Description

The invention relates to a copying apparatus for copying a magnetic pattern from a master magnetic tape on a duplicate magnetic tape, comprising two facing elongate platens having facing substantially parallel sides between which a gap having an entrance end and an exit end is situated and having at least one row of passages in the gap sides of the two platens, copying means adapted to promote the signal transfer from the magnetic pattern on the master magnetic tape to the duplicate magnetic tape, transport means adapted to move the master magnetic tape and the duplicate magnetic tape through the gap in the longitudinal direction of the platens, pressure means adapted to press the master magnetic tape and the duplicate magnetic tape against one another in the gap, by means of which a pressurized fluid is fed from the passages in the platens adjacent the two tapes into the gap. A copying apparatus of the type defined in the opening sentence is disclosed in United States Patent Specification 3,762,619. In this known apparatus two magnetic tapes are guided between two facing platens in which passages are formed through which pressurized air is fed in to form air cushions which tend to bring the two tapes in contact with one another. In particular at higher speeds of the tapes through the gap air trapped between the tapes after antry into the gap is not expelled effectively in said known apparatus, so that during the movement past the copying means the contact between the tapes is poor. This may result in a poor signal transfer to the duplicate tape and the track pattern on the duplicate tape may deviate from the pattern on the master tape.

In particular in recently proposed magnetic tape systems, such as the R-DAT audio system, it is necessary that during the signal transfer from the magnetic pattern on the master tape to the duplicate tape a comparatively high signal-transfer efficiency for short-wavelength signals is obtained and the track pattern on the master magnetic tape is transferred to the duplicate magnetic tape with an optimum accuracy.

In order to enable an acceptable copying quality to be obtained by means of the prior-art copying apparatus the speed with which the tapes are fed through the gap during duplication can be only slightly higher than the nominal speed. As a result of this, the rate of production of prerecorded duplicate tapes in this apparatus is comparatively low.

It is the object of the invention to construct a copying apparatus of the type defined in the opening sentence in such a way that rapidly after entering the gap the master magnetic tape and the duplicate magnetic tape are in intimate contact with each other in the gap between the two platens, so that a satisfactory copying quality is also assured at comparatively high tape speeds.

To this end the invention is characterized in that in the gap sides of the platens expulsion means are provided to expel the air present between the tapes, the expulsion means in each gap side, viewed at said gap sides, being arranged in at least one V-shape between the entrance end of the gap and the copying means, the axis of symmetry of said V-shape extending substantially parallel to the longitudinal direction of the platens, at least a plurality of the passages being situated within the outline of the V-shape, which expulsions means ensure that as the tapes move through the gap the air initially present between the tapes is expelled at least substantially towards the tape edges in order to bring the tapes inside the gap in intimate contact with each other. The use of such expulsion means arranged in a V-shape in the gap sides, preferably at a short distance from the entrance end of the gap already provides a correct pressure build-up in the gap near the entrance end of this gap, so that immediately upon entry of the tapes into the gap the air present between the tapes is expelled uniformly from the centre in a lateral direction by a kind of "ironing-out" effect, without an excessive pressure being required in the gap, which could lead to undesired effects, such as excessive noise production.

As a result of this satisfactory and uniform pressure build-up in the fluid-cushion support, which holds the tapes in intimate contact with each other, mutual displacements of the two tapes are substantially excluded. Moreover, the neutral lines of the two tapes in the gap area where the signal transfer takes place coincide. Thus even at comparatively high transport speeds the tapes can move through the gap in intimate contact with each other and without contact with the gap sides, so that short-wavelength signals are duplicated satisfactorily, the magnetic pattern transferred to the duplicate magnetic tape having a track position which is highly identical to the track position of the signals on the master magnetic tape. This is of particular advantage for magnetic-tape systems with narrow closely-spaced tracks, such as the said R-DAT system. It has been found that R-DAT tapes can be copied at a speed of transport of the tapes which is more than hundred times the nominal speed of transport of the R-DAT tape. At this high speed of transport the copying apparatus in accordance with the invention enables many high-quality duplicate tapes to be produced within a very short time, which is of particular advantage in the manufacture of prerecorded magnetic-tape cassettes.

Another preferred embodiment of a copying apparatus in accordance with the invention is characterized in that the expulsion means of each plat-

en have a profile which converges in a V-shape towards the entrance end and which is raised relative to the adjoining portions of the gap side, said plurality of passages being situated within said profile. The use of expulsions means having V-shaped raised profile effectively produces said "ironing-out" effect near the entrance side, so that as the tapes enter the gap the air can be expelled effectively towards the tape edges and the tapes are very soon in intimate contact with one another, even at comparatively high transport speeds.

A preferred embodiment of a copying apparatus in accordance with the invention is characterized in that the expulsion means of each platen comprise grooves which converge in a V-shape towards the entrance end, said passages terminating in the bottoms of the grooves. Expulsion means having grooves converging in a V-shape near the entrance ends also provide a correct local pressure build-up of the fluid in the gap, producing said "ironing-out" effect.

A preferred embodiment of a copying apparatus in accordance with the invention is characterized in that the expulsion means of each platen comprise two rows of passages, which two rows converge in a V-shape towards the entrance end. Expulsion means comprising rows of closely spaced passages arranged in a V-shape pattern also provide said "ironing-out" effect.

A preferred embodiment of a copying apparatus in accordance with the invention is characterized in that the expulsion means of each platen are arranged as a plurality of V-shapes situated after one another in the longitudinal direction of the platens. The use of expulsion means comprising a plurality of V-shapes provides an even better expulsion of air trapped between the tapes.

Yet another embodiment of a copying apparatus in accordance with the invention is characterized in that a groove which extends in the longitudinal direction of the platen is formed in the raised profile and passages terminate in the bottom of said groove, and is suitably characterized in that said groove extends across V-shapes e situated after one another. This ensures that the pressure gardient across the V-shapes is maintained and it enables the length of the platens to be comparatively short.

