

Tape-recording and/or reproducing apparatus with rotatable magnetic head.

The invention relates to a recording and/or reproducing apparatus for a magnetizable record carrier in the form of a tape, which apparatus comprises at least one rotatable magnetic head which scans the record carrier along information tracks and which is mounted on a support which has a hub by means of which the support is force-coupled to a rotatable shaft, the hub comprising at least one axially projecting hollow cylindrical tubular portion which is coaxial with the shaft and on which is placed a releasable clamping device for engaging said portion and clamping it on the shaft so as to provide the force-coupling between the support and the shaft. Such apparatus is known from AT-PS 345 577.

In the known apparatus the clamping device is constituted by a substantially annular, split, clamping ring which surrounds the tubular portion substantially over its full circumference in order to clamp the tubular portion on the shaft. When the tubular portion is clamped in position, the clamping ring should uniformly tighten and urge said portion against the shaft over substantially its entire circumference, which demands comparatively large actuating forces. However, the application of such large actuating forces when tightening the clamping device may lead to a deformation of the shaft, which deformation remains after tightening and thus results in an eccentric rotation of the support when the shaft is driven. Such an eccentricity of the support, which carries for example two magnetic heads, will adversely affect the recording and/or reproduction of information on and/or from the record carrier.

Further, large actuating forces applied to tighten a clamping device may lead to damaging of the shaft bearings. These bearings are generally constructed as ball-bearings, so that when large actuating forces are applied the balls

may be depressed into their ball races, resulting in a disturbed irregular rotation of the shaft and thus of the support carrying the magnetic heads, which also disturbs the recording and/or reproduction of information.

5 It is an object of the invention to provide a clamping device for an apparatus of the type defined in the opening sentence, which device serves for clamping a support for at least one magnetic head onto a shaft, which can be actuated by small actuating forces, and which guaran-
10 tees that the support is reliably and accurately clamped on the shaft without the actual clamping operation having any adverse effect on the entire system. Furthermore, the clamping device should be simple to actuate, so that the support can both be mounted and removed in a simple way.
15 This is important, for example, with respect to mechanization of the clamping operation or, in any case, during mounting or replacement of the support. Such replacement of the support may be required several times, because in general the magnetic heads mounted on the support have only a limited
20 lifetime. Furthermore, such a clamping device should guarantee that every support secured to the shaft by this service occupies exactly the same position, so that the conditions during the recording and/or reproduction are always the same.

25 To this end the invention is characterized in that the clamping device comprises a first clamping jaw, a second clamping jaw and a third clamping jaw which are force-coupled to each other and which each have a clamping surface which engages the tubular portion in a plane tangen-
30 tial thereto, the clamping surfaces engaging the tubular portion at locations which are spaced circumferentially of the shaft at an angular distance of 120° from each other substantially in one plane perpendicular to the shaft axis, and in that by means of an adjusting device, in order to
35 obtain the force-coupling between the support and the shaft, at least one of the three clamping jaws is adjustable to move its clamping surface in a direction substantially perpendicular to the axis of the shaft and, when said

clamping jaw is adjusted in order to clamp the tubular portion onto the shaft, each of the three clamping jaws exerts a clamping force on the tubular portion, which force is directed perpendicularly on the tangential plane in which the clamping surface of the respective clamping jaw engages the tubular portion.

In this way it is achieved that the clamping device always clamps the support on the shaft in an accurate and reliable manner. The clamping device then acts centrically symmetrically on the tubular portion in a manner which is entirely statically defined, because it does not act over the full circumferences of said portion but only at three points of application which are uniformly spaced at 120° from each other and which are disposed substantially in one plane which extends perpendicularly to the shaft axis. The clamping forces exerted at the three points of application by the three clamping jaws are exactly equal and are exactly centred relative to the tubular portion and the shaft respectively. This exactly symmetrical engagement of the clamping device with the tubular portion ensures that inherently the shaft cannot be deformed as a result of the clamping action exerted by the clamping device. Since the clamping device acts on the tubular portion at only three points of application which are spaced 120° from each other, said portion is pressed against the shaft at only three locations as it is being tightened, for which only comparatively small actuating forces are required. This ensures that the shaft cannot be deformed and the shaft bearings cannot be damaged when the actuating forces are applied. In this way all the said defects and problems which occur when the shaft is deformed or the shaft bearings are damaged are precluded, so that a correct and satisfactory information recording and/or reproduction process is guaranteed and thus a high-quality recording and/or reproducing apparatus is obtained.

In the apparatus in accordance with the invention the tubular portion is clamped onto the shaft by adjusting the clamping jaw on which the actuating force required for

clamping is to be exerted or to which it is to be transmitted. By a suitable construction of the clamping jaws, for which of course various possibilities exist, the requirements and specifications for a simple actuation of
5 the clamping device can readily be met. In this way a simple operation of the clamping device can readily be achieved, thus enabling simple mounting and removal of the support in order to replace said support, for example if the magnetic head arranged on the support exhibits excessive wear or is
10 defective.

It is found to be advantageous if the first and second clamping jaws are interconnected by a first pivotal joint, in that the clamping device comprises a first connecting bar which is connected to the first clamping jaw
15 by a second pivotal joint, and a second connecting bar which is connected to the second clamping jaw by a third pivotal joint, the first and second connecting bars being interconnected by at least one further pivotal joint and the axes of all said joints extending substantially parallel to
20 the axis of the shaft, and the axis of the first joint being disposed in the plane of symmetry relative to the two tangential planes in which the clamping surfaces of the first and second clamping jaws engage the tubular portion, which plane of symmetry contains the axis of the shaft, and the
25 axis of the second joint and the axis of the third joint being arranged mirror-symmetrically with respect to each other relative to the plane of symmetry related to the two tangential planes and a first connecting plane which contains the axes of the second joint and the at least one further
30 joint connected to the first connecting bar, and a second connecting plane, which contains the axes of the joints, intersecting each other in the plane of symmetry related to the two tangential planes and in that the third clamping jaw bears against an abutment provided in the vicinity of
35 the at least one further joint and by means of the adjusting device is adjustable to move its clamping surface relative to the abutment in a direction which is substantially perpendicular to the axis of the shaft in order to obtain the

force-coupling between the support and the shaft, the clamping force exerted by the first clamping jaw comprising a first force component which acts perpendicularly to the plane of symmetry related to the two tangential planes through the axis of the first joint, and a second force component which acts in the first connecting plane, the clamping force exerted by the second clamping jaws comprising a first force component which acts perpendicularly to the plane of symmetry related to the two tangential planes through the axis of the first joint, and a second force component which acts in the second connecting plane, and the clamping force exerted by the third clamping jaw acts in the plane of symmetry related to the two tangential planes through the axis of the first joint. Such a clamping device can be placed on the tubular portion by simply fitting it onto said portion in the direction of the shaft axis. For clamping the tubular portion onto the shaft it is necessary only to adjust a single clamping jaw, which is consequently very simple. Owing to the pivotal interconnection of the three clamping jaws it is furthermore ensured that when the tubular portion is clamped onto the shaft, the three clamping jaws are so positioned relative to each other that although only one clamping jaw is adjusted by means of the adjusting device all the three clamping jaws always exert absolutely equal clamping forces on said portion, which forces are moreover exactly centred relative to the shaft. This results in a very uniform force distribution on the tubular portion and on the shaft respectively, so that any deformation of the shaft is absolutely precluded. The simple actuation moreover ensures that both mounting and removing, i.e. replacement of the support, can always be effected in a simple and reproducible manner.

It is furthermore found to be advantageous if the abutment for the third clamping jaw is constituted by a third connecting bar which extends between the first connecting bar and the second connecting bar and which is connected to the first connecting bar via a first further pivotal joint and to the second connecting bar via a se-

cond further pivotal joint. In this way a very reliable and stable embodiment is obtained, which excels in a simple and compact construction.

In this respect it is found to be advantageous
5 that the third clamping jaw of the clamping device is constituted by a resilient expander which is bent into substantially a V-shape along a line which extends perpendicularly to the plane of symmetry related to the two tangential planes, the expander comprising a first expander limb and a second
10 expander limb, the free end of the first expander limb constituting the clamping surface of the third clamping jaw and the free end of the second expander limb bearing against the third connecting bar, and in that a set-screw acts on the expander substantially at the junction of the two limbs
15 of said expander, said limbs being expandable by the actuation of said set-screw in order to clamp the tubular portion onto the shaft. Thus the desired result is obtained in a very simple manner with a very small actuating force, because by means of the expander a high force transmission ratio can
20 be obtained between the clamping forces and the required actuating force. Since the expander limbs are resilient, this furthermore yields the advantage that in the case of mass production the clamping forces provided by the expander limbs of the various clamping devices are relatively independent of tolerances and adjustment accuracies, because
25 different tolerances and slight differences in adjustment are compensated for by the resilient properties, so that in any case substantially equal clamping forces are obtained. Furthermore, clamping, which is effected by tightening
30 the set-screws, is simple and easy, so that the support can readily and rapidly be replaced and always resumes the desired position.

