). The result may be a difference in treatment between the leading part and the remainder of the sheet, and this in turn may lead to a difference in result, e. g. when processes such as those described in Swiss patent specification No. 240,472 are carried out in the said apparatus. With more up-to-date transfer processes, for example those according to the United States patent applications Serial Nos. 341,197 and 341,198, which are based upon "bodily transfer," the maintenance of an exact and predetermined duration for the immersion of the material(s) in the liquid, right from the leading edge thereof, is often of particular importance, and for these processes the apparatus of the cited British patent specification will in many instances be unsuitable.

A further drawback of the apparatus according to British patent specification No. 672,844 is that it is very difficult to combine it with automatic sheet-feeding devices.

It is an object of the invention to eliminate or minimize the said disadvantages.

The apparatus according to the present invention is characterized in that at least one of the press rollers is also adapted to act as a transport roller for one of the materials and is immersed in the liquid reservoir over an area of its surface extending in the direction of rotation in front of the pressing zone formed between the two press rollers, said transport press roller being provided with a device for clamping the leading edge of the material to be conveyed through the liquid against the roller surface, which device consists of at least one clamping roller, mounted for rotation in a yoke adapted to swing about the axis of said transport press roller, said clamping roller holding said leading edge against

the surface of the transport press roller by exerting pressure on the latter, an abutment being arranged for limiting the motion of the clamping roller when the latter is carried along by the transport press roller.

Various embodiments of the invention are illustrated in the accompanying drawings in which:

Figure 1 is a cross-sectional elevation of an apparatus in which both press rollers are immersed in a liquid reservoir.

Figure 2 is a plan view, partly in horizontal cross-section on the line II—II in Figure 1.

Figure 3 shows the apparatus of Figures 1 and 2 in the position in which the two moistened materials are about to be pressed together between the rollers.

Figure 4 shows the same apparatus in the position in which the materials are already partly pressed together, and are in course of being separated (by hand).

Figures 5 and 6 illustrate two embodiments of the invention in which only one of the press rollers is immersed in the liquid reservoir.

Figure 7 shows a detail of Figure 6 relating to an electrical actuating device.

Figure 8 shows a vertical cross-section of an apparatus in which each of the press rollers is immersed in a liquid reservoir, the two liquid reservoirs being separated from each other.

Figure 9 shows means for actuating a tumbler-switch for arresting the apparatus.

In the drawings, identical reference numbers refer to corresponding parts.

Figure 1 shows the apparatus while out of operation, i. e. at a standstill. The press rollers are designated **1** and **2**, and one or both of them may be rubber-lined rollers (the rubber linings may have a hardness of 75° Shore). Both rollers form transport press rollers and both are immersed in the liquid reservoir **7**, which is filled up to a suitable level with liquid **10**. The shafts or trunnions **4** and **5** of the rollers are supported in bearings mounted on the liquid reservoir **7**. The distance between these bearings is so chosen that the rollers **1** and **2** will be kept close together, so as to cause pressure in the pressing zone **3** between the rollers. Clamping rollers **11** and **12** are mounted for rotation in the yokes or frames **15** and **16**, which are adapted to swing about the axes of the rollers **1** and **2**. For a reliable operation of the apparatus, it is preferable to have the yokes **15** and **16** swinging about the trunnions **4** and **5** of the transport press rollers **1** and **2** by means of bearings **17** and **18**. Even greater reliability is obtained if there is some friction between the bearings **17** and **18** and the trunnions **4** and **5**, which friction, however, should preferably not be higher than is necessary to ensure the yokes being taken along by the transport press rollers upon rotation. The clamping roller **11** rests against the transport press roller **1**, and in the same way the clamping roller **12** rests against the transport press roller **2**. Two tables **31** and **32**, having end-flanges **36** and **37**, are mounted opposite the places where the materials are to be fed to the press rollers. The tables **31** and **32** are mounted on the reservoir **7** by means of the supports **92** and **91**. The sheets **51** and **52**, one of which is the sheet of imagewise-exposed light-sensitive material, whilst the other is a receiving sheet, are so arranged that the sides which have to cooperate in the transfer, are down. They are placed in the position as indicated, i. e. sheet **51** with its leading edge inserted into the gripping zone between the rollers **1** and **11** and with its trailing edge against the flange **36**, and sheet **52** with its leading edge inserted into the gripping zone between the rollers **2** and **12** and with its trailing edge resting against the flange **37**. Before the apparatus is started, the yoke **15** is swung clockwise and the yoke **16** counter-clockwise about the

trunnions 4 and 5, until they reach the position shown in dotted lines, in which each clamping roller has rolled the leading edges of the respective sheets 51 and 52 between itself and its press roller and gripped them. This position of the yokes and clamping rollers, and the corresponding positions in the other figures, will hereinafter be referred to as the "gripping position."