In this respect yet another preferred embodiment of a copying apparatus in accordance with the invention is characterized in that said groove forms part of a plurality of first grooves which, like said V-shape, are situated within an area of the gap side, which area has a width smaller than the width of the tape, mutually spaced passages terminating in the bottoms over the entire length of the first grooves and the passages in the gap sides being arranged in facing pairs. This arrangement of the first grooves and the V-shape in the gap sides within the width dimension of the tapes results in the fluid-cushion support providing a certain automatic position correction for the tapes. In this respect it is important that the passages are arranged in facing pairs, so that the tapes move rectilinearly through the gap without contact with the gap sides.

A further preferred embodiment of a copying apparatus in accordance with the invention is characterized in that second grooves are formed in each gap side and extend substantially perpendicularly to the first grooves, passages being situated at the junctions between the first and the second grooves. Providing the platens with first and second grooves which extend perpendicularly to one another and having passages at the groove junctions results in a satisfactory pressure distribution in the fluid-cushion support in the gap between the platens, enabling a substantially equal pressure to be maintained on both sides of the tapes, which is important in order to ensure that the tapes move rectilinearly through the gap.

A further embodiment of a copying apparatus in accordance with the invention, in which the copying means comprise a copying element which has one end face terminating in the gap side of one of the platens, is characterized in that said end face of the copying element is situated in the gap side of one of the platens in such a way that the bounding edges of said end face are spaced at substantially equal distances from the respective adjacent first grooves. Such a substantially symmetrical arrangement of the copying element in the gap sides of one of the platens does not disturb the pressure build-up in the fluid-cushion support, so that the tape motion is not affected by the copying element.

In this respect a further embodiment of a copying apparatus in accordance with the invention is characterized in that the end face of the copying element comprises an end wall with grooves adjoining the grooves in the associated platent. The end wall with grooves adjoining the other grooves has no effect at all on the pressure build-up on both sides of the tapes and is therefore very advantageous for a most accurate tape motion through the gaps.

Yet another embodiment of a copying apparatus in accordance with the invention is characterized in that the copying means also comprise an auxiliary element terminating in the gap side of the other platen, the end face of said auxiliary element facing the end face of the copying element and an end wall being formed with grooves adjoining the grooves in the associated platen. Such an auxiliary element whose end face is situated in the platen opposite the copying element may yield an even better signal transfer from the master tape to the

duplicate tape. The arrangement opposite the end face of the copying element ensures that the end face of the auxiliary element is also arranged symmetrically relative to the adjacent first grooves, so that the pressure build-up cannot be disturbed by the auxiliary element.

A further embodiment of a copying apparatus in accordance with the invention is characterized in that on opposite sides of the gap-side part provided with grooves the gap side of each platen is formed with vent grooves which extend parallel to the direction of movement of the tapes through the gap. In comparison with the passages in the platens said vent grooves have such cross-sectional dimensions that the laterally escaping fluid can be discharged effectively, which is advantageous in order to preclude turbulence and to sustain a uniform pressure distribution in the fluid-cushion support inside the gap. It is to be noted that the dimensions of the vent grooves are suitably not too large in order to maintain an adequate fluid pressure.

In this respect yet another preferred embodiment of a copying apparatus in accordance with the invention is characterized in that the platens comprise bridge portions which at least locally bridge the vent grooves and which each adjoin the adjacent surface of the gap side of the associated platen. The presence of the bridge portions ensures the vent grooves do not impair insertion of the tapes into the gap. When the tape transport begins the tapes will rapidly assume the correct position after the pressure build-up in the gap has started. Thus, the copying process can be started rapidly and easily.

The invention further relates to a method of operating such a copying apparatus. To this end e invention is characterized in that immediately after entering the gap the expulsion means press the tapes against each other, initially at the centre and subsequently to a gradually increasing extent across the entire width, so that during the movement through the gap air present between the tapes is pressed at least substantially towards the tape edges and is expelled.

Embodiments of the invention will now be described in more detail, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic plan view of a copying apparatus in accordance with the invention, in which a master magnetic tape and a duplicate magnetic tape are moved in intimate contact with one another between two platens.

Figure 2 is an enlarged-scale perspective view of the two platens in Figure 1, the two platens being shown rotated out of the operating position for a better understanding of the invention,

Figure 3 shows two platens in a perspective view similar to Figure 2, which platens form part of a second embodiment of a copying apparatus, the first and second grooves in one of the platens also being shown in an enlarged-scale perspective view,

Figures 4a, 4b, 4c and 4d are enlarged-scale perspective views of platen end-portions adjoining the entrance side in further embodiments of the copying apparatus in accordance with the invention.

Fig. 5 is a perspective view of a platen used in a further embodiment of the copying apparatus in accordance with the invention, and

Fig. 6 is a perspective view of another platen used in a further embodiment of the copying apparatus in accordance with the invention.

Figure 1 is a diagrammatic view of a copying apparatus 1 comprising a deck plate 2 on which two pairs of tape reels 3 and 4 are rotatably supported. The upper pair of tape reels 4 contains a length of master tape 5 which is fed from the left-hand to the right-hand reel 4. A duplicate magnetic tape 6 is wound on the reels 3. The tapes 5 and 6 are guided over tape-tension controls 7 which ensure that the tapes are sufficiently taut, further tape guides 8 being arranged in the deck plate 2 in an area at substantially equal distances from the tape reels 3 and 4. Thus, as is illustrated, the tapes 5 and 6 between the tape guides 8 are moved in the proximity of each other as the reels rotate. The tapes then move between two mutually parallel platens 9 and 10, to be described in more detail hereinafter with reference to Figure 2. In the area between the platens 9 and 10 the tapes are in intimate contact with each other. Therefore, it is adequate to drive only the duplicate magnetic tape 6 by means of a pressure roller 11 and a capstan 12, because as a result of the contact of the two tapes the master magnetic tape 5 is also moved between the platens 9 and 10. The transport speeds of the magnetic tapes are determined by the speed of the capstan 12. This transport speed can be adjusted as desired, so that the copying apparatus 1 can operate at any desired speed.

