

## DAMPING UNIT FOR DISCONTINUOUSLY DAMPING A ROTATIONAL MOVEMENT

The present invention relates to a damping unit for discontinuously damping a rotational movement of a drive wheel rotatable about a drive axle, particularly a drive wheel of an access barrier, by means of a discontinuous transmission, which is constructed from two intermeshing eccentrically mounted non-circular gearwheels, and the drive wheel connects with a damping element associated with an output axle.

A damping unit of that kind is already known from German published specification DE 36 38 353 A1. A continuous rotation of the end of a toggle joint connected with a door closer is there converted into a discontinuous rotation by means of a transmission consisting of two identical non-circular gearwheels, the discontinuous rotation ultimately being subjected to damping.

In the case of door closers of that kind, but particularly also in the case of access barriers used in person separating equipment, the access to a protected region is usually made dependent on a condition, for example on the presence of a valid entry ticket. Such an access barrier after each passage of a person will therefore allow a lock to detent so that no more persons with a valid entry ticket can enter the protected area. A mechanical blocking of the access barrier, which prevents further rotation, is triggered by this detenting. If the access barrier were to be moved at undiminished speed to the end position then the detenting of the locking mechanism would on the one hand strongly stress the material and on the other hand mean an output of noise. Output of noise of that kind in the region of access barriers is also usually perceived as a negative quality feature, so that there is also a need on the part of the manufacturer to avoid this.

In principle, it is thus desired in the case of damping of that kind, whether with access barriers, door closers or other comparable devices, to so damp the movement of the access barrier in the region of the end position that a gentle, but rapid running to end position is achieved. A continuous rotational movement could, in the case of a direct damping, take place only in a steady manner so that the door would, due to the damping, be merely sluggish, at most running more easily in the region of the extreme points of the damper piston deflection. Due to the fact that the damping action is dependent on the rotational speed, in which case a high rotational speed means a high level of damping and a low rotational speed means a low level of damping, an increasing rotational speed has to

be achieved in the region of the end positions. This can be achieved through use of a discontinuous transmission which is constructed so that an increasing rotational speed of the crank takes place after the unstable position and until shortly before the end position.

However, the gearwheels, which are previously known from the above-mentioned published specification and which are of identical construction, have the disadvantage in the conversion of the continuous rotational movement into a discontinuous rotational movement that due to the identical design of the gearwheels a significant departure from ideal courses of damping has to be taken into account.

The prior art therefore offers other possibilities of producing a damping motion which is as ideal as possible. For this purpose, for example, a locking element for a turnstile installation is known from German Patent Specification DE 10 2007 010 385 B4. A turnstile installation of that kind represents a possibility of an access barrier in which a blocking element imparting a physical subdivision is provided. Through an incrementing step of the blocking element a passage through the access barrier is possible on each occasion by one person, whereby separation of persons is realised. Within the scope of the disclosure of this German patent specification, incrementing of the blocking element by a motor which is so controlled that damping is provided in the end region of the movement, thus in the region of the end position of the blocking element, is realised. This damping is realised in that the motor is slowed down in the region of the end position so that this does not exceed the end position.

For various reasons, whether for reasons of reduction in noise, protection from explosion or also because customers expect a higher service life from a mechanical solution than in the case of electronic components, there is also a quest for purely mechanical access barriers which then, however, have to have correspondingly good damping in terms of quality. In that regard - as in the case of motorised variants - an increasing damping until shortly before reaching the end position has to be achieved, wherein ideally a product variant which is as identical as possible in terms of construction to the motorised case is desired so as to enable changeover in type or slimmer production.

The present invention therefore has the object of indicating a damping unit for continuously increasing end position damping of a rotational movement which makes possible a course of damping which is as ideal as possible without permitting overswing and at the same

time dispenses with use of a motor.

This object is fulfilled by the damping unit according to the features of claim 1. Further feasible embodiments of the damping unit can be inferred from the subclaims.

In terms of construction, in the first instance a drive wheel is present against which the access barrier acts by its force. The torque of the movement of the access barrier is transmitted to the damping unit by the drive wheel, which is mounted to be rotatable about a drive axle. Instead of providing a motor for this purpose, here there would be provided at the outset a blackbox which should have the same functioning as a motor in the above-described control. For this purpose it has proved to be an inventive solution to provide for the blackbox a discontinuous transmission which converts the continuous rotation - which is generated by the rotation of the person passing through - of the access barrier or the drive wheel of the access barrier into a non-continuous rotation. In the end result, by virtue of the continuous rotation of a drive axle of the discontinuous transmission employed, a non-continuous movement of an output axle of the same discontinuous transmission is thus produced, in which case a speed-dependent damping of the output axle now causes strong damping at high speeds of the output axle, whereas a low speed of the output axle is accompanied by a small level of damping.