Figure 2 illustrates the apparatus of Figure 1 in plan view (partly in section). It shows how the transport press roller 1 cooperates with the yoke 15 and the two clamping rollers 11. The figure also shows how the transport press roller 2 cooperates with the yoke 16 and the two clamping rollers 12. In substantially the same manner there may also be arranged more than two clamping rollers 11 on the yoke 15, and more than two clamping rollers 12 on the yoke 16, but there may also be one clamping roller to each yoke. The clamping roller(s) may have greater or smaller axial length than is indicated in Figure 2. If only one clamping roller is used for each yoke, it may, for example, have substantially the same axial length as the press roller. The clamping rollers 11 and 12 may be made of resilient material, and they may have such axial length (or if, as in Figure 2, two clamping rollers 11 and two clamping rollers 12 are used, be so spaced from each other) that their axial clamping range is slightly greater than the width of the sheets to be clamped. They will then, during operation, ont only clamp the leading edges of the sheets, but will also (because they are resilient) rest against their respective transport press rollers beyond the sides of the sheet, and this will make their operation more reliable. A system of a co-operating press roller and its clamping roller(s) will hereinafter be referred to as a "press roller-clamping roller combination."

Mounted on the shaft 4 of the roller 1 is a toothed wheel 81, and on the shaft 5 of the roller 2 a toothed wheel 82, which are in mesh. The apparatus is driven by an electric motor 84 via a reduction gear 85 and a pinion 83, so that the press roller 1 will move counterclockwise and the press roller 2 clockwise.

After starting the apparatus, the press rollers 1 and 2 will take along the clamping rollers 11 and 12 in their motion (the latter not yet rotating about their own axes), together with the yokes 15 and 16 and the sheets 51 and 52, the latter being pulled through the liquid 10. The sheet 51 is clamped with its leading edge between the rollers 1 and 11, and the sheet 52 between the rollers 2 and 12. After having moved through a certain angle, the clamping rollers 11 and 12 will meet, as shown in Figure 3 (in these end positions the rollers 11 and 12 are denoted by 11*a* and 12*a*, and the yokes 15 and 16 by 15*a* and 16*a*). The clamping rollers, owing to their meeting, will arrest the swinging motion of the yokes. Additionally abutments 25 and 26 for limiting the motion of the yokes may be provided. As shown in Figure 1, these abutments 25, 26 are fixed abutments, adjustable in slots 27 and 28. The rollers 1 and 2 continue their motion, thus causing the clamping rollers 11 and 12 to start rotating about their own axes in their positions 11*a* and 12*a* (roller 11 clockwise and roller 12 counterclockwise). This occurs because they are in contact with the sheets which are moved along by the transport press rollers 1 and 2 (or, if far enough apart and resilient, partly in contact with these transport press rollers themselves). Notwithstanding the fact that their yokes have been arrested in their motion along with the transport press rollers, the clamping rollers 11, 12 will thus continue to assist in the transport of the sheets 51 and 52; at any rate they will not impede this transport.

In Figure 3 the situation is shown in which the sheets have nearly reached the pressing zone. Upon further motion the sheets will be pressed together with some of the liquid in between and proceed together through the pressing zone 3, upon which they adhere to each other and will thus proceed upwards. Upon leaving the pressing zone in the upward direction, as indicated by the arrow 56, they can be separated by hand as illustrated in Figure 4. Separation immediately after pressing-together is only effected in those cases where the transfer proper takes place substantially instantaneously, as is often the case when processing according to United States patent applications Serial Nos. 341,197 and 341,198. In most of the diffusion transfer processes, such as those of Swiss Patent No. 240,472, the sheets have to remain in contact with each other for some time, and in these cases they are left together, and taken out of the machine by one hand (instead of two) and separated later.