As is illustrated in Figure 2, the two platens 9 and 10 are substantially mirror-symmetrical, so that hereinafter in some instances only the construction of the platen 10 will be described. This platen comprises a profiled block of material of at least substantially rectangular cross-section. Between the platens 9 and 10 a gap 13 is formed through which the two tapes are moved, which gap is bounded at opposite sides by gap sides formed by the sides 9A and 10A of the platens 9 and 10 respectively. The gap side 10A adjoins a bevelled upper edge 10B. Similarly, the platen 9 has a bevelled upper edge 9B. The two upper edges 9B and 10B facilitate insertion of the tapes into the gap

13. For the purpose of insertion the platens 9 and 10 may be moved apart in a manner not shown. In the gap side 10A two vent grooves 14 are formed, which extend over the entire length of the platen parallel to the direction of movement of the tapes through the gap 13, as is indicated by the arrow 15 in Figure 1. Between the vent grooves 14 in the gap side 10A a plurality of grooves are formed, comprising first grooves 16 and second grooves 17 which subtend an angle with and preferably extend perpendicularly to said first grooves. The first grooves 16 extend substantially parallel to the arrow 15 towards the entrance end of the gap side, where the first grooves adjoin the grooves 16A which converge in a V-shape. The V-shape of the grooves 16A has an axis of symmetry which extends parallel to the arrow 15. The grooves are thus arranged symmetrically relative to the vent grooves 14, and a groove 17 extends between the ends of the grooves 16A. In the grooves 16 passages 18 are formed at the junctions between the grooves 16 and the grooves 17. Another passage 18 is formed at the junction of the grooves 16A with each other. The passages 18, which terminate in the bottoms of the grooves 16, are arranged in facing pairs in the gap sides 9A and 10A of the two platens. The openings 18 in each platen communicate with an inlet port 19 in a manner not shown via the interior of the platen, which port in a manner not shown is connected to a line through which a pressurized fluid such as air is fed to the passages 18. For this purpose the apparatus comprises pressure means, not shown, such as an air pump, which supplies the air under a certain pressure.

Further, copying means are arranged in the platens, which means comprise a copying element 20 in the platen 10 and an auxiliary element 21 in the platen 9. These copying means are shown only diagrammatically and each comprise an end wall, 20A and 21A respectively, terminating in the gap side of the platen and arranged at substantially equal distances from the adjacent grooves 16. As a result of this, the end walls 20A and 21A are also situated directly opposite one another in the platens. The end walls may comprise, for example, a glass plate whose surface which faces the gap 13 are flush with the adjoining surface of the gap side of the platen. The copying element 20 is constructed, for exampled, as a block in which a magnetic head is arranged to produce a magnetic field in the gap 13. This field is sustained by the presence of the auxiliary element 21 which is made, for example, of a suitable ferromagnetic material. Instead of a copying element which operates with anhysteresis, i.e. via a magnetic field, it is possible to construct the copying element, in a manner not shown, as a laser. Another alternative is to construct the copying element 20 as a thermally operating element.

After the tapes 5 and 6 have been inserted in the gap 13 between the platens 9 and 10 a magnetic pattern on the master magnetic tape 5 can be copied onto the duplicate magnetic tape. The principle underlying this process is that the coercivity of the master magnetic tape is substantially higher than that of the duplicate tape in order to ensure that the recording on the master magnetic tape is not affected by the field produced in the tape 13 by the copying means. Suitably, the coercivity of the master tape is at least 2^1 x as high as that of the duplicate tape. By holding the two tapes in intimate contact with each other inside the gap 13 during passage of the copying element 20 the magnetic pattern is transferred to the duplicate magnetic tape 6 via a contact-printing process.

During the movement through the gap 13 it is important for the signal transfer that under the pressure of the fluid in the fluid-cushion support the two tapes 5 and 6 are brought rapidly in intimate contact with each other by initially expelling the air present between the tapes rapidly and effectively towards the tape edges. It is then also important that as a result of the profile of the platens and the grooves formed therein and as a result of the fluid pressure the tapes move rectilinearly in the gap 13 parallel to the gap sides 9A and 10A.

The signal transfer is obtained by the use of the copying element 20 and the auxiliary element 21. In this respect it is of advantage that the platens 9 and 10 have a comparatively great length and the elements 20 and 21 are arranged at short distances from the exit end of the gap 13. Thus, the tapes 5 and 6 are in contact over a comparatively long path, enabling the air present between the tapes to be expelled effectively. During passage of the copying element it is thus ensured that the tapes 5 and 6 are in intimate contact with one another. Further, this long path over which the tapes are in contact is advantageous for a comparatively small surface loading of the tapes and for minimal disturbances in tape tension.

The use of facing passages 18 and first grooves 16 extending perpendicularly to the grooves 17 ensures a uniform pressure build-up on both sides of the tapes. Important in this respect the V-shaped arrangement of the grooves 16A constituting the expulsion means for expelling air which is initially trapped between the tapes, so that after having passed the entrance ends of the platens the tapes are initially pressed against one another at the centre and subsequently to a gradually increasing extent over the entire width, yielding a kind of "ironing-out" effect to expell the air present between the tapes from the centre towards

the tape edges. It is also important that the distance between the parallel portions of the grooves 16 is smaller than the width of the tapes. Thus, the fluid-cushion support can automatically provide a correction for an asymmetrical path of the tapes 5 and 6 through the gap 13. The grooves 16 and 17 produce a satisfactory and uniform pressure distribution in the air-cushion support in the gap 13, excess air being discharged by the vent grooves 14. To this end the vent grooves 14 have cross-sectional dimensions which are comparatively large relative to the dimensions of the passages 18; however, it is important that the grooves 14 are not too large in order to ensure an adequate pressure in the air-cushion support. It is to be noted that instead of pressurized air an other fluid may be used. The number of passages 18 to be used is adapted to the width of the gap 13, to the length of the platens 9 and 10, and to the physical properties of the tapes. In order to achieve the desired removal of the air between the tapes and to maintain an intimate contact between the tapes, the air pressure in the air-cushion support in the gap 13 can be comparatively low. This is important in order to avoid the production of noise in the copying apparatus in accordance with the invention. Pressing the tapes against each other by means of a fluid has the advantage that temperature effects can be neutralized, because the air supply also has a cooling effect. Moreover, insertion of tapes is simplified. The correct pressure build-up and the correct guidance in the air-cushion support between the platens enable the tapes to be fed rectilinearly between the platens, as is indicated by the arrow 15, the neutral lines of the two tapes coinciding and a mutual displacement of the tapes being substantially excluded. This ensures that even at high speeds of transport of the tapes through the gap 13 no tracking errors occur during copying and the magnetic pattern is transferred most accurately from the master tape to the duplicate tape.