The expander may for example be constituted by a simple angular resilient sheet-metal part. However, it is
35 found to be particularly advantageous if the expander, which serves as the third clamping jaw, is constituted by a V-shaped leaf spring comprising at least two laminations. This ensures that the actuating force for expanding the

expander is very small, because a laminated expander having an overall thickness equal to the sum of the thicknesses of the individual laminations is easier to expand than a single-layer expander having the same overall thickness, whilst in a direction substantially perpendicular to the shaft axis substantially the same load may be exerted on the laminated expander in order to clamp the tubular portion onto the shaft.

It is also found to be advantageous if the third clamping jaw of the clamping device is constituted by an L-shaped bracket, which is supported on the third connecting bar so as to be pivotable relative to said bar about an axis perpendicular to the plane of symmetry relative to the two tangential planes and which comprises a first limb which extends substantially parallel to the axis of the shaft and a second limb which extends substantially perpendicularly to the axis of the shaft, the clamping surface of the third clamping jaw being formed on the first limb, and a set-screw acts on the second limb, the bracket being pivotable relative to the third connecting bar by the actuation of said set-screw in order to clamp the tubular portion onto the shaft. This provides a very simple and robust clamping device which can be simply actuated with small actuating forces, the ratio between the actuating force and the resulting clamping forces being defined by a suitable choice of the lengths of the limbs of the bracket.

It is found to be particularly advantageous if the hub of the support is provided with two tubular portions which project axially in opposite directions from the hub and which are coaxial with the shaft and each of which is engaged by a clamping device, the third clamping jaws of the two clamping devices being arranged mirror-symmetrically with respect to each other relative to a further plane of symmetry which extends perpendicularly to the shaft axis and which is situated between the two clamping devices, and for adjusting the two third clamping jaws there is provided a single set-screw which extends parallel to the shaft axis through the two third clamping

jaws and which is actuable to tighten said third jaws relative to each other. This ensures a very reliable and absolutely play-free mounting of the support on the shaft, because the two tubular portions are clamped onto the shaft
5 in two clamping zones which are spaced from each other in the axial direction of the shaft. This is of particular advantage if the support has comparatively large dimensions in the direction of the shaft axis. Clamping in two clamping zones ensures that the support, as it rotates, will exhibit
10 neither radial nor axial unbalance. In this respect it is to be noted that, although the support is clamped on the shaft in two clamping zones which are spaced from each other in the axial direction of the shaft, the shaft is not deformed because of the small clamping forces, so that problems as
15 a result of such deformation are avoided. Furthermore, it is found to be particularly advantageous that both clamping devices can be actuated with the common set-screw in one operation, which is particularly simple and time-saving.

The clamping jaws and the connecting bars of the
20 clamping device may be constructed as separate components formed, for example, with corresponding bores into which the pins may be inserted to form the pivotal joints. However, it is found to be very advantageous if the first clamping jaw, the second clamping jaw and the connecting bars of the
25 clamping device are formed as an integral clamping plate, and the pivotal joints are constituted by hinges formed integrally with the clamping plate, which hinges are elastically deformable in a plane substantially perpendicular to the axis of the shaft. In this way a particularly compact,
30 simple and reliable construction is obtained, so that the clamping plate can be manufactured easily and economically by a simple mechanized punching operation.

It is also found to be advantageous if the first clamping jaw and the second clamping jaw are rigidly connected to each other and are constituted by the limbs of a
35 substantially V-shaped clamping member, which limbs each comprise a clamping surface which engages the tubular portion in a plane tangential thereto, and the third clamping jaw

is adjustable substantially perpendicularly to the shaft axis by means of the adjusting devices. This provides a clamping device which is simple to actuate, which also complies with the requirements for an exact clamping and which
5 is furthermore of a simple and stable construction, so that a high degree of reliability is obtained.

With respect to the cooperation between the third clamping jaw and the V-shaped clamping member there are several possibilities. As an example, the third clamping jaw
10 may be connected to the two limbs of the clamping member by means of one set-screw each. For a simple construction it is found to be advantageous that the third clamping jaw is pivotally connected to at least one of the two limbs of the clamping member.

15 In this respect it is further found to be advantageous if two connecting bars are connected one to each of the two limbs of the clamping member via pivotal joints, which two connecting bars are in turn pivotally connected to each other and are arranged mirror-symmetrically with
20 respect to each other relative to the plane of symmetry relative to the two tangential planes and the third clamping jaw bears against an abutment which is pivotally connected to the connecting bars and which is disposed substantially symmetrically relative to the plane of symmetry relative to
25 the two tangential planes, and, in order to obtain the force-coupling between the support and the shaft, the third clamping jaw is adjustable relative to said abutment. This provides a simple and stable construction having a substantially symmetrical construction, so that although only one clamping
30 jaw is actuated in order to clamp the tubular portion onto the shaft a uniform force distribution is guaranteed in a simple manner. As a result of this, the tubular portion is clamped exactly in position on the shaft, without giving rise to a deformation of the shaft.

35 With respect to the cooperation between the third clamping jaw and the V-shaped clamping member it is also found to be advantageous if the third clamping jaw substantially takes the form of a bar and at one end is

connected directly to one limb of the clamping member via a pivotal joint and at the other end is connected to the other limb of the clamping member via a set-screw which functions as adjusting device and which extends substantially transversely of the shaft axis, in order to provide the force-coupling between the support and the shaft. This also provides a simple and robust clamping device which, before the set-screw is fitted, can be opened like pliers and can be placed on the tubular portion in the radial direction, which may be advantageous depending on the construction of the support.

Furthermore, it is found to be advantageous if the first clamping jaw, the second clamping jaw and the third clamping jaw are each constituted by a tongue which projects radially towards said shaft from a ring which is coaxial with the shaft axis, the tongues being inclined relative to the shaft, and the free ends of said tongues constituting the clamping surfaces and, by means of the adjusting device, all the three clamping jaws are adjustable to move their clamping surfaces in directions substantially perpendicular to the axis of the shaft by moving the ring in the direction of the shaft axis. This results in a simple construction for the clamping device, guaranteeing an exact clamping of the sleeve-shaped portions on the shaft.

The invention will be described in more detail with reference to the drawings, which show some embodiments to which the invention is not limited. In the drawings:

Fig. 1 is a schematic plan view which shows a part of a recording and/or reproducing apparatus for a record carrier in the form of a tape, which is partly wrapped around a two-part guide drum for said record carrier,

Fig. 2 is a sectional view of the guide drum of the apparatus of Fig. 1, taken on the line II-II in Fig. 1, the magnetic-head support which forms the one part of the guide drum being clamped onto the drive shaft with a clamping device in accordance with a first embodiment of the invention,

Fig. 3 is a plan view of a part of the guide drum shown in Fig. 2 taken on the line III-III in Fig. 2, the clamping device in accordance with the first embodiment

being shown to an enlarged scale in comparison with Fig. 2,

Fig. 4 is a sectional view taken on the line IV-IV in Fig. 3,

Fig. 5, similarly to Fig. 3, is a plan view of a part of a guide drum with a clamping device in accordance with a second embodiment of the invention,

Fig. 6 is a sectional view taken on the line VI-VI in Fig. 5,

Fig. 7, similarly to Figs. 3 and 5, is a plan view of a part of a guide drum with a clamping device in accordance with a third embodiment of the invention,

Fig. 8 is a sectional view taken on the line VIII-VIII in Fig. 7,

Fig. 9, similarly to Figures 3, 5 and 7, is a plan view of a part of a guide drum with a clamping device in accordance with a fourth embodiment of the invention,

Fig. 10 also is a plan view of a part of a guide drum with a clamping device in accordance with a fifth embodiment of the invention,

Fig. 11 is also a plan view of a part of a guide drum with a clamping device in accordance with a sixth embodiment of the invention,

Fig. 12, similarly to Figures 3, 5, 7, 9, 10 and 11, is a plan view of a part of a guide drum with a clamping device in accordance with a seventh embodiment of the invention, and Fig. 13 is a sectional view taken on the line XIII-XIII in Fig. 12.

Fig. 1 represents schematically a part of a recording and/or reproducing apparatus for recording and/or reproducing video and audio information on/from a magnetizable record carrier 2 in the form of a tape, hereinafter briefly referred to as "tape". The apparatus 1 comprises a deck plate 3, which carries a supply spindle 4 and a take-up spindle 5, which respectively serve for driving a supply reel 6 and a take-up reel 7 mounted on the corresponding winding spindles 4 and 5. Between the supply reel 6 and the take-up reel 7 the tape 2 travels round a tape-guide pin 8 for diverting the tape, past a magnetic erase-head 9 for

erasing all the information stored on the tape, round a tape guide drum 10, to be described in more detail hereinafter, past a magnetic recording and/or playback head 11 for recording and/or reproducing audio information on the tape and/

5 from the tape, past a capstan 12, which in cooperation with a pressure roller 13, which is urged against the capstan in a manner not shown, ensures the uniform transport of the tape during a recording and/or reproduction process, and past two further tape guide pins 14 and 15 for diverting the

10 tape 2. Obviously, the supply reel 6 and the take-up reel 7 may be accommodated in a cassette, in which case the tape can be extracted from the cassette and threaded over the aforementioned components by means of a suitable device.