In the foregoing description of the operation of the apparatus of Figures 1–4 it was assumed that the apparatus had been arrested after the previous transfer operation. It is, however, possible to construct apparatus according to the invention in which the press rollers 1 and/or 2 run continuously, and in such continuously running apparatus provision is desirable (such provision also being useful in apparatus which operates discontinuously) for producing greater accuracy of operation. In an embodiment of the invention such a provision consists of a mechanism for holding in readiness, and for feeding to the gripping zone of a press roller-clamping roller combination immersed in the liquid reservoir, the sheet to be transported through the liquid reservoir by the said combination.

The apparatus of Figure 8 shows two such feeding mechanisms. One of these is formed by the table 31, the flange 36 and the stop 41. The other is formed by the table 32, the flange 37 and the stop 42. The rollers 1 and 2 run continuously, and the transport mechanism 66—67—61 is shown as out of operation.

When the stops 41 and 42 are actuated (lifted) at the right moment, the imagewise exposed sheet 51 and the receiving sheet 52, which are each placed with the sides co-operating in the transfer downwards, in clamped and bent-up position between the said stops and flanges, will shoot forward. The clamping rollers 11 and 12, which at the same time proceed to positions a little higher than the positions 11 and 12, will grip the leading edges of the sheets. The apparatus will further operate as illustrated in Figures 3 and 4, and during operation fresh sheets may be placed in readiness on the tables 31 and 32 on top of the preceding sheets, even when the latter are still moving on these tables, provided the stops 41 an 42 have meanwhile been lowered again.

In an embodiment of the invention the apparatus comprises besides the feeding device to the gripping zone, means for actuating it, by the swinging back of the clamping roller to its gripping position. The feeding mechanism may be actuated by retraction of the stop electromagnetically. The electric impulse can easily be produced by causing the yoke, when approaching and/or reaching the gripping position, to touch an electric contact, which closes the electric circuit of the electro-magnet and energizes the latter, so as to raise the said stop or, as is the case in Figure 8, the stops.

Figure 5 illustrates an embodiment of the invention comprising one "press roller-clamping roller combination" (1—11), immersed in the liquid reservoir (for the transport of sheet 51) and a second press roller 2 not immersed in a liquid reservoir. The roller 2 is mounted with its shaft 5 in supports 94, provided on the reservoir 7. Means for press roller 2 against roller 1 are provided, but not shown. A conveying device is provided for conveying a sheet 52, out of contact with the liquid, to the pressing zone 3. This conveying device is indicated by the rollers 66 and 67, co-operating with a slotted guide 61. The apparatus will thus treat the sheet 51 with liquid, whilst the sheet 52 will not be so treated. This arrangement fulfills the requirements of a number of transfer processes described in the aforesaid United States

patent applications. The apparatus is mounted on a base 93.

This apparatus operates as follows: After a previous transfer operation the clamping roller 11 and the yoke 15 (Figure 5) will be in the positions 11*a* and 15*a*. It is supposed that the apparatus has subsequently come to a standstill. A fresh sheet 52 is now placed on the table 32 in the clamped and bent-up position as shown, with that side upwards which is active in the transfer. The yoke 15 is now swung in a counter-clockwise direction in order to bring the clamping roller 11 a small distance below its position 11. The sheet 51, with that side downwards which is active in the transfer is now inserted with its leading edge into the girpping zone of the clamping roller 11 and is there gripped through a slight counter-clockwise movement of the yoke 15 so that the clamping roller reaches the exact position 11 indicated in Figure 5. The apparatus is subsequently started, the press rollers 1 and 2 now rotating in the direction of the respective arrows. The sheet 51 will be taken along by the clamping roller 11, and will follow the surface of the roller 1 through the liquid 10 in the reservoir 7. After the yoke has reached the abutment 25 and has been arrested by the latter in the position 15*a*, so that the clamping roller starts rotating about its own axis in the position 11*a*, the sheet 51 will proceed through the slot 62 to the pressing zone 3.

The rollers 66 and 67, which are driven together with the rollers 1 and 2 (the driving means are not shown in the drawing) will also have started rotating in the directions indicated by arrow simultaneously with the rollers 1 and 2. Thus they will meanwhile have conveyed the sheet 52 through the guide slot 61 to the pressing zone 3. The speed of the conveying mechanism 66—67 is so adjusted that the sheets 51 and 52 will be substantially in register when they meet to be pressed together in the pressing zone 3. They then proceed in the direction of the arrow 56, and can be separated by hand, as shown diagrammatically by the arrows 57 and 58.