The discontinuous transmission used for that purpose comprises two non-circular gearwheels having different rolling curves. It was determined that the gearwheel arranged at the drive axle can preferably have a substantially oviform rolling curve, whereas the other non-circular gearwheel, which is seated on the output axle, is by comparison with the gearwheel at the drive side shortened in the direction of the extremity, but thereagainst widened in transverse direction relative thereto. Allocation of the rolling curves in that manner produces, particularly by comparison with use of identical, for example oviform, rolling curves, a significantly more progressive speed plot at the output axle as the system response to the presence of a continuous rotation at the drive axle. This results in a smoother end position motion and a more uniform damping behaviour during the rotation, from which as a result there is independence from the speed of passage, in which case a controlled end position motion takes place in every instance.

A less preferred, in particular less satisfactory configuration in end position motion and in the region of the unstable position, arises through interchange of the two gearwheels, thus

disposing the widened and shortened gearwheel on the drive axle. However, protection is also expressly sought for that.

The two non-circular gearwheels are, with advantage, each of symmetrical design so that rotation of the access barrier in two directions can take place. In that regard, the zero position as well as an unstable equilibrium are located in the medial rotational position in a setting of the gearwheels in which the axes of symmetry thereof are congruent. For preference, the gearwheels have the same numbers of teeth so as to allow passage through several times in the same direction.

An advantage of the identical rolling curves according to the prior art is that merely one tool has to be produced for manufacture of the identical gearwheels. Due to the costs of tools of that kind this represents a decisive advantage which does indeed allow worse rotational behaviour to be tolerated. However, the invention uses for this purpose MIM or CIM parts in order to keep the tool costs low. The costs of the tools thereby required are lower by a multiple than the costs of conventional tools required for metallic gearwheels of that kind.

According to the invention, damping of the output axle can take place either by a motor which is again provided thereat and which is controlled in similar mode and manner to that described in the introduction. Insofar as the discontinuous transmission, which is known from the prior art, with two identical gearwheels is used then the use of a motor for drive of the transmission will lead from the actual output side to an identical curve plot of the speed, which means that a constant rotation of the motor has the consequence of a rotation of the revolving door which is very rapid in the region of the unstable centre position. The motor would have to be subject to complicated control in such a manner that its movement in correspondence with function takes place with constant rotation on the drive side. In addition, the motor would have to be substantially stronger than provided as standard. Thereagainst, the transmission according to the invention is designed in its form so that the inverse function is a sine or cosine, in order that - at constant rotational speed of the motor - running-up and running-down are realised automatically, thus a maximum speed is attained at the peak of the movement. The damping unit according to the invention is therefore designed and suitable not only for motorised drive by a constant-speed motor, but also for manual operation, wherein in the case of motor operation the functions of drive axle and output axle are interchanged. The motor thus acts on the

output axle and produces rotation of the access barrier by way of the discontinuous transmission. The design of the transmission in accordance with the invention in that case ensures that the behaviour of the transmission is exactly the same in both operational directions, thus that in the case of a constant motor speed at the output axle the inverse function at the drive axle is a sine or cosine. As a consequence, due to the similarly lower level of force required for acceleration and deceleration it is possible to use lower power motors, which saves costs by comparison with more powerful motors.

The determination of an ideal damping function can take place on the basis of a geared n-bar linkage in that the ideal breakaway moment in the stable position, thus the so-called moment of inertia, is determined by changing the crank spacing in the geared n-bar linkage. It is possible to read off from the integrated crank in the geared n-bar linkage, as an inverse function, a sine or cosine function which brings the above-mentioned advantages for motorised operation. The determined function and the inverse function are now transferred to two non-circular gearwheels, since the mounting of a geared n-bar linkage would be substantially more difficult and therefore more cost-intensive by comparison with use of the discontinuous transmission according to the invention with two gearwheels. Nevertheless, use of a geared n-bar linkage instead of the transmission with two non-circular wheels is expressly covered by the invention.