As is common practice in such equipment, the tape

15 is helically wrapped around the circumferential surface of the tape guide drum, at least one rotatable magnetic head, which is accommodated in said drum and which serves for recording and/or reproducing video information, cooperating with the tape and scanning the tape along information tracks

20 which extend obliquely relative to the longitudinal direction of said tape. As can be seen in Fig. 2, the tape guide drum 10 in the present embodiment comprises a stationary drum half 16, which is rigidly mounted on the deck plate 3, and a rotatable drum half 17, which is coaxial with said first-

25 mentioned drum half.

The rotatable drum half 17, which in the present case serves as a support for two magnetic heads 18 and 19, comprises a hub 20, by which the drum half 17 is force-coupled to the free end 23 of a shaft 22 which is rotatable about

30 an axis 21. The shaft 22 and the drum half 17 are driven directly by a motor 24, shown schematically, which directly cooperates with the shaft 22 in that the rotor 25 of the motor is coaxially arranged on and connected to said shaft. The stator 26 of the motor is accommodated in a motor housing

35 27, which forms a unit with the stationary drum half 16. In this way the motor 24 and the complete tape guide drum 10 constitute a structural unit which can be mounted on the deck plate 3.

The hub 20 comprises two tubular portions 28 and 29, which are coaxial with the shaft, which extend in opposite directions, and which each carry and cooperate with a releasable clamping device 30 and 31 respectively, which devices, in order to obtain the force-coupling between the drum half 17 and the shaft 22, clamp the tubular portions 28 and 29 respectively onto the shaft 22 at two clamping zones which are spaced from each other in the axial direction of the shaft. For a trouble-free and satisfactory operation of the apparatus, in view of a correct recording and/or reproducing process of the video information by means of the magnetic heads provided for this purpose, it is essential that the rotatable drum half 17, which serves as the magnetic-head support, is accurately and firmly clamped on the shaft 22 by means of the clamping devices 30 and 31, without the shaft being deformed or the shaft bearings being damaged during clamping, so that the drum half 17 rotates absolutely uniformly and without eccentricities.

Hereinafter the two clamping devices 30 and 31 will be described with reference to Figures 3 and 4. As can be seen in these Figures, the two clamping devices are fully identical and are arranged mirror-symmetrically with respect to each other relative to a plane of symmetry 32, represented by a broken line in Figure 4, which extends perpendicularly to the axis 21 of the shaft 22 and which is situated between the two clamping devices 30 and 31. For this reason the corresponding individual parts of the two clamping devices 30 and 31 bear the same reference numerals, the reference numerals for the parts of the clamping device 31 being primed.

Each of the two clamping devices 30 and 31 comprises a first clamping jaw 33 and 33' respectively, a second clamping jaw 34 and 34' respectively, and a third clamping jaw 35 and 35' respectively, which are force-coupled to one another. The three clamping jaws of each clamping device 30 or 31 each comprise a clamping surface which engage the tubular portion in a plane tangential thereto and engage the respective tubular portion 28 or 29 at locations

which are spaced circumferentially of the shaft 22 at an angular distance of 120° from each other and in one plane 36 or 36' respectively which extends perpendicularly to the shaft and is represented by a broken line in Fig. 4.

5 The first clamping jaw 33 or 33' and the second clamping jaw 34 or 34' of each clamping device are constituted by plate-shaped clamping levers which are interconnected by a first pivotal joint 37 or 37' respectively. The two clamping levers 33, 34 or 33', 34' comprise clamping
10 surfaces 40, 41 or 40', 41' respectively which engage the respective tubular portion 28 or 29 in planes 38, 39 or 38', 39' respectively which are tangential thereto and which are each represented by a broken line in Figure 3, which clamping surfaces are plane surfaces in the present case.

15 The two tangential planes 38, 39 or 38', 39' respectively, in which the clamping surfaces 40, 41 or 40', 41' of the respective first clamping lever 33 or 33' and the second clamping lever 34 or 34' engage the corresponding tubular portion 28 or 29, enclose an angle of 60° with each other.

20 The two clamping devices 30 and 31 further each comprise a first plate-shaped connecting bar 42 or 42' respectively and a second plate-shaped connecting bar 43 or 43' respectively. The first connecting bar 42 or 42' is connected to the first clamping lever 33 or 33' via a second
25 pivotal joint 44 or 44' respectively, and the second connecting bar 43 or 43' is connected to the second clamping lever 34 or 34' via a third pivotal joint 45 or 45' respectively. Between the first connecting bar 42 or 42' and the second connecting bar 43 or 43' there extends a third plate-
30 shaped connecting bar 46 or 46' respectively, which is connected to the first connecting bar via a first further pivotal joint 47 or 47' respectively and to the second connecting bar via a second further pivotal joint 48 or 48' respectively.

35 The axes of all the pivotal joints extend substantially parallel to the axis 21 of the shaft 22. In the present case the axes of the joints are disposed at a small angle of approximately 3° relative to the shaft axis, but this has no influence on the performance of the clamping

devices and may be regarded as negligibly small. The axis of the first joint 37 or 37' is situated in a plane of symmetry 49 or 49' respectively relative to the two tangential planes 38, 39 or 38', 39' respectively in which the clamping surfaces 40, 41 or 40', 41' respectively of the first and second clamping jaws 33, 34 or 33', 34' respectively engage the respective tubular portion 28 or 29, which plane of symmetry 49, 49' contains the axis 21 of the shaft 22 and is represented by a dash-dot line in Fig. 3. Furthermore, the axis of the second joint 44 or 44' and the axis of the third joint 45 or 45' of each clamping device are arranged mirror-symmetrically with respect to each other relative to the plane of symmetry 49 or 49' respectively through the axis 21 of the shaft 22 and through the axis of the first joint 37 and 37' respectively. Moreover, the joints are arranged so that a first connecting plane 50 or 50' which contains the axes of the second joint and the first further joint of the respective first connecting bar 42 or 42' and is represented by a broken line, and a second connecting plane 51 or 51' which contains the axes of the third joint and the second further joint of the respective second connecting bar 43 or 43' and is also represented by a broken line, intersect each other in the respective plane of symmetry 49 or 49' related to the two tangential planes 38, 39 or 38', 39' respectively.

As can be seen in Figures 3 and 4, the first clamping lever and the second clamping lever and the three connecting bars of each of the two clamping devices 30 and 31 are combined to form an integral clamping plate 52 or 52' respectively and the joints of each clamping device are constituted by hinges formed integrally with the respective clamping plate 52 or 52', which hinges are elastically deformable in a plane substantially perpendicular to the axis 21 of the shaft 22. In this way a particularly simple, compact and stable construction is obtained.

In this embodiment the third clamping jaw 35 or 35' of each of the two clamping devices 30 and 31 respectively is constituted by a resilient expander which is bent

into a V-shape along a line which extends perpendicularly to the respective plane of symmetry 49 or 49' and which expander comprises a first expander limb 53 or 53' and a second expander limb 54 or 54'. Each expander 35 or 35' is constituted by a leaf spring which comprises two laminations formed by folding a single layer of material through 180°, the fold being located at a free end 55 or 55' of the respective first expander limb 53 or 53'. The folded free end 55 or 55' of the respective first expander limb 53 or 53', which is disposed on the respective third connecting bar 46 or 46', constitutes the clamping surface of the third clamping jaw 35 or 35', which surface is rounded and engages the corresponding tubular portion 28 or 29 in a further plane 56 or 56' tangential thereto, which plane extends perpendicularly to the plane of symmetry 49 or 49' related to the two respective tangential planes 38, 39 or 38', 39' and is represented by a broken line in Figures 3 and 4. The free end of the second expander limb 54 or 54' bears against an angular lug 57 or 57' bent up from the connecting bar 46 or 46', which lug serves as an abutment for the respective expander and is connected to the first connecting bar 42 or 42' and the second connecting bar 43 or 43' via the two further joints 47, 48 or 47', 48' respectively. The force-coupling of the third clamping jaw 35 or 35' to the first and second clamping jaws 33, 34 or 33', 34' respectively, which in turn are force-coupled to each other via the first joint 37 or 37', is thus obtained via the third connecting bar 46 or 46', which serves as an abutment for the third clamping jaw, and the first and second connecting bars 42, 43 or 42', 43' respectively.