It is arranged that the sheets, which start simultaneously, meet in register in the pressing zone 3 by making the quotient of the length of the conveying path up to the pressing zone and the travelling speed therein substantially equal for the conveying paths of the two sheets 51 and 52 (on the roller 1 and in the slot 61). The simplest arrangement is that in which the two paths have equal length, the rollers 66 and 67 having the same circumferential speed as the rollers 1 and 2.

If for any reason the paths are not equal, the rollers 66 and 67 can be driven by means of a slip-coupling or these rollers may be so arranged that there may be some slip between the rollers and the sheet 52. The rollers 66 and 67 may also be separated from each other at the moment when the leading edge of the sheet 52 enters the pressing zone 3.

In order to prevent folds being formed in the sheet 52, it may be advisable to give the rollers 66 and 67 a circumferential speed of, for example, 9/10 of that of the press rollers, and to give the conveying path between the rollers 66—67 and the pressing zone 3 a length of 9/10 of that between the points 11 and 3 along the circumference of the roller 1. As a result the sheet 52, after its leading edge has entered the pressing zone, will be stretched and thus freed of folds.

In an apparatus comprising the above mentioned additional sheet-conveying device (which latter device in order to make the sheets register with each other—in the pressing zone—must begin to transport the sheet to be conveyed at the moment the other sheet is gripped and started), means are preferably also provided for actuating the additional sheet-conveying device (66—67—61 in Fig. 5) at the moment when the clamping roller has reached its extreme position, where it starts gripping the leading edge of the material to be transported between itself and its co-operating press roller. The actuation may be achieved by causing the yoke, when this approaches and/or reaches the gripping position, to touch an electric contact, and thus to close an electric circuit, which causes the closing of a switch, which in turn starts the electric motor driving the conveying mechanism 66—67.

A further embodiment of the invention is shown in Fig. 6. It comprises a press roller-clamping roller combination (1—11) immersed in the liquid reservoir 7 for the transport of the sheet 51, a second press roller 2 not in contact with the liquid, and a mechanism for holding a sheet 52 in readiness and for feeding it substantially directly to the pressing zone 3. Furthermore there are means, as illustrated in Fig. 7, for actuating the latter feeding mechanism some time after the starting of the sheet 51, so as to enable said feeding to be in timed relation with the transport of the sheet 51 by the press roller-clamping roller combination.

In the apparatus of Figure 6, the sheet 52 with that side downwards which is active in the transfer, is held in readiness for feeding to the pressing zone 3 by the mechanism formed by the table 32, the stop 42 and the end flange 37. The support 91 of the table 32 insulates this mechanism electrically from the reservoir 7 and from the bearings of the roller 1. The stop 42 extends upwards through one or more openings in the table 32, which openings do not interrupt the table completely. The sheet 52 is held in clamped and bent-up position between the raised stop 42 and the flange 37. When the operation starts, the sheet 51, also with that side downwards which is active in the transfer, will be gripped by the press roller-clamping roller combination 1—11. It will be transported underneath the roller 1 through the liquid, and the clamping roller will proceed from position 11 to position 11*a*. Meanwhile the stop 42 will remain in the position shown in Figure 6, and will hold the sheet 52. When, however, after the clamping roller has reached the position 11*a*, the leading edge of the sheet 51 approaches the pressing zone 3, a mechanism (illustrated in Fig. 7) will actuate the feeding mechanism by lowering stop 42 at a timed moment. The sheet 52, now released from the clamped and bent-up position, will sheet forward with its leading edge directly into the pressing zone 3, where it will be gripped and pressed together with the sheet 51.

The compressed sheets 51 and 52 will then follow the direction of the arrow 56, and upon separation the sheet 51 will follow the direction of the arrow 57, whilst the sheet 52 will follow that of the arrow 58. The separation can again be carried out by hand. There are several possibilities for actuating the feeding mechanism in timed relation with the transport of the sheet by the transport press roller-clamping roller combination. One of these is illustrated in Figure 7. In this figure, which shows an enlarged detail of Figure 6, the press roller 1 is a metal roller and the press roller 2 is a rubber-lined roller. The metal table 32 points with its end towards the pressing zone 3. To its end there is affixed a small plate spring carrying a small, rotatably mounted contact cylinder 103, which is in electrical contact with the roller 1. An electric circuit is formed by conductor 102, table 32, contact 103, press roller 1, from there via a sliding contact (not shown) through the conductor 104, through electro-magnet 101, and then through conductor 105. The conductors 102 and 105 are connected to the current supply lines. The magnet 101 is thus energized and holds down the rear end of the lever carrying the stop 42. The said lever pivots about the axis 107. When the sheet 51, on its way to the pressing zone 3, passes underneath the contact roller 103, the electric resistance in the circuit is increased, and thus the electric current decreased, and the magnet 101 will no longer hold the stop 42. This stop falls down under the influence of the weight 106 and thus releases the sheet 52, which, as described above, will