Figure 3 shows a second embodiment comprising two platens 9 and 10 forming part of the copying apparatus 1 in accordance with the invention, corresponding parts bearing the same reference numerals. A difference is that now more mutually parallel first grooves 16 are provided. In the present example five mutually parallel grooves 16 are provided, but different numbers of grooves 16 are also possible. The use of more grooves 16 situated within the width of the tapes can provide an even better and uniform pressure distribution on both sides of the tapes 5 and 6 in the gap 13. A passage 18 is formed a every junction between a groove 16 and a groove 17. In the present embodiment the grooves 16 extend parallel to one another into the area near the entrance end of the platen and adjoin the expulsion means already described for the preceding embodiment, which means comprise the grooves 16A which converge towards one another in a V-shape. Moreover, the grooves 16 are continued in the end walls 20A and 21A, which end walls form part of a cover of the copying element 20 and the auxiliary element 21, the grooves at this location being disposed in line with the grooves 16 and having a corresponding depth. Thus, said end walls 20A and 21A do not form local interruptions and do not affect the uniformity of the pressure build-up in the air-cushion support.

In the present embodiment bridge portions 22 are arranged across the vent grooves 14, which portions locally bridge said grooves 14 and adjoin the adjacent surface of the gap side 9A and 10A, respectively. These bridge portions 22 facilitate insertion of the tapes 5 and 6 into the gap 13 from the top, the presence of the bridge portions ensuring that the tapes cannot enter the vent grooves.

Figures 4a, 4b, 4c and 4d show how, as an alternative, the gap side 10A of the platen 10, may be profiled additionally near the entrance end. In the embodiment shown in Figure 4a bevelled edges 10C and 10D adjoin the adjacent vent groove 14, which edges can provide a favourable pressure build-up during entry of the tapes into the gap 13 and a satisfactory discharge of air to the grooves 14. The platen 9 is provided with a corresponding profile. Figure 4b shows that the gap side of the platen 10 comprises a main surface 10E, which is V-shaped towards the entrance end and which main surface is adjoined by symmetrically arranged surfaces 10F and 10G which extend in a V-shape in the direction indicated by the arrow 15. The last-mentioned surfaces adjoin bevelled edges 10H and 10J, which are similar to the edges 10C and 10D. As a result of the V-shaped raised profile the present embodiment enhances said "ironing-out" effect, namely directly near the entrance end of the platens 9 and 10. Thus, the V-shaped profile also forms part of said expulsion means for expelling the air present between the tapes from the centre toward the tape edges. Instead of the embodiment shown in Fig. 4b other V-shaped profiles of the end portion may also provide said "ironing-out" effect. An example of this is shown in Fig. 4c. Such a raised profile 10E as shown in Fig. 4b and 10K as shown in Fig. 4c can be realised easily by grinding away the adjoining portions of the gap sides of the platens and is of particular advantage at higher speeds of transport of the tapes between the platens 9 and 10.

Fig. 4d shows how within the outline of the profile 10K two rows 23 of comparatively closely spaced passages 18 converge to form a V-shaped arrangement. These rows 23 now perform the function of the grooves 16A and thus form part of the expulsion means for expelling air trapped between

the tapes. As shown partly in Fig. 4d, the rows 23 of apertures 18 may be extended towards the exit end, to replace the grooves 16 and, in addition, transverse rows 24 of passages may be provided to replace the grooves 17.

Fig. 5 shows an embodiment comprising three expulsion means each having a profile 10K and arranged in V-shape. In the first profile 10K near the exit end a groove 16B is situated, which groove extends within the outline of the profile parallel to the arrow 15 and comprises passages 18. The second profiel 10K comprises both the grooves 16A of the preceding embodiments and the groove 16B within the outline. The third profile 10K adjoins the remainder of the gap side of the platen and has a groove pattern corresponding to that of Fig. 2, but in a shortened version.

In the construction shown in Fig. 5 the pressure gradient in the first profile 10K of each platen is less steep than in the second profile. This provides an even more effective expulsion of air present between the tapes.

The embodiment shown in Fig. 6 has the same principles as that shown in Fig. 5, the groove 16 being continued in the three profiles 10K. This ensures that a pressure gradient is sustained throughout the gap. Moreover, the platen can have a comparatively short length.

It is to be noted that by the use of a plurality of V-shaped profiles arranged after one another it is possible to reduce the number of passages 18 in the platen at a comparatively high tape speed. It is also possible to use different numbers of profiles. Moreover, the profiles 10K may be arranged slightly asymmetrically relative to the centre of the platen.

Claims

1. A copying apparatus (1) for copying a magnetic pattern from a master magnetic tape (5) on a duplicate magnetic tape (6), comprising
   - two facing elongate platens (9, 10) having facing substantially parallel sides (9A, 10A) between which a gap (13) having an entrance end and an exit end is situated and having at least one row of passages (18) in the gap sides (9A, 10A) of the two platens (9, 10),
   - copying means (20) adapted to promote the signal transfer from the magnetic pattern on the master magnetic tape to the duplicate magnetic tape,
   - transport means (12) adapted to move the master magnetic tape (5) and the duplicate magnetic tape (6) through the gap (13) in the longitudinal direction of the platens (9, 10)
   - pressure means adapted to press the master magnetic tape (5) and the duplicate magnetic tape (6) against one another in the gap (13), by means of which a presserized fluid is fed from the passages (18) in the platens (9, 10) adjacent the two tapes into the gap, characterized in that in the gap sides of the platens expulsion means (16A, 10E, 10K, 23) are provided to expel the air present between the tapes (5, 6), the expulsion means in each gap side (9A, 10A), viewed at said gap sides, being arranged in at least one V-shape between the entrance end of the gap and the copying means (20), the axis of symmetry of said V-shape extending substantially parallel to the longitudinal direction of the platens, at least a plurality of the passages (18) being situated within the outline of the V-shape, which expulsions means ensure that as the tapes move through the gap (13) the air initially present between the tapes is expelled at least substantially towards the tape edges in order to bring the tapes inside the gap (13) in intimitate contact with each other.