In a further embodiment, provision is made to associate a crank element with the output axle so that an eccentric connection of the damping element, which, for example, is constructed as a spring damper element, with the output axle is made possible. A damping element of that kind can, for example, be advantageously integrated in a gas compression spring comprising a piston and cylinder. In the case of linear movement of the piston into the cylinder or out of the cylinder the movement in question is damped so that through connection of this piston eccentrically with the output axle, for example by way of the mentioned crank element, but selectably also directly with parts of the discontinuous transmission, the desired damping is brought about.

In order to here further avoid over-swinging in the end position provision is made for the end setting of the drive wheel to be reached where the discontinuous transmission and the spring element are in stable equilibrium. This means that the discontinuous transmission is disposed in the region of fastest movement of the output axle whilst the piston is in its potential-free position. Moreover, in this regard it is provided that the piston damps merely

in one direction, particularly in outward stroke direction, so that in the converse direction, thus particularly in the case of the inward stroke, an undamped movement is possible. For this purpose the piston of the gas compression spring comprises, for example, an appropriate valve by way of which oil flows via the valve opening of the piston and thus damping in the said direction does not take place.

However, it is also readily possible to reverse the direction of action in the manner that the gas compression spring damps merely in the inward stroke, which is to be expressly comprehended by the invention. Equally, damping in both inward stroke and outward stroke is possible, albeit not the preferred variant.

An additional resetting element designed in the form of, for example, a resetting spring can be used for the purpose of bringing the access barrier back from an unstable position to an end setting, for example if it is let go after the start of rotation again in opposite direction. For this purpose, resetting is always taken to the closest end setting so as not to produce an undesired completion of the rotation if the rotation which has started is discontinued.

In order to obtain greatest possible freedom in the use of a damping unit of that kind provision is made to utilise - instead of a simple crank at the output axle of the discontinuous transmission, which merely allows eccentric connection with the damping element - a crank disc which provides, in distribution over its circumference, fastening means for the damping element, the fastening means having different eccentricities. Insofar as a splined shaft is used as drive axle and/or output axle, the fastening means are distributed in the same number around the fulcrum as splines are provided at the splined shaft. The crank disc can thereby be associated in suitable manner with every position of the fastening means. It is thus possible to reset the degree of damping, particularly to individually adapt the degree of damping in the case of differently sized access barriers with differently sized mass. Apart from the possibility of fine setting, a possibility is also thereby given of undertaking adaptation to different products such as, for example, turnstiles, revolving doors with different pitches, etc.

A further additional damping can be achieved if the discontinuous transmission is accommodated in a housing filled with transmission oil. A gentler running of the discontinuous transmission is thereby ensured, in which case a damping measure which acts uniformly on the entire continuous rotation of the drive wheel is in question.

A further integration step is achieved if the drive axle, which is operatively connected with the drive wheel, as well as the output axle, at which the damping acts, are in each instance integrally produced with the associated non-circular wheel. Together with the ball bearings used, which mount the non-circular wheels inclusive of axles in the double-shell housing provided for that purpose, no more than eight parts are thus needed for the entire non-circular transmission. The mounting of a non-circular transmission of that kind is extremely simple and very favourable in cost.

As already illustrated in the foregoing, a damping unit of that kind is to be usable for a number of products, particularly also for revolving doors and turnstiles of different pitch. In the case of a  $90^\circ$  pitch of the turnstile the drive wheel requires a 1:4 translation in the direction of the access barrier, so that a quarter revolution of the turnstile produces a single complete revolution of the drive axle or the output axle.

The drive axle also executes a full revolution in that case, so that by virtue of the discontinuous transmission initially a rapid movement, then a region of slower movement and then again a rapid movement follow in succession. There are thus two regions of rapid movement, in which it is to be established that the damping of the damping element is stronger for a rapid movement so that in the case of a conventional damping cylinder these two regions would, in fact, be strongly damped. However, due to the fact that the damping element acts merely in one direction, an appreciable damping takes place merely for the last-mentioned rapid movement, this region being disposed in the region of the end position of the turnstile. As a consequence of the spring pressure of the damping element a more stable end position running arises here. The same unit is usable for a  $120^\circ$  pitch or also  $180^\circ$  pitch by a different translation if a 1:3 or also 1:2 translation is then provided.