shoot forward into the pressing zone 3, where it will be joined with the sheet 51. As soon as the sheets have left the apparatus, the contact between the contact roller 103 and the press roller 1 is restored, as a result of which the stop 42 will return to its original position, after which a fresh sheet 52 can be placed on the table 32 in clamped and bent-up position, and can thus be kept in readiness for the next transfer operation.

In the apparatus illustrated in Figures 1–4 both press rollers are provided with a clamping roller and both are immersed in a liquid reservoir. This embodiment is particularly suitable for carrying out transfer operations requiring special care, such as, for example, transfers to planographic surfaces, which have to be used as printing plates in planographic printing (e. g. in the offset process), and in general for carrying out more difficult transfer operations, which require the wetting of both cooperating surfaces.

From the embodiment of Figures 1–4, however, there has been developed an embodiment of the apparatus in which two different image transfers can be achieved, e. g. on to both sides of one and the same receiving sheet, in a single operation. In this embodiment, the apparatus comprises two "press roller-clamping roller combinations," each immersed in a liquid reservoir. The two liquid reservoirs are spaced from each other, and there is a conveying mechanism for conveying a sheet upwards through the space between the liquid reservoirs to the pressing zone. Thus the apparatus has three conveying paths through which sheets may travel. The quotients of the length of the path and the travelling speed are chosen substantially equal for the three paths. Thus three sheets, which have been fed in simultaneously, will register with each other in the pressing zone.

Such an embodiment of the invention is illustrated in Figure 8. The two liquid reservoirs are designed by 7 and 8. They are both filled with liquid 10. Between the two liquid reservoirs there is a space for accommodating the slot 61, which, together with the rollers 66 and 67, forms the conveying mechanism for conveying a sheet upwards to the pressing zone 3. The lengths of the paths along the roller 1 from 11 to 3, along the roller 2 from 12 to 3, and through the slot 61 from 66—67 to 3 are equal, and the circumferential speed at which the rollers 66 and 67 rotate is the same as that of the press rollers 1 and 2.

The sheets 51 and 52 are two imagewise exposed sheets placed in readiness with their image side down in the two feeding mechanisms 31, 41, 36 and 32, 42, 37, already described, to be gripped by the clamping rollers 11 and 12. A receiving sheet 53, both sides of which are suitable for receiving an image in the transfer operation, is kept in readiness in a similar feeding mechanism 33, 43, 38, in order to be conveyed by the conveying mechanism represented by the rollers 66 and 67 and the slot 61. When the apparatus is started, the three feeding mechanisms are actuated, i. e. the stops 41, 42, and 43 are lifted, the three sheets will shoot forward, the clamping roller 11 will take the sheet 51 along through the liquid, the clamping roller 12 will do likewise with the sheet 52, whilst the sheet 53 will be conveyed through the slot 61. When the clamping rollers have reached the respective positions 11*a* and 12*a* (the yokes being arrested in the positions 15*a* and 16*a* by the abutments 25 and 26), the sheets 51 and 52 will proceed through the slots 62 and 63, and when their leading edges reach the pressing zone 3, they will find the leading edge of sheet 53 in between them. The three sheets will now be pressed together in the pressing zone. They will proceed upwards as indicated by the arrow 56, and can then be separated by three hands, as indicated, diagrammatically by the arrows 57, 58 and 59. The receiving sheet 53, which follows the arrow 59, will carry a transfer image on each of its sides.

The apparatus according to Figure 8 may likewise be used for carrying out a double transfer in a single operation, when the sheet 53 is a sheet imagewise exposed on both sides, and the sheets 51 and 52 are receiving sheets. The latter will then, after the transfer operation, each carry one transfer image. An apparatus having only one liquid reservoir for the two press rollers, but having underneath the pressing zone a guideway (through the said reservoir) for the third sheet, is naturally an obvious equivalent of the apparatus described above.