2. A copying apparatus as claimed in Claim 1, characterized in that the expulsion means of each platen (9, 10) have a profile (10E, 10K) which converges in a V-shape towards the entrance end and which is raised relative to the adjoining portions of the gap side, said plurality of passages (18) being situated within said profile.

3. A copying apparatus as claimed in Claim 1 or 2, characterized in that the expulsion means of each platen (9, 10) comprise grooves (16A) which converge in a V-shape towards the entrance end, said passages (18) terminating in the bottoms of the grooves.

4. A copying apparatus as claimed in Claim 1 or 2, characterized in that the expulsion means of each platen (9, 10) comprise two rows (23) of passages (18), which two rows converge in a V-shape towards the entrance end.

5. A copying apparatus as claimed in any one of the Claims 1 to 4, characterized in that the expulsion means of each platen (9, 10) are arranged as a plurality, of V-shapes (10K) situated after one another in the longitudinal direction of the platens.

6. A copying apparatus as claimed in Claim 2,

the tapes. As shown partly in Fig. 4d, the rows 23 of apertures 18 may be extended towards the exit end, to replace the grooves 16 and, in addition, transverse rows 24 of passages may be provided to replace the grooves 17.

Fig. 5 shows an embodiment comprising three expulsion means each having a profile 10K and arranged in V-shape. In the first profile 10K near the exit end a groove 16B is situated, which groove extends within the outline of the profile parallel to the arrow 15 and comprises passages 18. The second profiel 10K comprises both the grooves 16A of the preceding embodiments and the groove 16B within the outline. The third profile 10K adjoins the remainder of the gap side of the platen and has a groove pattern corresponding to that of Fig. 2, but in a shortened version.

In the construction shown in Fig. 5 the pressure gradient in the first profile 10K of each platen is less steep than in the second profile. This provides an even more effective expulsion of air present between the tapes.

The embodiment shown in Fig. 6 has the same principles as that shown in Fig. 5, the groove 16 being continued in the three profiles 10K. This ensures that a pressure gradient is sustained throughout the gap. Moreover, the platen can have a comparatively short length.

It is to be noted that by the use of a plurality of V-shaped profiles arranged after one another it is possible to reduce the number of passages 18 in the platen at a comparatively high tape speed. It is also possible to use different numbers of profiles. Moreover, the profiles 10K may be arranged slightly asymmetrically relative to the centre of the platen.

Claims

1. A copying apparatus (1) for copying a magnetic pattern from a master magnetic tape (5) on a duplicate magnetic tape (6), comprising
   - two facing elongate platens (9, 10) having facing substantially parallel sides (9A, 10A) between which a gap (13) having an entrance end and an exit end is situated and having at least one row of passages (18) in the gap sides (9A, 10A) of the two platens (9, 10),
   - copying means (20) adapted to promote the signal transfer from the magnetic pattern on the master magnetic tape to the duplicate magnetic tape,
   - transport means (12) adapted to move the master magnetic tape (5) and the duplicate magnetic tape (6) through the gap (13) in the longitudinal direction of the platens (9, 10)
   - pressure means adapted to press the master magnetic tape (5) and the duplicate magnetic tape (6) against one another in the gap (13), by means of which a presserized fluid is fed from the passages (18) in the platens (9, 10) adjacent the two tapes into the gap, characterized in that in the gap sides of the platens expulsion means (16A, 10E, 10K, 23) are provided to expel the air present between the tapes (5, 6), the expulsion means in each gap side (9A, 10A), viewed at said gap sides, being arranged in at least one V-shape between the entrance end of the gap and the copying means (20), the axis of symmetry of said V-shape extending substantially parallel to the longitudinal direction of the platens, at least a plurality of the passages (18) being situated within the outline of the V-shape, which expulsions means ensure that as the tapes move through the gap (13) the air initially present between the tapes is expelled at least substantially towards the tape edges in order to bring the tapes inside the gap (13) in intimitate contact with each other.

2. A copying apparatus as claimed in Claim 1, characterized in that the expulsion means of each platen (9, 10) have a profile (10E, 10K) which converges in a V-shape towards the entrance end and which is raised relative to the adjoining portions of the gap side, said plurality of passages (18) being situated within said profile.

3. A copying apparatus as claimed in Claim 1 or 2, characterized in that the expulsion means of each platen (9, 10) comprise grooves (16A) which converge in a V-shape towards the entrance end, said passages (18) terminating in the bottoms of the grooves.

4. A copying apparatus as claimed in Claim 1 or 2, characterized in that the expulsion means of each platen (9, 10) comprise two rows (23) of passages (18), which two rows converge in a V-shape towards the entrance end.

5. A copying apparatus as claimed in any one of the Claims 1 to 4, characterized in that the expulsion means of each platen (9, 10) are arranged as a plurality, of V-shapes (10K) situated after one another in the longitudinal direction of the platens.

6. A copying apparatus as claimed in Claim 2,

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characterized in that a groove (16, 16B) which extends in the longitudinal direction of the platen is formed in the raised profile (10K) and passages (18) terminate in the bottom of said groove.

7. A copying apparatus as claimed in Claims 5 and 6, characterized in that said groove extends across V-shapes which are situated after one another.

8. A copying apparatus as claimed in Claims 6 and 7, characterized in that said groove (16) forms part of a plurality of first grooves (16) which, like said V-shape, are situated within an area of the gap side, which area has a width smaller than the width of the tape, mutually spaced passages terminating in the bottoms over the entire length of the first grooves and the passages (18) in the gap sides being arranged in facing pairs.