In order to obtain the force-coupling between the drum half 17 and the shaft 22, each expander 35 or 35', which serves as the third clamping jaw of the respective clamping device 30 or 30', is adjustable to move its clamping surface, which is constituted by the free end 55 or 55' of the respective first expander limb 53 or 53' in a direction perpendicular to the axis 21 of the shaft 22 relative to the respective third connecting bar 46 or 46', which serves as

abutment for the expander. For this purpose a set-screw 58, which serves as adjusting device, acts on each expander 35 and 35' at the junction of the two limbs of the expander, the tightening of said set-screw causing the two limbs of each expander to be expanded in order to clamp the corresponding tubular portion 28 or 29 onto the shaft 22. For adjusting the two expanders 35 and 35' of the clamping devices 30 and 31 the present embodiment comprises a single setscrew, which extends parallel to the axis of the shaft. The setscrew 58 passes through a bore 59 in the rotatable drum half 17 and is surrounded by a sleeve 60, against whose free ends the third connecting bars 46 and 46' of the two clamping devices 30 and 31 bear. This defines the distance between the two clamping devices, measured axially of the shaft. The set-screw 58 extends through the two expanders 35 and 35', passing through slots 61 and 61' formed in the expanders for this purpose. The head 62 of the setscrew 58 bears against the expander 35', which faces the stationary drum half 16, and the nut 63 acts on the expander 35, which is situated adjacent the free end 23 of the shaft 22. In this way the setscrew 58 tensions the two expanders 35 and 35', relative to each other. At the end on which the nut 63 is fitted the setscrew 58 is formed with a slot 64 for its adjustment, so that both the slotted head of the setscrew 58 and the nut 63 are readily accessible for actuation near the free end of the shaft.

When adjusting the expanders 35 and 35' of the clamping devices 30 and 31, in order to clamp the tubular portions 28 and 29 onto the shaft 22, which is effected by tightening the setscrew 58, the two respective clamping levers 33, 34 or 33', 34' and the respective expander 35 or 35' each exert a clamping force P_1 , P_2 , P_3 respectively or P_1' , P_2' , P_3' respectively on the respective tubular portion 28 or 29, which forces are directed perpendicularly to the respective tangential planes 38, 39, 56 or 38', 39', 56' in which the respective clamping surfaces 40, 41, 55 or 40', 41', 55' thereof engage the tubular portion 28 or 29 respectively.

The clamping force P1 or P1' exerted on the respective tubular portion 28 or 29 by the first clamping lever 33 or 33' comprises a first force component N1 or N1' respectively having a direction which intersects the axis of the
5 respective first joint 37 or 37' and is perpendicular to the respective plane of symmetry 49 or 49' related to the two tangential planes 38, 39 or 38', 39' respectively. Similarly, the clamping force P2 or P2', exerted on the respective tubular portion 28 or 29 by the second clamping lever 34 or 34'
10 respectively, comprises a first force component N2 or N2' respectively having a direction which intersects the axis of the respective first joint 37 or 37' and is perpendicular to the respective plane of symmetry 49 or 49' related to the two tangential planes 38, 39 or 38', 39' respectively.
15 Therefore, after the clamping operation only forces which extend perpendicularly to the plane of symmetry 49 or 49' are exerted on the first joint, so that the first joint retains the position it has assumed and, consequently, the positions of the first clamping lever 33 or 33' and the
20 second clamping lever 34 or 34' relative to the tubular portion 28 or 29 do not change. Thus it is ensured that the angle of 60° between the two tangential planes 38, 39 or 38', 39' in which the respective clamping surfaces 40, 41 or 40', 41' engage the respective tubular portion 28 or 29
25 is always maintained. This guarantees that the three clamping forces P1, P2, P3 or P1', P2' and P3' act on the respective tubular portion 28 or 29 at locations which are uniformly spaced round the circumference of said portion at 120° from each other, so that the two portions 28 and 29 can be clamped
30 onto the shaft 22 in a perfectly symmetrical manner.

The clamping force P1 or P1' exerted on the respective tubular portion 28 or 29 by the respective first clamping lever 33 or 33' furthermore has a second force component Z1 or Z1' respectively having a direction which extends in
35 the respective first connecting plane 50 or 50' and thus intersects the axis of the respective second joint 44 or 44' and also the axis of the respective first further joint 47 or 47'. In a similar way the clamping force P2 or P2'

exerted on the respective tubular portion 28 or 29 by the respective second clamping lever 34 or 34' has a second force component Z2 or Z2' having a direction which extends in the respective second connecting plane 51 or 51' and thus intersects the axis of the respective third joint 45 or 45' and also the axis of the respective second further joint 48 or 48'. The clamping force P3 or P3' exerted on the respective tubular portion 28 or 29 by the respective first expander limb 53 or 53' of the respective expander 35 or 35', which force acts in a direction which intersects the axis of the respective first joint 37 or 37' and extends in the respective plane of symmetry 49 or 49' related to the two tangential planes 38, 39 or 38', 39' respectively, produces a reaction force R1 or R1' which acts on the third connecting bar 46 or 46' via the respective second limb 54 or 54' of the expander, which limb bears with its free end against the respective angular abutment 57 or 57' on the respective third connecting bar 46 or 46'. The reaction force R1 or R1' is of the same magnitude as the respective clamping force P3 or P3' and also has a direction which extends in the respective plane of symmetry 49 or 49'. The reaction force R1 or R1' comprises a first force component K1 or K1', the direction of which extends in the respective first connecting plane 50 or 50' and which acts on the respective first connecting bar 42 or 42' via the respective first further joint 47 or 47', and a second force component K2 or K2', the direction of which extends in the respective second connecting plane 51 or 51' and which acts on the respective second connecting bar 43 or 43' via the respective second further joint 48 or 48'. The two force components Z1 and K1 or Z1' and K1' of the clamping force P1 or P1' respectively and the respective reaction force R1 or R1', which components have directions which extend in the respective first connecting plane and the force components Z2 and K2 or Z2' and K2' of the respective clamping force P2 or P2' and the respective reaction force R1 or R1', which components have directions which extend in the respective second connecting plane 51 or 51',

are equal because of the equilibrium of forces. Furthermore, owing to the symmetrical construction of each of the two clamping devices 30 and 31 relative to the respective plane of symmetry 49 or 49', the two force components K1, K2 or K1', K2' of the respective reaction force R1 or R1' are also equal. In this way it is achieved that the two clamping forces P1, P2 or P1', P2' and the respective reaction force R1 and R1' and consequently the respective third clamping force P3 or P3', are all equal. This is very important for a clamping action which is uniformly distributed around the circumference of each of the tubular portions 28 and 29, because this results in a uniform load on the shaft, so that the shaft is not deformed when the rotatable drum half 17 is clamped in position.

In order to secure the rotatable drum half 17 to the shaft 22 the respective clamping plates 52 and 52' of the two clamping devices 30 and 31 are first of all placed on the respective tubular portions 28 and 29, after which the two expanders 35 and 35' and the setscrew 58 are fitted, without the setscrew exerting an actuating force on the expanders to expand them. The drum half 17 together with the two clamping devices 30 and 31 thus constitute an assembly which can be slid simply onto the shaft 22. After the assembly has been slid onto the shaft, the drum half being accurately positioned in the axial direction by positioning devices, not shown, such as stops or the like, the two clamping devices are actuated simultaneously by simply tightening the setscrew and the drum half is clamped in position on the shaft in two clamping zones which are spaced from each other in the axial direction of the shaft. The setscrew 58 is tightened by means of, for example, a screwdriver placed in the slot 64 in the setscrew, the nut being held by hand or by means of a tool. In order to remove the rotatable drum half 17 the setscrew 58 is simply loosened, so that the clamping action of the two clamping devices 30 and 31 is removed and the drum half together with the clamping devices mounted on it can readily be removed from the shaft.

The two clamping devices clamp the two tubular portions onto the shaft in a perfectly symmetrical and statically defined manner, because the three clamping forces acting on each tubular portion are equal and act at angular distances of exactly 120° from each other in one plane which extends perpendicularly to the shaft axis. This prevents any deformation of the shaft due to the action of the two clamping devices on the shaft via the tubular portion. Since the clamping devices each clamp the respective tubular portion onto the shaft at three locations only, only small actuating forces are required for clamping, because each tubular portion need be tightened only in the three clamping areas and not over its entire circumference. For clamping it suffices to tighten one of the clamping jaws of each clamping device, which can be effected simply by means of a single setscrew. Moreover, in order to tighten the two clamping devices only very small actuating forces are required, which are exerted by means of the setscrew, because the expanders provide a very high force-transmission ratio. Thus, the application of the actuating forces does not give rise to the risk of either deformation of the shaft or damage to the shaft bearings. Since the setscrew extends parallel to the shaft axis and the tightening of the setscrew is effected from the free end of the shaft, this also yields the advantage of easy accessibility and simplicity of actuation of the clamping device. This ensures that the rotatable drum half can be replaced very easily and rapidly if, for example, the magnetic heads on the drum half are excessively worn or damaged. The simple construction of each of the two clamping devices is particularly advantageous, which is mainly attributable to the construction of the first and second clamping levers and the three connecting bars as an integral clamping plate. In this way an apparatus is obtained in which the rotatable drum half can be secured to the drive shaft in a very simple, easy and rapid manner and is reliably and exactly retained on said shaft without the risk of deformation of the shaft or damage to the shaft bearings. This ensures that the

rotatable drum half rotates absolutely without any unbalance, so that always an optimum and correct recording and/or reproduction process of video information is obtained by means of the magnetic heads provided for this purpose on the rotatable drum half.