The apparatus of Figure 8 may be used in such a manner that only the right-hand side is in operation. Upon the starting of the apparatus the stops 42 and 43 are lifted, the sheets 52 and 53 will shoot forward, the sheet 52 (the imagewise exposed sheet) will be inserted with its leading edge into the gripping zone of the clamping roller 12, and the sheet 53 (the receiving sheet) will be inserted with its leading edge between the conveying rollers 66 and 67. The remainder of the cycle of operations will be the same as described with reference to Figure 5. The result will be essentially identical with that obtained with the apparatus of Figure 5. However, there is the difference that in the pressing zone the back of the sheet 53 has travelled in contact with the wet surface of the pressing roller 1 and has been slightly moistened by it. The sheet 53, which has been moistened on both sides, will show less curling tendency than a sheet which has been moistened on one side only.

A further embodiment of the invention comprises means for arresting the transport press roller(s) after a predetermined length of material has passed through the apparatus. This arrangement can be described with reference to Figures 4 and 9.

When in a phase of the operation a short time after that shown in Figure 4 the two sheets will have left the pressing zone 3, the press rollers will have covered a circumferential distance which is equal to the path along the circumference of the roller 1 between the position of roller 11 in Figure 1 and the pressing zone 3, and in addition a circumferential distance corresponding to the length of the compressed sheet material. After having covered this total distance, the apparatus will arrest itself, for example in the following simple way:

The electric motor 116 (Figure 9) driving the apparatus is fed with electric current via the tumbler-switch 115 shown in Figure 9 when this takes up the "switched-on" position, i. e. with its handle to the left.

To one of the pressing rollers are connected two sprocket wheels 112 and 113 (Figure 9), carrying an endless chain 111. This endless chain carries a projection 114, which when travelling past the tumbler-switch 115 in the direction of the arrow 117, will reverse the handle of this tumbler-switch to the right-hand side (represented by dotted lines), thus switching off the electric motor 116. For restarting the apparatus, the handle of the tumbler-switch 115 is again moved to the left, either by hand or otherwise. The device according to Figure 9 is so coupled with the apparatus and the length of the endless chain 111 is so chosen that, after restarting, the abutment will again travel past the switch 115 after the apparatus has covered the above-mentioned predetermined distance. Other means for achieving the same result are obvious.

It is, for example, not necessary to use a chain with a projection; a simple disc having a projection may also be used.

In the operation of the apparatus according to the invention, either the press roller 1 or 2 or both can be driven. In a discontinuous apparatus, for example of the type of Figure 6, the roller 2 may be driven continuously, while, for arresting the roller 1, the roller 2 has to be lifted. In an apparatus of the type of Figure 5 the conveying device 66—67 may be driven by the roller 1, while by lifting the roller 2, the roller 1 and the conveying device are both arrested, and by bringing

the press roller 2 against the roller 1 again, this roller and the conveying device are both started.

The apparatus according to Figures 1–4 may be used for carrying out Examples II and III of Swiss patent specification No. 240,472, and also for carrying out Example II of United States patent application Serial No. 341,197 and Example I of United States patent application Serial No. 341,198. In the two latter cases the separation can be effected, as in Figure 4, shortly after pressing together. In carrying out Examples II and III of Swiss patent specification No. 240,472 the sheets are left together during the time indicated in these examples, and are then separated.

The apparatus of Figures 5 and 6 may be used, inter alia, for the purpose of carrying out different other examples of the above-mentioned United States patent applications, e. g. Example XXVIII of United States patent application No. 341,197 and Example IV of United States patent application No. 341,198, by using for the sheet **51** the imagewise exposed sheet with its image side down and for the sheet **52** the receiving sheet. Likewise Example XXI of United States patent application No. 341,197 and Example II of United States patent application No. 341,198 may be carried out in the apparatus according to Figures 5 and 6 by using sheet **51** for the receiving sheet.

When an apparatus according to the invention operates discontinuously, e. g. because, as described, it arrests itself, then in one embodiment of the invention means are provided for actuating (through the swinging back of the clamping roller to its gripping position), the mechanism for starting the apparatus.