9. A copying apparatus as claimed in Claim 8, characterized in that second grooves (17) are formed in each gap side and extends substantially perpendicularly to the first grooves (16), passages (18) being situated at the junctions between the first and the second grooves.

10. A copying apparatus as claimed in Claim 8 or 9, the copying means comprising a copying element (20) which has one end face terminating in the gap side (10A) of one of the platens (9, 10), characterized in that said end face of the copying element is situated in the gap side of one of the platens in such a way that the bounding edges of said end face are spaced at substantially equal distances from the respective adjacent first grooves (16).

11. A copying apparatus as claimed in Claim 10, characterized in that the end face of the copying element comprises an end wall (20A) with grooves (16) adjoining the grooves (16) in the associated platen (10).

12. A copying apparatus as claimed in Claim 10 or 11, characterized in that the copying means also comprise an auxiliary element (21) terminating in the gap side (9A) of the other platen (9), the end face of said auxiliary element facing the end face of the copying element (20) and comprising an end wall (21A) with grooves (16) adjoining the grooves (16) in the associated platen (9).

13. A copying apparatus as claimed in any one of the preceding Claims, characterized in that on opposite sides of the gap-side part provided with grooves (16, 17) the gap side (9A, 10A) of each platen (9, 10) is formed with vent grooves (14) which extend parallel to the direction of movement of the tapes (5, 6) through the gap (13).

14. A copying apparatus as claimed in Claim 13, characterized in that the platens (9, 10) comprise bridge portions (22) which at least locally bridge the vent grooves (14) and which each adjoin the adjacent surface of the gap side (9A, 10A) of the associated platen.

15. A method of operating the copying apparatus as claimed in Claim 1, for copying a magnetic pattern from a master magnetic tape (5) on a duplicate magnetic tape (6), the two tapes (5, 6) being moved through the gap (13) between two elongate platens (9, 10), pressure means supplying a fluid from passages (18) in the platens (9, 10) to press the tapes against each other, and copying means (20) transferring the magnetic pattern from the master magnetic tape (5) to the duplicate magnetic tape (6), characterized in that immediately after entering the gap (13) the expulsion means (16A, 10E, 10K, 23) press the tapes (5, 6) against each other, initially at the centre and subsequently to a gradually increasing extent, across the entire width, so that during the movement through the gap (13) air present between the tapes (5, 6) is pressed at least substantially towards the tape edges and is expelled.

Revendications

1. Appareil à copier (1) destiné à copier un motif magnétique d'une bande magnétique maîtresse (5) sur une bande magnétique de copie (6), comprenant :
   - deux plateaux oblongs (9,10) qui se font face et qui comportent des côtés en substance parallèles (9A, 10A) qui se font face, entre lesquels est ménagé un interstice (13) comportant une extrémité d'entrée et une extrémité de sortie, ainsi qu'au moins une rangée de passages (18) dans les côtés d'interstice (9A, 10A) des deux plateaux (9, 10),
   - des moyens de copie (20) propres à favoriser le transfert du signal du motif magnétique présent sur la bande magnétique maîtresse vers la bande magnétique de copie,
   - des moyens de transport (12) propres à faire défiler la bande magnétique maîtresse (5) et la bande magnétique de

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copie (6) à travers l'interstice (13) dans le sens longitudinal des plateaux (9, 10),

- des moyens de pression propres à presser la bande magnétique maîtresse (5) et la bande magnétique de copie (6) l'une contre l'autre dans l'interstice (13), ces moyens intervenant pour introduire un fluide sous pression à partir des passages (18) prévus dans les plateaux (9, 10) à proximité des deux bandes, dans l'interstice caractérisé en ce que dans les côtés d'interstice des plateaux sont prévus des moyens d'expulsion (16A, 10E, 10K, 23) destinés à expulser l'air présent entre les bandes (5, 6), les moyens d'expulsion dans chaque côté d'interstice (9A, 10A), vu de ces côtés étant disposés au moins sous la forme d'un V entre l'extrémité d'entrée de l'interstice et les moyens de copie (20), l'axe de symétrie du V s'étendant en substance parallèlement à la direction longitudinale des plateaux au moins une pluralité de passages (18) étant située dans les confins du V, ces moyens d'expulsion assurant que lorsque les bandes défilent à travers l'interstice (13), l'air initialement présent entre elles soit expulsé au moins en substance vers leurs bords afin d'amener les bandes, à l'intérieur de l'interstice (13), en contact étroit l'une avec l'autre.

2. Appareil à copier suivant la revendication 1, caractérisé en ce que les moyens d'expulsion de chaque plateau (9, 10) ont un profil (10E, 10K) qui converge en V vers l'extrémité d'entrée et qui est en relief par rapport aux parties adjacentes du côté d'interstice les nombreux passages (18) étant situés dans ledit profil.

3. Appareil à copier suivant la revendication 1 ou 2, caractérisé en ce que les moyens d'expulsion de chaque plateau (9, 10) comprennent des rainures (16A) qui convergent en V vers l'extrémité d'entrée les passages (18) se terminant dans les fonds des rainures.

4. Appareil à copier suivant la revendication 1 ou 2, caractérisé en ce que les moyens d'expulsion de chaque plateau (9, 10) comprennent deux rangées (23) de passages (18), ces deux rangées convergeant en V vers l'extrémité d'entrée.

5. Appareil à copier suivant l'une quelconque des revendications 1 à 4, caractérisé en ce que les moyens d'expulsion de chaque plateau (9, 10) sont disposés sous la forme de plusieurs profils en V (10K) situés l'un derrière l'autre dans la direction longitudinale des plateaux.

6. Appareil à copier suivant la revendication 2, caractérisé en ce qu'une rainure (16, 16B) qui s'étend dans la direction longitudinale du plateau est formée dans le profit en relief (10H) et les passages (18) se terminent dans le fond de la rainure.