It is to be noted that in the embodiment described above it is, of course, not essential for the two clamping devices to be fully identical. Especially in respect of the construction of the expanders it is to be noted that it is readily possible to construct the expanders differently from one another in order to obtain different clamping forces in the two axially spaced clamping zones. This may be important and advantageous for example, to compensate for different temperature conditions in the two clamping areas. Clamping forces of different magnitude in the two clamping areas can be also obtained by selecting different materials, such as, for example, steel or brass, for the clamping plates of the two clamping devices. Moreover, it is to be noted that the nut on the setscrew may be accommodated in a cage, which ensures that the nut is not rotated when the setscrew is turned; such a cage may be provided for example in a cover plate which covers the free end of the rotatable drum half and which is secured thereto, which plate need then only be formed with a hole through which the slot in the setscrew is accessible. Finally, it is to be noted that the rotatable drum half may also be clamped onto the shaft by means of a single clamping device of the construction described in the foregoing.

The embodiment shown in Figures 5 and 6 is of a construction similar to that of the embodiment described in the foregoing. However, in this case the third clamping jaw of each of the two clamping devices 30 and 31 is constituted by an L-shaped angular member 65 or 65' respectively. The member 65 or 65' is pivotably connected to the respective third connecting bar 46 or 46', the third connecting bar comprising a tongue 66 or 66' which is slightly bent out of the plane of the respective clamping plate 52 or 52' and on which the member 65 or 65' bears. In this

way the free end of the tongue 66 or 66' constitutes a pivotal axis for the respective member 65 or 65', which axis is perpendicular to the respective plane of symmetry 49 or 49' related to the two respective tangential planes 38, 39 or 38', 39'. The force-coupling between the respective third clamping jaw 65 or 65' and the first and second clamping jaws 33, 34 or 33', 34', which in turn are force-coupled to the first joint 37 or 37', is thus obtained via the third connecting bar 46 or 46', which acts as an abutment for the third clamping jaw and the first and second connecting bars 42, 43 or 42', 43' respectively. The member comprises a first limb 67 or 67', which extends substantially parallel to the axis 21 of the shaft 22, and a second limb 68 or 68', which extends substantially perpendicularly to the axis of the shaft. The clamping surface with which the member 65 or 65' engages the respective tubular portion 28 or 29 in the respective tangential plane 56 or 56' which is perpendicular to the plane of symmetry 49 or 49', is constituted by that limb surface 69 or 69' of the respective first limb 67 or 67' of the respective member 65 or 65' which faces the respective tubular portion 28 or 29.

In order to clamp the tubular portion 28 or 29 onto the shaft 22 a setscrew 58, which serves as an adjusting device common to the two members, engages with the second limb 68 or 68' of each respective member 65 or 65', which setscrew passes through the two second limbs and tensions them relative to each other. In this case the setscrew extends through a bore 70 in the rotatable drum half 17, which bore has two widened portions to receive two spacer sleeves 71 and 72 which surround the setscrew 55 and are inserted from opposite ends of the bore. The third connecting bars 46 and 46' of the respective clamping devices 30 and 31 bear against the free ends of the spacer sleeves, so that the two clamping devices are situated at a specific distance from each other in the axial direction of the shaft. The head 62 of the setscrew 58, which head is formed with a slot 73, cooperates with the member 65 of the clamping device, which member is situated adjacent the free end of

the shaft 22, whilst the nut 63 acts on the other member 65' of the clamping device 31. To lock nut 63 against rotation the nut is lodged in a correspondingly shaped, forked end 74 of a member 75 which is secured to the drum half 17.

5 The operation of the clamping devices in this embodiment is similar to the operation of the embodiment described in the foregoing. However, it is to be noted that in the present embodiment the reaction force R_1 or R_1' , corresponding to the respective clamping force P_3 or P_3' , is transmitted from the first limb 67 or 67' of the
10 respective member 65 or 65' to the respective tongue 66 or 66' of the respective third connecting bar 46 or 46'. Furthermore, it is to be noted that one of the advantages of these clamping devices is that by designing the third
15 clamping jaw as a simple L-shaped member a particularly high rigidity and reliability is obtained. It is obvious that in this case also the clamping devices need not be perfectly identical; for example, the members of the two clamping devices may have first limbs of different length,
20 so that different clamping forces are obtained in the axially spaced clamping zones, for example, in order to compensate for different temperature conditions at the locations of the two clamping zones. Alternatively, it is possible to use only one such clamping device to secure
25 the rotatable drum half to the shaft.

 Figures 7 and 8 show an embodiment in which the rotatable drum half 17 comprises only one tubular portion 28 on its hub 20, so that said drum half 17 is clamped onto the shaft 22 by means of one clamping device 30 only. The
30 clamping device 30 again comprises an integral clamping plate 52, which comprises a first clamping lever 33 and a second clamping lever 34 as well as a first connecting bar 42 and a second connecting bar 43, the two connecting bars 42 and 43 now being interconnected directly via a single
35 further pivotal joint 76.

 For the third clamping jaw this embodiment employs a resilient clamping member 77, which is bent into a V-shape along a line which is perpendicular to the plane

of symmetry 49 related to the two tangential planes 38 and 39, said member comprising a first limb 78 and a second limb 79. The two limbs 78 and 79 are arranged mirror-symmetrically with respect to each other relative to the
5 plane of the clamping plate 52. The bend 80 which interconnects the two limbs 78 and 79 constitutes the clamping surface of the third clamping jaw, which surface engages the tubular portion 28 in the further tangential plane 56 which is perpendicular to the plane of symmetry 49.

10 Passing through the free ends of the two limbs 78 and 79, which ends are bent so as to extend substantially parallel to the clamping plate 52, is a setscrew 58 which serves as an adjusting device, whose head 62 cooperates with the free end of the limb 79 and whose nut 63 cooperates with
15 the free end of the limb 78, so that the two limbs 78 and 79 of the clamping member 77 are tensioned relative to each other. At its centre the setscrew 58 bears against the further joint 76. The further joint 76 thus constitutes an abutment on which the clamping member 77, which serves as
20 a third clamping jaw, acts via the setscrew 58. As a result of this construction the reaction force R1, which corresponds to the clamping force P3, is directly transmitted to the further joint 76 by the setscrew 58. The force-coupling of the third clamping jaw 77 to the first and the second
25 clamping jaws 33 and 34, which in their turn are force-coupled to each other via the first joint 37, is thus obtained via the further joint 76, which functions as an abutment for the third clamping jaw, and the first and the second connecting bars 42 and 43.

30 At their free ends the limbs 78 and 79 of the clamping member 77 are each extended by a pair of narrow strip-shaped fixing portions 81 and 82, by means of which the clamping member 77 is secured to the first connecting bar 42 and to the second connecting bar 43. The fixing
35 portions maintain the clamping member 77, together with the associated setscrew 58, in a symmetrical position relative to the clamping plate 52, but have no influence on the clamping action of the clamping device.

Since the clamping member together with the associated clamping screw is always connected to the clamping plate via the fixing portions, these components constitute an easy-to-handle assembly, which is very advantageous.

5 This assembly is simply placed onto the tubular portion of a rotatable drum half which is to be mounted on the shaft, without the clamping member exerting a clamping action on the tubular portion. Subsequently, the drum half together with the clamping device on its tubular portion is slid

10 onto the shaft and positioned appropriately. After this the clamping device is simply actuated by means of the set-screw, which serves as adjusting device, the free ends of the limbs of the clamping member being moved towards each other and the clamping surface of the member thus being

15 urged against the tubular portion, so that the tubular portion is clamped onto the shaft. In this way the rotatable drum half is tightly secured to the shaft. The clamping device in accordance with this embodiment of the invention also ensures an accurate, reliable and uniform clamping of the

20 rotatable drum half on the shaft, the clamping action of the clamping device causing no deformation of the shaft. Also in this case only very small actuating forces are required for tightening the clamping device, because the clamping device acts on the tubular portion at three clamping areas

25 only. Furthermore, it is advantageously with respect to a small actuating force that the clamping member also provides a high force-transmission ratio. Another particularly advantageous feature of this clamping device is its particularly simple, easy and rapid actuation. Furthermore, it is

30 advantageous that the entire clamping device takes the form of a pre-assembled unit, which is of advantage for a simple mounting of said device onto the tubular portion.