Thus, for example, in the apparatus according to Figures 1–4 (assuming the two yokes to be mutually coupled) an abutment of yoke **11** may, upon the two clamping rollers reaching the gripping position, as shown in Figure 1, reverse a switch such as the switch **115** in Figure 9, but in this case in order to close the circuit of the motor **116**, which was switched off at the end of the previous transfer operation by the device of Figure 9. This motor will thus be restarted so as to put in motion the press rollers **1** and **2**.

In the apparatus of Figure 5, when the clamping roller reaches its gripping position **11**, the press rollers **1** and **2** and the transporting rollers **66** and **67** may be started similarly.

In the apparatus according to Figure 6 the same applies to the press rollers **1** and **2**, whilst the feeding mechanism will be actuated later, as described with reference to Figures 6 and 7.

In the apparatus of Figure 8 (assuming the two yokes to be mutually coupled), when the clamping rollers reach the positions **11** and **12**, the press rollers **1** and **2** and the rollers **66** and **67** may be started, while at the same time the stops **41**, **42** and **43** may be actuated.

In all embodiments of the invention comprising one or more mechanisms for holding a sheet in readiness and feeding it to the pressing zone (Figure 6) or to a gripping zone (Fig. 8), to a conveying device (Fig. 8) or to a gripping zone and a conveying device (Fig. 8), the feeding mechanisms can take the form of sheet-feeding devices which hold in readiness a pile of sheets. Many variants of such sheet-feeding devices are known. In one such sheet-feeding device, for example, there is arranged, over the pile of sheets, a pushing member which pushes the topmost sheet of the pile in the direction of either the gripping zone, the conveying device or the pressing zone, and will thus bend up the topmost sheet, each time in such a way that when a stop preventing the topmost sheet from shooting forward is withdrawn, the topmost sheet will feed itself to the gripping zone, the conveying device or the pressing zone.

The provision of sheet-feeding mechanisms may permit a considerable simplification of operation of the apparatus in question.

When, for example, in the apparatus according to Figure 5 the table **32** is replaced by a sheet-feeding mechanism, and when transfer processes according to the aforesaid United States patent applications are carried out, the sheet **52** will preferably represent the topmost sheet of a pile of receiving sheets, and each time the operator will only have to handle an imagewise exposed sheet **51**, cause it to be gripped, start the apparatus, and carry out the separation by hand. Other applications of sheet-feeding devices which may replace the feeding mechanisms of the drawings will be obvious.

In an apparatus according to the invention one of the cooperating materials may be used in the form of a web, coming from a feed reel, in particular when the apparatus runs continuously. In most cases it will be the receiving support which will be so handled. In the apparatus according to Figure 6, the table **32** with the flange **37** and the stop **42** may be replaced, for example by a reel of receiving sheet **52**, which will proceed via the pressing zone **3** to be reeled up in the direction of the arrows **56** and **58**. Whenever the clamping roller reaches the gripping position **11**, the apparatus can take a fresh sheet **51** of imagewise exposed material, which after having travelled through the liquid, in the pressing zone **3** will be pressed on the web **52**, upon which the latter, while proceeding in the direction of the arrow **58**, will take along the sheet **51** pressed on to it. The sheets **51** are preferably taken off by hand, as indicated diagrammatically by the arrow **57**.

What I claim is:

1. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers having a part of its surface ahead of said pressing zone immersed in the liquid space of said reservoir, a sheet clamping roller, means holding said clamping roller rollable relative to the surface of said immersed roller and swingable about the axis thereof so that it may be rolled over the leading edge of a sheet to press the same against said surface and advanced bodily with said surface toward said zone, and means for stopping the swinging movement of said clamping roller at an advanced position thereof from which continued movement of said surface will move the sheet beyond said clamping roller into said pressing zone.

2. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers having a part of its surface ahead of said pressing zone immersed in the liquid space of said reservoir, a sheet clamping roller, means holding said clamping roller rollable relative to the surface of said immersed roller and swingable about the axis thereof so that it may be rolled over the leading edge of a sheet to press the same against said surface and advanced bodily with said surface toward said zone, said holding means comprising a yoke rotatably carrying said clamping roller and mounted for swinging movement about said axis, and means for stopping the swinging movement of said yoke at an advanced position of said clamping roller from which continued movement of said surface will move the sheet into said pressing zone.

3. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers having a part of its surface ahead of said pressing zone immersed in the liquid space of said reservoir, a sheet clamping roller, means holding said clamping roller rollable relative to the surface of said immersed roller and swingable about the

axis thereof so that it may be rolled over the leading edge of a sheet to press the same against said surface and advanced bodily with said surface toward said zone, means operative upon the rotation of said immersed roller to induce a swinging movement of said clamping roller with the rotational movement of said surface, and means for stopping said swinging movement at an advanced position of said clamping roller from which continued movement of said surface will move the sheet into said pressing zone.

4. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers having a part of its surface ahead of said pressing zone immersed in the liquid space of said reservoir, a sheet clamping roller, means holding said clamping roller rollable relative to the surface of said immersed roller and swingable about the axis thereof so that it may be rolled over the leading edge of a sheet to press the same against said surface and advanced bodily with said surface toward said zone, means operative upon the rotation of said immersed roller to induce a swinging movement of said clamping roller with the rotational movement of said surface, and means for stopping said swinging movement at an advanced position of said clamping roller from which continued movement of said surface will move the sheet into said pressing zone, said holding means comprising a yoke forming an axle for said clamping roller, and said movement inducing means comprising friction bearings pivotally mounting legs of said yoke on trunnions of said immersed roller.

5. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers being partly immersed in the liquid space of said reservoir to provide a wetting zone ahead of said pressing zone, a sheet feeding mechanism arranged to deliver the leading edge of a sheet to the surface of said immersed roller at a starting position ahead of said wetting zone, a sheet clamping roller, means for holding said clamping roller rollable relative to said surface and swingable about the axis thereof so that said leading edge may be gripped to said surface by rolling said clamping roller over said edge, said clamping roller being swingable bodily about said axis with the rotation of said immersed roller to carry the gripped edge through said wetting zone, and means for stopping the swinging movement of said clamping roller at an advanced position thereof from which the continued movement of said surface will advance the sheet into said pressing zone.

6. An apparatus as described in claim 5, and means operated by swinging said clamping roller back to said starting position for actuating said sheet feeding mechanism.

7. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, a reservoir for a transfer liquid, at least one of said rollers being partly immersed in the liquid space of said reservoir to provide a wetting zone ahead of said pressing zone, sheet feeding means arranged to locate the leading edge of a sheet on the

surface of said immersed roller at a starting position ahead of said wetting zone, a sheet clamping roller, means for holding said clamping roller rollable relative to said surface and swingable about the axis thereof so that said leading edge may be gripped to said surface by rolling said clamping roller over said edge, said clamping roller being swingable bodily about said axis with the rotation of said immersed roller to carry the gripped edge through said wetting zone, means for stopping the swinging movement of said clamping roller at an advanced position thereof from which the continued movement of said surface will advance the sheet into said pressing zone, and means for conveying an additional sheet into said pressing zone in timed relation to the movement of the aforesaid sheet so that the leading edges of the two sheets meet substantially in register in said pressing zone.

8. An apparatus as described in claim 7, said last mentioned means leading the additional sheet through a path isolated from the liquid space of said reservoir.

9. An apparatus as described in claim 7, and means operated upon the movement of said clamping roller over the leading edge of a sheet at said starting position for actuating said additional sheet-conveying means and starting said press rollers in rotation.

10. An apparatus for carrying out a transfer process, comprising a pair of cooperating press rollers mounted with their surfaces contiguous to form a pressing zone through which sheet materials may be passed under pressure by rotation of said rollers, at least one reservoir for a transfer liquid, each of said rollers being partly immersed in the liquid space of such a reservoir to provide a wetting zone ahead of said pressing zone, a sheet feeding means for each of said rollers arranged to locate the leading edge of a sheet on the surface thereof at a starting position ahead of its wetting zone, at least one sheet clamping roller for each of said rollers, means for holding the respective clamping rollers rollable relative to the surfaces of and swingable about the axes of their respective press rollers so that they may be rolled over the leading edges of the respective sheets at said starting positions to grip said edges to said surfaces, said clamping rollers being swingable bodily about said axes with the rotation of said press rollers to carry the gripped edges through said wetting zones, and means for stopping the swinging movements of said clamping rollers at advanced positions thereof beyond which the respective sheets will be moved into said pressing zone by continued rotation of said press rollers.

11. An apparatus as described in claim 10, each of said press rollers being immersed in a separate liquid reservoir, and means for conveying a third sheet into said pressing zone through a path extending upwardly between the two reservoirs.

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