7. Appareil à copier suivant les revendications 5 et 6, caractérisé en ce que la rainure s'étend en travers des V qui sont situés l'un derrière l'autre.

8. Appareil à copier suivant les revendications 6 et 7, caractérisé en ce que la rainure (16) fait partie d'une pluralité de premières rainures (16) qui, comme la forme en V, sont situées dans une zone du côté d'interstice dont la largeur est inférieure à la largeur de la bande, des passages mutuellement espacés se terminant dans les fonds sur toute la longueur des premières rainures et les passages (18) dans les côtés d'interstice étant disposés en des paires qui se font face.

9. Appareil à copier suivant la revendication 8, caractérisé en ce que des secondes rainures (17) sont ménagées dans chaque côté d'interstice et s'étendent en substance perpendiculairement aux premières rainures (16), des passages (18) étant situés aux jonctions entre les premières et secondes rainures.

10. Appareil à copier suivant la revendication 8 ou 9, les moyens de copie comprenant un élément de copie (20) qui présente une face d'extrémité se terminant dans le côté d'interstice (10A) d'un des plateaux (9, 10), caractérisé en ce que la face d'extrémité de l'élément de copie est située dans le côté d'interstice d'un des plateaux d'une manière telle que les bords de délimitation de la face d'extrémité soient espacés de distances en substance égales des premières rainures adjacentes respectives (16).

11. Appareil à copier suivant la revendication 10, caractérisé en ce que la face d'extrémité de l'élément de copie comprend une paroi d'extrémité (20A) avec des rainures (16) contiguës aux rainures (16) du plateau (10) associé.

12. Appareil à copier suivant la revendication 10 ou 11, caractérisé en ce que les moyens de copie comprennent également un élément auxiliaire (21) se terminant dans le côté d'in-

terstice (9A) de l'autre plateau (9), la face d'extrémité de l'élément auxiliaire faisant face à la face d'extrémité de l'élément de copie (20) et comprenant une paroi d'extrémité (21A) avec des rainures (16) contiguës aux rainures (16) du plateau (9) associé.

13. Appareil à copier suivant l'une quelconque des revendications précédentes, caractérisé en ce que de part et d'autre de la partie de côté d'interstice pourvue de rainures (16,17), le côté d'interstice (9A, 10A) de chaque plateau (9, 10) est pourvu de rainures-évents (14) qui s'étendent parallèlement à la direction de défilement des bandes (5, 6) à travers l'interstice (13).

14. Appareil à copier suivant la revendication 13, caractérisé en ce que les plateaux (9, 10) comprennent des parties de pontage (22) qui, au moins localement, pontent les rainures-évents (14) et qui sont chacune contiguës à la surface adjacente du côté d'interstice (9A, 10A) du plateau associé.

15. Procédé de mise en oeuvre d'un appareil à copier suivant la revendication 1, en vue de copier un motif magnétique d'une bande magnétique maîtresse (5) sur une bande magnétique de copie (6) les deux bandes (5, 6) défilant à travers l'interstice (13) ménagé entre deux plateaux oblongs (9, 10) des moyens à pression fournissant un fluide par des passages (18) dans les plateaux (9, 10) afin de presser les bandes l'une contre l'autre et des moyens de copie (20) transférant le motif magnétique de la bande magnétique maîtresse (5) sur la bande magnétique de copie (6), caractérisé en ce qu'immédiatement après l'entrée des bandes dans l'interstice (13), les moyens d'expulsion (16A, 10E, 10H, 23) pressent les bandes (5, 6) l'une contre l'autre, initialement au milieu et ensuite; dans une mesure croissant progressivement, sur toute leur largeur, de telle sorte que, pendant leur défilement à travers l'interstice (13), l'air présent entre les bandes (5, 6) soit refoulé au moins en substance vers les bords des bandes et soit expulsé.

Patentansprüche

1. Kopiereinrichtung (1) zum Kopieren eines magnetischen Musters von einem Mutter-Magnetband (5) zu einem Kopie-Magnetband (6), wobei diese Kopiereinrichtung die nachfolgenden Elemente aufweist:

- zwei einander gegenüberliegende längliche Führungsbahnen (9, 10) mit einander zugewandten, sich nahezu parallel zueinander erstreckenden Seiten (9A, 10A), zwischen denen sich ein Spalt (13) mit einem Einlauf- und einem Auslaufende und mit mindestens einer Reihe von Durchgängen (18) in dem Spaltseiten (9A, 10A) der beiden Führungsplatten (9, 10),
- Kopiermittel (20) zur Förderung der Signalübertragung von dem magnetischen Muster aufdem Mutter-Magnetband zu dem Kopie-Magnetband,
- Transportmittel (12) zum Transportieren des Mutter-Magnetbandes (5) und des Kopie-Magnetbandes (6) durch den Spalt (13) hindurch in der Längsrichtung der Führungsplatten (9, 10),
- Preßmittel zum gegeneinander Pressen des Mutter-Magnetbandes (5) und des Kopie-Magnetbandes (6) in dem Spalt (13), wobei durch diese Preßmittel aus den Öffnungen (18) in den Führungsplatten (9,10) aufbeiden Seiten der beiden Bänder ein Medium unter Druck in den Spalt eingeführt wird, dadurch gekennzeichnet, daß in den Spaltseiten der Führungsplatten Austreibungsmittel (16A, 10E, 10K, 23) vorgesehen sind zum Austreiben der zwischen den Bändem (5,6) vorhandenen Luft, wobei diese Austreibungsmittel in jeder Spaltseite (9A, 10A), auf die Spaltseiten gesehen, in wenigstens einer V-Form zwischen dem Eingangsende des Spaltes und den Kopiermitteln (20) vorgesehen sind, wobei die Symmetrieachse dieser V-Form sich im wesentlichen parallel zu der Längsrichtung der Führungsplatten erstreckt, wobei wenigstens eine Anzahl Öffnungen (18) innerhalb der Begrenzung der V-Form liegen, wobei die Austreibungsmittel gewährleisten, daß beim Transport der Bänder durch den Spalt (13) die anfangs zwischen den Bandem vorhandene Luft wenigstens im wesentlichen in Richtung der Bandkanten ausgetrieben wird, damit die Bänder innerhalb des Spaltes (13) in einen sehr engen Kontakt miteinander gebracht werden.

2. Kopiereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Austreibungsmittel jeder Führungsplatte (9, 10) ein Profil (10E, 10K) aufweisen, das in Richtung des Eingangsendes V-förmig konvergiert und gegenüber den abgrenzenden Teilen der Spaltwand erhaben ist, wobei diese Öffnungen (18) innerhalb des ge-

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nannten Profils liegen.

3. Kopiereinrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Austreibungsmittel jeder Führungsplatte (9, 10) Rillen (16A) aufweisen, die in Richtung des Eingangsendes V-förmig konvergieren, wobei die Öffnungen (18) in den Boden der Rillen münden.

4. Kopiereinrichtung nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Austreibungsmittel jeder Führungsplatte (9, 10) zwei Reihen (23) von Öffnungen (18) aufweisen, die in Richtung des Eingangsendes V-förmig konvergieren.

5. Kopiereinrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Austreibungsmittel (9, 10) in einer Anzahl in der Längsrichtung der Führungsplatten hintereinander liegender V-förmiger Konfigurationen (10K) vorgesehen sind.

6. Kopiereinrichtung nach Anspruch 2, dadurch gekennzeichnet, daß eine sich in der Längsrichtung der Führungsplatte erstreckende Rille (16, 16B) in dem erhabenen Profil (10K) gebildet ist und daß in den Boden dieser Rille Öffnungen (18) münden.

7. Kopiereinrichtung nach Anspruch 5 und 6, dadurch gekennzeichnet, daß die genannte Rille sich über hintereinander liegende V-förmige Muster hinweg erstreckt.

8. Kopiereinrichtung nach Anspruch 6 und 7, dadurch gekennzeichnet, daß die genannte Rille (16) einen Teil einer Anzahl erstrer Rillen (16) bildet, die, wie die genannte V-Form, innerhalb eines Gebietes der Spaltseite liegen, dessen Breite geringer ist als die des Bandes, wobei über die ganze Länge in regelmäßigen Abstanden voneinander liegende in den Boden der ersten Rillen mündende Öffnungen und die Öffnungen (18) in den Spaltseiten in einander gegenüberliegenden Paaren vorgesehen sind.

9. Kopiereinrichtung nach Anspruch 8, dadurch gekennzeichnet, daß in jeder Spaltseite zweite Rillen (17) gebildet sind und sich im wesentlichen senkrecht zu den ersten Rillen (16) erstrecken, wobei an den Verbindungsstellen der ersten und zweiten Rillen Öffnungen (18) vorgesehen sind.

10. Kopiereinrichtung nach Anspruch 8 oder 9, wobei die Kopiermittel ein Kopierelement (20) mit einer in die Spaltseite (10A) einer der Führungsplatten (9, 10) mündenden Endfläche aufweisen, dadurch gekennzeichnet, daß diese Endfläche des Kopierelementes derart in der Spaltseite einer der Führungsplatten vorgesehen ist, daß die Begrenzungsränder der genannten Endfläche in nahezu gleichen Abständen von den betreffenden angrenzenden ersten Rillen (16) liegen.

11. Kopiereinrichtung nach Anspruch 10, dadurch gekennzeichnet, daß die Endfläche des Kopierelementes eine Endwand (20A) mit an die Rillen (16) in der zugeordneten Führungsplatte (10) grenzenden Rillen (16) aufweist.

12. Kopiereinrichtung nach Anspruch 10 oder 11, dadurch gekennzeichnet, daß die Kopiermittel ebenfalls ein in die Spaltseite (9A) der anderen Führungsplatte (9) mündendes Hilfselement (21) aufweisen wobei die Endfläche dieses Hilfselementes der Endfläche des Kopierelementes (20) zugewandt ist und eine Endwand (21A) mit an die Rillen (16) in der zugeordneten Führungsplatte (9) grenzenden Rillen (16) aufweist.

13. Kopiereinrichtung nach einem der vorstehenden Ansprüche, dadurch gekennzeichnet, daß an einander gegenüberliegenden Seiten des Spaltseitenteils mit Rillen (16, 17) die Spaltseite (9A, 10A) jeder Führungsplatte (9, 10) mit Luftentweichungsrillen (14) ausgebildet ist, die sich parallel zu der Bewegungsrichtung der Bänder (5, 6) durch den Spalt (13) erstrecken.

14. Kopiereinrichtung nach Anspruch 13, dadurch gekennzeichnet daß die Führungsplatten (9,10) Brückenteile (22) aufweisen, die wenigstens örtlich die Luftentweichungsrillen (14) überbrücken und die an die anliegende Oberfläche der Spaltseite (9A, 10A) der zugeordneten Führungsplatte grenzen.

15. Verfahren zum Betreiben der Kopiereinrichtung nach Anspruch 1 zum Kopieren eines magnetischen Musters von einem Mutter-Magnetband (5) zu einem Kopie-Magnetband (6), wobei die beiden Bänder (5, 6) durch den Spalt (13) zwischen zwei länglichen Führungsplatten (9,10) hindurchgeführt werden , wobei Preßmittel aus Öffnungen (18) in den Führungsplatten (9,10) zum gegeneinander Pressen der Bänder ein Medium liefern und wobei Kopiermittel (20) das Magnetmuster von dem Mutter-Magnetband (5) zu dem Kopie-Magnetband (6) übertragen, dadurch gekennzeichnet, daß unmittelbar nach dem Eintritt in den Spalt (13) die Austreibungsmittel (16A, 10E, 10K, 23) die

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Bänder (5, 6) gegeneinander drücken, zunächst in der Mitte und danach allmählich zunehmend über die ganze Breite, so daß während des Durchgangs durch den Spalt (13) zwischen den Bändern (5, 6) vorhandene Luft wenigstens im wesentlichen zu den Bandkanten gedrückt und ausgetrieben wird.