Fig. 9 shows an embodiment in which the rotatable drum half 17 again comprises a tubular portion 28

35 on its hub, which portion is clamped onto the shaft 20 by means of a clamping device 30. The clamping device 30 comprises a substantially V-shaped plate-shaped clamping member 83 comprising a first limb 84 and a second limb 85

which is rigidly connected thereto. The first limb 84 constitutes the first clamping jaw and the second limb 85 the second clamping jaw of the clamping device 30, which jaws are force-coupled to each other and in this case also form-
5 coupled. On each of the two limbs 84 and 85 of the clamping member 83 there is provided a clamping surface 86 or 87 respectively which engages the tubular portion 28 in a plane 38 or 39 tangential thereto, which clamping surfaces are constituted by the plane edge faces of the limbs 84
10 and 85. The tangential planes 38 and 39, in which the clamping surfaces 86 and 87 of the first clamping jaw 84 and the second clamping jaw 85 engage the tubular portion, enclose an angle of 60° with each other.

Plate-shaped first and second connecting bars 90
15 and 91 respectively, which are pivotally connected to each other, are connected to the two limbs 84 and 85 respectively of the plate-shaped clamping member 83 via pivotal joints 88 and 89 respectively. For this purpose a plate-shaped third connecting bar 92 is connected to the first connecting
20 bar 90 via a pivotal joint 93 and to the second connecting bar 91 via a pivotal joint 94. As is shown in Figure 9, the first and second connecting bars are arranged mirror-symmetrically with respect to each other relative to the plane of symmetry 49 related to the two tangential planes
25 38 and 39, which plane of symmetry contains the axis 21 of the shaft 22, and the third connecting bar 92 is also arranged mirror-symmetrically relative to said plane of symmetry 49. The clamping member 83 and the three connecting bars 90, 91 and 92 are formed as an integral clamping plate
30 95, the joints 88, 89, 93 and 94 being constituted by hinges formed integrally with the clamping plate, which hinges are deformable in a plane substantially perpendicular to the axis 21 of the shaft 22.

The third connecting bar 92 serves as abutment
35 for a third clamping jaw 96 which is constituted by an expander consisting of a simple leaf spring which is bent into a V-shape along a line which extends perpendicularly to the plane of symmetry 49. This expander has a similar

construction to that of the expander of the embodiment described with reference to Figures 3 and 4. The expander 96 comprises a first expander limb 97 and a second expander limb 98. The free end 99 of the first expander limb 97, which end bears on the third connecting bar 92, constitutes a clamping surface of the third clamping jaw 96, which surface engages the tubular portion 28 in a further tangential plane 56 which extends perpendicularly to the plane of symmetry 49 related to the two tangential planes 38 and 39 in which the clamping surfaces 86 and 87 of the first clamping jaw 84 and the second clamping jaw 85 engage the tubular portion 28. The free end of the second expander limb 98 is also positioned on the third connecting bar 92 and bears against an abutment formed by a lug 100 up from the third connecting bar. In this way the force-coupling of the third clamping jaw 96 to the first and second clamping jaws 84 and 85, which in their turn are force-coupled and form-coupled to each other, is obtained via the third connecting bar 92, which serves as an abutment for the third clamping jaw 96, and the first and the second connecting bars 90 and 91.

For the force-coupling between the rotatable drum half 17, which serves as a support, and the shaft 22, the expander which forms the third clamping jaw 96 is adjustable by means of the adjusting device to move the clamping surface 99, constituted by the free end of the first expander limb 97, in a direction which is substantially perpendicular to the axis 21 of the shaft 22. In the present case the adjusting device is constituted by a setscrew 101, whose head 102 bears on the expander 96 at the junction of its two limbs and which passes through a slot 103 in the expander and can be screwed into the drum half 17 in a manner not shown. By tightening the setscrew 101 the expander 96 is urged against the third connecting bar 92, the expander limbs 96 and 98, which bear against the third connecting bar at their free ends, thereby being expanded. The clamping surface 99, which is constituted by the free end of the first expander limb 97, is moved

by the third clamping jaw in a direction which is substantially perpendicular to the axis 21 of the shaft 22, the tubular portion 28 being clamped onto the shaft 22 by the three clamping jaws, which are force-coupled to each other.

5 As is apparent from Figure 9, the three clamping jaws 84, 85 and 96, which are force-coupled to each other, engage the tubular portion 28 with their clamping surfaces 86, 87 and 99 at locations which are spaced circumferentially of the shaft 22 at an angular distance of 120° from
10 each other substantially in one plane which is perpendicular to the shaft axis. The clamping forces P1, P2 and P3, which are schematically represented in Fig. 9, are also equal.

In this way a clamping device is obtained by
15 means of which the rotatable drum half is clamped onto the shaft in an accurate and reliable manner, the clamping device securing the tubular portion onto the shaft at three clamping areas only, so that the desired clamping action can be obtained by means of a small actuating force. For
20 clamping it suffices to adjust an expander which provides a high force-transmission ratio, by means of a readily accessible setscrew. Owing to the simple operation of the clamping device the rotatable drum half can be mounted and removed several times in an easy and reproducible manner,
25 for example in order to replace or clean the magnetic heads accommodated on said drum half. The symmetrical pivotal connection of the adjustable clamping jaw to the clamping member ensures a uniform clamping action in a simple manner. Furthermore, it is advantageous that the clamping member
30 and the connecting bars are formed as an integral plate, so that a simple construction of the clamping device is obtained, which clamping device can be manufactured in mass-production quantities in a very economic manner. Thus, an accurate, reliable and simple clamping device is obtained,
35 whose clamping action or actuation cannot give rise to a deformation of the shaft and damage to the shaft bearings, thereby ensuring that the rotatable drum half revolves without unbalance, which as already stated is essential for

a satisfactory and disturbance-free recording and/or reproducing process.

The clamping device 30 in the embodiment shown in Fig. 10 also comprises an essentially V-shaped plate-shaped clamping member 83 having a first limb 84 and a second limb 85, which are force-coupled and form-coupled to each other. The two limbs 84 and 85 constitute the first and second clamping jaws of the clamping device and each comprise a clamping surface 86 or 87 respectively which engages the tubular portion 28 in a plane 38 or 39 tangential thereto. The third clamping jaw 96 is also constructed as a simple expander similar to that in the embodiment shown in Fig. 9, the free end 99 of the first expander limb 97 constituting the clamping surface of the third clamping jaw, which surface engages the tubular portion 28 in the further tangential plane 56 which extends perpendicularly to the plane of symmetry 49 related to the two tangential planes 38 and 39. In order to obtain the force-coupling between the rotatable drum half 17 and the shaft 22, the third clamping jaw 96 is adjustable by means of the setscrew 101, which serves as an adjusting device, to move the clamping surface 99 of said clamping jaw perpendicularly to the axis 21 of the shaft 22.

In this embodiment the abutment for the third clamping jaw 96 is constituted by a plate-shaped connecting bar 104, which is arranged symmetrically relative to the plane of symmetry 49 related to the two tangential planes 38 and 39, and which is rigidly connected to the two limbs 84 and 85 of the clamping member 83. The clamping member 83 and the connecting bar 104 together constitute an integral clamping plate 105. The expander is positioned with the free ends of its two expander limbs 97 and 98 bearing on the connecting bar 104, which serves as abutment for the expander 96, the free end of the second expander limb 98 bearing against a lug 106 bent up from the connecting bar 104. In this way the force-coupling between the third clamping jaw 96 and the first and second clamping jaws 84 and 85, which themselves are force-coupled and form-coupled

to each other, is obtained via the connecting bar 104, which serves as abutment for the third clamping jaw 96 and which is force-coupled and form-coupled to the integral clamping plate 105 by the first and second clamping jaws.

5 In this embodiment the force-coupled clamping jaws also engage the tubular portion with equal clamping force at three locations which are spaced at an angular distance of 120° from each other circumferentially of the shaft in one plane which is perpendicular to the shaft, so that an accurate, reliable and statically defined clamping action is
10 obtained. The clamping device in accordance with this embodiment is of a very simple construction, which is an advantage with respect to the robustness and reliability of the clamping device.

15 In this respect it is to be noted that in clamping devices as described in the foregoing with reference to Figs. 9 and 10 it is obvious that other constructions for the three clamping jaws may be used, for example those as employed in the clamping devices in accordance with Figs.
20 5 and 6 and Figs. 7 and 8 respectively.

 Fig. 11 shows a clamping device 30 having a substantially V-shaped clamping member 107, whose two limbs 108 and 109, which serve as first and second clamping jaws, have clamping surfaces in the form of protrusions 110 and
25 111 which project from the limbs in the direction of the axis 21 of the shaft 22. The protrusions 110 and 111 engage the tubular portion 28 in planes 38 and 39 tangential thereto, the two tangential planes enclosing an angle of 60° with each other. The third clamping jaw of this clamping
30 device essentially takes the form of a bar 112. The bar 112 comprises an angled end 113 which is stepped on two sides and engages in a groove-like recess 114 in the free end of the first limb 108 of the clamping member 107 and is directly connected to the first limb 108 via a pivotal
35 joint 115. At the other end 116 the bar 112 is adjustably connected to the other limb 109 of the clamping member 107 via a setscrew 117 which serves as an adjusting device and extends substantially transversely of the axis 21 of

the shaft 22, in order to obtain the force-coupling between the rotatable drum half 17 and the shaft 22. For this purpose, the threaded stem 118 of the screw passes through a bore 119 formed in the bar end 116 and is screwed into a threaded bore 120 in the limb 109 of the clamping member 107, the head 121 bearing against the bar end 112. In this way the third clamping jaw 112 is force-coupled to the first clamping jaw 108 via the joint 115 and to the second clamping jaw 109 via the screw 117, the first and second clamping jaws themselves being force-coupled and form-coupled to the integral clamping member 107.

The clamping surface of the bar 112 is constituted by a protrusion 122 which projects in the direction of the shaft axis and engages the tubular portion 28 in the further tangential plane 56 which extends perpendicularly to the plane of symmetry 49 related to the two tangential planes 38 and 39 in which the protrusions 110 and 111 engage the tubular portion 28, which plane of symmetry contains the axis 21 of the shaft 22. In order to obtain the force-coupling between the rotatable drum half 17 and the shaft 22, the bar 112 serving as the third clamping jaw is adjustable by means of the setscrew 117 to move the protrusion 122, which serves as the clamping surface of the third clamping jaw, in a direction substantially perpendicular to the axis 21 of the shaft 22.

To clamp the tubular portion 28 onto the shaft 22 the setscrew 117 is tightened, the three protrusions 110, 111 and 122 then engaging the tubular portion with equal forces P1, P2 and P3 at three locations which are spaced at an angular distance of 120° from each other circumferentially of the shaft in one plane which is perpendicular to the shaft axis. This clamping device also requires only a small actuating force, because the clamping device acts not over the entire circumference of the tubular portion but only at three clamping areas which are uniformly spaced from each other. This clamping device also has a very simple construction and, before the setscrew 117 is fitted, can be opened by suitably pivoting the bar like pliers relative

to the clamping member 107, after which the device can be placed on the tubular portion 28 in a radial direction.

The embodiment shown in Figures 12 and 13 comprises a clamping device 30 in which, in order to obtain the force-coupling between the rotatable drum half 17 and the shaft 22, all three clamping jaws are adjusted by means of an adjusting device to move their clamping surfaces in a direction which is substantially perpendicular to the axis 21 of the shaft 22. The first clamping jaw 123, the second clamping jaw 124 and the third clamping jaw 125 of this clamping device 30 are each constituted by a tongue which projects radially towards the shaft from a ring 126 which is coaxial with the shaft 22, the tongues being inclined relative to the shaft 22. The three clamping jaws 123, 124 and 125 constituted by the tongues are thus force-coupled to each other via the ring 126. The three tongues are spaced at an angular distance of 120° from each other circumferentially of the shaft and are inclined towards the drum half 17 from the ring 126. The free ends 127, 128 and 129 of the tongues 123, 124 and 125, which ends are semi-circular, constitute the clamping surfaces of the clamping jaws and each engage the tubular portion 28 in a plane 38, 39 and 56 respectively tangential to said portion. The tubular portion 28 comprises a step 130, on which the tongues which are inclined from the ring 126 towards the drum half, bear at their free ends. This ensures that the three clamping jaws engage the tubular portion in one plane perpendicular to the shaft axis.

Mounted on the ring 126 is a compression ring 131, which by means of three radial outward projections 132, 133 and 134 which cooperate with the inner surface of a hollow cylindrical portion 135 of the rotatable drum half 17, which portion is coaxial with the axis 21 of the shaft 22, is retained in a position which is coaxial with the axis of the shaft and thus coaxial with the ring 126. The compression ring 131 cooperates with a screwthreaded ring 136 which serves as an adjusting device and which cooperates with a screwthread on the inner surface of the portion 135

of the drum half 17 so as to be adjustable axially of the shaft 22. The threaded ring 136 has three bores 137, 138 and 139, to receive a suitable tool for turning the threaded ring.

5 In order to obtain the force-coupling between the rotatable drum half 17 and the shaft 22, when the ring 126 has been placed on the tubular portion 28 and the compression ring 131 has been fitted, the threaded ring 136, which serves as an adjusting device, is tightened relative
10 to the portion 135 in the direction of the drum half 17. This adjusting movement of the threaded ring 136 is uniformly transmitted to the ring 126 by means of the compression ring 131, so that the ring 126 is moved towards the drum half 17 in the direction of the axis 21 of the shaft 22.
15 The free ends 127, 128 and 129 of the tongues 123, 124 and 125, which initially rest loosely on the step 130, are consequently moved in directions substantially perpendicular to the shaft axis until they engage the tubular portion and clamp said portion firmly to the shaft.

20 In this way a simple clamping device is obtained, which in a simple manner provides a uniform clamping action. Since the clamping device acts on the tubular portion at only three clamping areas, only a small actuating force is required. The actuating force required can be made very small
25 by a suitable choice of the angle between the tongues and the shaft; if the tongues have only a small angle relative to the ring carrying them, for example 3 to 5°, a very high force-transmission ratio is obtained between the actuating force to be applied by means of the threaded ring
30 136 and the clamping forces. Suitably, the ring and the tongues may consist of a resilient material, so that when the clamping device is released by suitably turning the threaded ring, the tongues automatically recede from the tubular portion and no longer exert a clamping action.
35 Furthermore, it is to be noted that it is not strictly necessary to provide the tubular portion with a step for supporting the free ends of the tongues when the clamping device described above is used. It is alternatively possible

for the tubular portion to be unstepped and the tongues to be retained in a specific plane perpendicular to the shaft axis by means of an addition tool during the clamping operation, in which plane they are retained automatically after clamping by the friction between the clamping surfaces and the tubular portion. As an adjusting device, instead of the threaded ring, it is possible to have, for example, three setscrews extending through the ring carrying the tongues, near the tongues and screwing into the rotatable drum half.

As can be seen in the drawings, series of embodiments of clamping devices are possible within the scope of the invention. Further constructions are also possible, for example with respect to the third clamping jaw which may take the form of a slide on the third connecting bar, which slide is adjustable in a direction perpendicular to the shaft axis, its adjustment being effected with a set-screw which cooperates therewith. The clamping jaws and connecting bars need not be plate-shaped, but may alternatively have a block-shaped or similar construction. Furthermore, when two clamping devices are used for mounting a rotatable drum half on a shaft, it is also possible to employ two separate adjusting devices, for example in the form of set-screws, for each clamping device. The support for the magnetic heads need not be a drum half which at the same time serves as a tape guide; clamping devices in accordance with the invention are equally suitable for use in conjunction with a disc-shaped magnetic-head support which is arranged between two stationary halves of a tape guide drum, the magnetic heads cooperating with the tape through a gap formed between the two stationary drum halves. Neither need the magnetic-head support be rotationally symmetrical; it may, for example, take the form of an arm. Depending on the manner in which the tape is wrapped around the tape-guide drum, the magnetic heads may not only scan information tracks which extend obliquely relative to the longitudinal direction of the tape, but also tracks which are oriented substantially transversely of the longitudinal

direction of the tape or which extend in the longitudinal direction thereof.

Above it is stated that the drawings illustrate embodiments of the invention and, in order to avoid misunderstandings, it is also stated that in those cases where technical features mentioned in a Claim are marked with corresponding reference signs in parentheses, these reference signs have been included excluviely for a better understanding of the Claims.

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1. A recording and/or reproducing apparatus for a magnetizable record carrier in the form of a tape, which apparatus comprises at least one rotatable magnetic head (18,19) which scans the record carrier along information tracks and which is mounted on a support (17) which has a hub (20) by means of which the support is force-coupled to a rotatable shaft (21), the hub comprising at least one axially projecting hollow cylindrical tubular portion (28, 29) which is coaxial with the shaft and on which is placed a releasable clamping device (30,31) for engaging said portion and clamping it on the shaft so as to provide the force-coupling between the support and the shaft, characterized in that the clamping device (30,31) comprises a first clamping jaw (33;33'), a second clamping jaw (34;34') and a third (35;35') clamping jaw which are force-coupled to each other and which each have a clamping surface (40,41, 55;40',41',55') which engages the tubular portion in a plane (38,39,56;38',39',56') tangential thereto, the clamping surfaces engaging the tubular portion (28,29) at locations which are spaced circumferentially of the shaft (22) at an angular distance of 120° from each other substantially in one plane (36;36') perpendicular to the shaft axis (21), and in that by means of an adjusting device (58,63), in order to obtain the force-coupling between the support (17) and the shaft (22), at least one of the three clamping jaws is adjustable to move its clamping surface (55;55') in a direction substantially perpendicular to the axis (21) of the shaft (22) and, when said clamping jaw is adjusted in order to clamp the tubular portion (28,29) onto the shaft (22). each of the three clamping jaws exerts a clamping force (P1 to P3; P1' to P3') on the tubular portion, which force is directed perpendicularly to the tangential plane in which the clamping surface of the



respective clamping jaw engages the tubular portion.

2. An apparatus as claimed in Claim 1, characterized in that the first and second clamping jaws are interconnected by a first pivotal joint (37;37'), in that the
5 clamping device (30,31) comprises a first connecting bar (42;42') which is connected to the first clamping jaw (33;33') by a second pivotal joint (44;44'), and a second connecting bar (43;43') which is connected to the second clamping jaw (34;34') by a third pivotal joint (45;45'),
10 the first and second connecting bars being interconnected by at least one further pivotal joint (47,48;47',48') and the axes of all said joints extending substantially parallel to the axis (21) of the shaft (22), and the axis of the first joint (37,37') being disposed in the plane of symmetry
15 (49;49') relative to the two tangential planes (38,39;38',39') in which the clamping surfaces (40,41;40',41') of the first and second clamping jaws (33,34;33',34') engage the tubular portion (28,29), which plane of symmetry contains the axis (21) of the shaft (22), and the axis of the second joint
20 (44;44') and the axis of the third joint (45,45') being arranged mirror-symmetrically with respect to each other relative to the plane of symmetry (49;49') related to the two tangential planes (38,38';39,39') and a first connecting plane (50;50') which contains the axes of the second joint
25 (44;44') and the at least one further joint (47;47') connected to the first connecting bar (42;42'), and a second connecting plane (51), which contains the axes of the joints, intersecting each other in the plane of symmetry (49;49') related to the two tangential planes (38,39;38',39') and
30 in that the third clamping jaw (35;35') bears against an abutment (46;46') provided in the vicinity of the at least one further joint and by means of the adjusting device (58,63) is adjustable to move its clamping surface (55;55') relative to the abutment (46;46') in a direction which is
35 substantially perpendicular to the axis (21) of the shaft (22) in order to obtain the force-coupling between the support (17) and the shaft (22), the clamping force (P1;P1') exerted by the first clamping jaw comprising a first force



component ($N_1; N_1'$) which acts perpendicularly to the plane of symmetry ($49; 49'$) related to the two tangential planes ($38, 39; 38', 39'$) through the axis of the first joint ($37; 37'$), and a second force component ($Z_1; Z_1'$) which acts in the first
5 connecting plane ($50; 50'$), the clamping force ($P_2; P_2'$) exerted by the second clamping jaws ($34; 34'$) comprising a first force component ($N_2; N_2'$) which acts perpendicularly to the plane of symmetry ($49; 49'$) related to the two tangential planes ($38, 39; 38', 39'$) through the axis of the first
10 joint ($37; 37'$), and a second force component ($Z_2; Z_2'$) which acts in the second connecting plane ($51; 51'$), and the clamping force ($P_3; P_3'$) exerted by the third clamping jaw ($35; 35'$) acts in the plane of symmetry ($49; 49'$) related to the two tangential planes ($38, 39; 38', 39'$) through the axis
15 of the first joint ($37; 37'$).

3. An apparatus as claimed in Claim 2, characterized in that the abutment for the third clamping jaw ($35; 35'$) is constituted by a third connecting bar ($46; 46'$) which extends between the first connecting bar and the second connecting bar ($42, 43; 42', 43'$) and which is connected to the
20 first connecting bar ($42; 42'$) via a first further pivotal joint ($47; 47'$) and to the second connecting bar (43) via a second further pivotal joint ($48, 48'$).

4. An apparatus as claimed in Claim 3, characterized
25 in that the third clamping jaw ($35; 35'$) of the clamping device is constituted by a resilient expander which is bent into substantially a V-shape along a line which extends perpendicularly to the plane of symmetry ($49; 49'$) related to the two tangential planes ($38, 39; 38', 39'$), the expander
30 comprising a first expander limb ($53; 53'$) and a second expander limb ($54; 54'$), the free end of the first expander limb ($53, 53'$) constituting the clamping surface ($55; 55'$) of the third clamping jaw ($35; 35'$) and the free end of the second expander limb ($54; 54'$) bearing against the third
35 connecting bar ($46; 46'$), and in that a set-screw (58) acts on the expander substantially at the junction of the two limbs of said expander, said limbs ($53, 54; 53', 54'$) being expandable by the actuation of said set-screw in order to



clamp the tubular portion onto the shaft (Figs. 1-4).

5. An apparatus as claimed in Claim 4, characterized in that the expander, which serves as the third clamping jaw (35;35'), is constituted by a V-shaped leaf spring comprising at least two laminations (Fig. 4).

6. An apparatus as claimed in Claim 3, characterized in that the third clamping jaw of the clamping device is constituted by an L-shaped bracket (65;65'), which is supported on the third connecting bar (46;46') so as to be pivotable relative to said bar about an axis perpendicular to the plane of symmetry (49;49') related to the two tangential planes (38,39;38',39') and which comprises a first limb (67;67') which extends substantially parallel to the axis (21) of the shaft (22) and a second limb (68;68') which extends substantially perpendicularly to the shaft axis, the clamping surface (69;69') of the third clamping jaw being formed on the first limb (67;67'), and in that a set-screw (58) acts on the second limb (68;68'), the bracket (65,65') being pivotable relative to the third connecting bar (46,46') by the actuation of said set-screw in order to clamp the tubular portion onto the shaft (22). (Figs.5-6).

7. An apparatus as claimed in any one of Claims 4, 5 or 6, characterized in that the hub (20) of the support is provided with two hollow cylindrical tubular portions (28,29) which project axially in opposite directions from the hub and which are coaxial with the shaft (22) and each of which is engaged by a clamping device (30,31), the third clamping jaws of the two clamping devices being arranged mirror-symmetrically with respect to each other relative to a further plane of symmetry (32) which extends perpendicularly to the shaft axis (21) and which is situated between the two clamping devices, and in that for adjusting the two third clamping jaws there is provided a single set-screw (58) which extends parallel to the shaft axis through the two third clamping jaws and which is actuatable to tighten said third jaws relative to each other.

8. An apparatus as claimed in any one of the Claims 2 to 7, characterized in that the first clamping jaw (33;33'),



the second clamping jaw (34;34') and the connecting bars (42,43;42',43') of the clamping device are formed as an integral clamping plate and in that the pivotal joints (37,44,45,48;37',44',45',47',48') are constituted by hinges
5 formed integrally with the clamping plate, which hinges are elastically deformable in a plane substantially perpendicular to the axis (21) of the shaft (22).

9. An apparatus as claimed in Claim 1, characterized in that the first clamping jaw and the second clamping jaw
10 are rigidly connected to each other and are constituted by the limbs of a substantially V-shaped clamping member (83 (Fig. 9, 10); 107 (Fig. 11)), which limbs each comprise a clamping surface which engages the tubular portion in a plane tangential thereto, and the third clamping jaw is
15 adjustable substantially perpendicularly to the shaft axis by means of the adjusting device.

10. An apparatus as claimed in Claim 9, characterized in that the third clamping jaw is pivotally connected to at least one of the two limbs of the clamping member (Fig. 11).

20 11. An apparatus as claimed in Claim 10, characterized in that two connecting bars (90,91) are connected one to each of the two limbs (84,85) of the clamping member (30) via pivotal joints (88,89), which two connecting bars are in turn pivotally connected to each other and are arranged
25 mirror-symmetrically with respect to each other relative to the plane of symmetry (49) related to the two tangential planes, and in that the third clamping jaw (96) bears against an abutment which is pivotally connected to the connecting bars (90,91) and which is disposed substantially symmetrically relative to the plane of symmetry (49) related to the two
30 tangential planes, and, in order to obtain the force-coupling between the support (30) and the shaft (22), the third clamping jaw is adjustable relative to said abutment (Fig. 9).

12. An apparatus as claimed in Claim 10, characterized
35 in that the third clamping jaw substantially takes the form of a bar (112) and at one end is connected directly to one limb (108) of the clamping member via a pivotal joint (115) and at the other end is connected to the other limb (109)



of the clamping member via a pivotal joint (115) and at the other end is connected to the other limb (109) of the clamping member via a set-screw (117) which functions as adjusting device and which extends substantially transverse-
5 ly of the shaft axis, in order to provide the force-coupling between the support and the shaft (Fig. 11).

13. An apparatus as claimed in Claim 1, characterized in that the first clamping jaw, the second clamping jaw and the third clamping jaw are each constituted by a tongue
10 (123-125) which projects radially towards said shaft from a ring (126) which is coaxial with the said shaft, the tongues being inclined relative to the shaft, and the free ends (127-129) of said tongues constituting the clamping
15 surfaces and in that by means of the adjusting device, all the three clamping jaws are adjustable to move their clamping surfaces in directions substantially perpendicular to the axis (21) of the shaft (22), by moving the ring in the direction of the shaft axis (Figs. 12-13).

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