Since the discontinuous transmission is usually enclosed in a housing and alignment of the discontinuous transmission will be required in order to locate the moment of greatest damping in the end region of the movement it appears useful to invoke measures to ensure correct positioning of the discontinuous transmission in the housing. For this purpose, the drive axle or the output axle can be formed at least in a section as a splined shaft so that the crank element can be directly placed on this splined shaft in the case of the output axle and the translation means or drive wheel can be directly placed on this splined shaft in the case of the drive axle. In that regard, it is particularly useful if

translation means or drive wheel has a multiple of the teeth provided at the splined shaft. In this case it is ensured that a correct setting is possible for every position of the translation wheel or the drive wheel.

However, provision can also be made to apply to the splined shaft a marking for the correct position of the discontinuous transmission.

An alternative embodiment of the damping unit, according to which the drive wheel is constructed as a gearwheel which engages in a rack or a cogged belt, allows use as a damping unit for a sliding door if the rack or the cogged belt is arranged in the region of the wall and the gearwheel rotates the drive wheel. The drive wheel can, if required, be stepped down in speed in such a manner that a complete sliding open corresponds with a complete revolution of the drive axle, wherein in the ideal case a rotation which is not entirely complete should be targeted so that the rest position is ideally reached at a damping maximum and thereby also at a torque maximum and the door securely closes. If the door is lightly pushed beyond the centre setting towards the open or closed position then it subsequently moves automatically, urged by the spring force of the spring/damper element, into the respective open or closed setting.

The same applies to the case of use of the damping unit in question for a swing door, wherein in this case a rack rail, which engages in the drive wheel or a gearwheel associated therewith, is arranged in the opening direction of the door. If required, a speed translation can be used here as well.

The invention described in the foregoing is explained in more detail in the following by way of an embodiment, in which:

Fig. 1 shows a damping unit according to the prior art in a perspective illustration obliquely from above,

Fig. 2 shows a damping unit according to the invention in a perspective illustration obliquely from above,

Fig. 3 shows a diagram of different piston output speeds according to the prior art, the invention and the ideal case,

Fig. 4 shows a diagram which shows the inverse function with respect to the function according to Fig. 3, in accordance with the invention,

Fig. 5 shows a revolving door with a damping unit according to Fig. 2 in a perspective illustration,

Fig. 6 shows a swing door with a damping unit according to Fig. 1 in a perspective illustration and

Fig. 7 shows a sliding door with a damping unit according to Fig. 1 in a perspective illustration.

Figure 1 shows a damping unit 10 according to the prior art, which is particularly suitable for damping a rotational movement of an access barrier. The rotational movement of the access barrier in that case acts on translation means (not illustrated in more detail), wherein the rotational movement is transmitted to the drive wheel 13. The drive wheel 13 is mounted on a drive axle 15, which is connected with a discontinuous transmission consisting of two identical non-circular gearwheels 11 and 12. By virtue of the ovoid rolling curve of the gearwheels 11 and 12 a continuous rotational movement of the access barrier is converted into a discontinuous rotational movement at an output shaft 16 connected with a damping element 17, 18. Due to the identical rolling curves it is not necessary to produce several tools for the two gearwheels 11, 12, so that the costs incurred for production of the gearwheels 11, 12 are kept low. However, the thereby-achieved rolling curve is not ideal, because it promotes intermediate damping and damps without precision in the region of the end position. In addition, the region of the unstable position is very pronounced.

Figure 2 shows the solution according to the invention, which is of substantially the same construction, but has two gearwheels 11 and 12 with different rolling curves. Thus, the rolling curve of a gearwheel 11 at the drive side is substantially ovoid, whereas the rolling curve of the gearwheel 12 at the output side is, by comparison with the rolling curve of the gearwheel 11 at the drive side, shortened in the direction of the eccentricity, but widened in transverse direction relative thereto. As a result, the two gearwheels 11, 12 have the same circumference and make possible an idealised course of the rotational speed

produced at the output axle 16 and thus of the damping.

This takes place by way of a piston 18, which engages the output axle 16, of a gas compression spring 17 connected with the output axle 16 by way of a crank element 14. The discontinuous rotational movement is thereby converted into a linear motion which is damped by the gas compression spring 17. The gas compression spring 17 damps merely in the outward stroke of the piston 18, so that in the case of a complete revolution of the output axle 16 the gas pressure spring 17 first begins damping in the second half, thus after a complete inward stroke of the piston 18 into the cylinder of the gas compression spring 17. Starting from the illustrated end position a rotation of the access barrier connected with the drive wheel 13 is thus carried out undamped until elapsing of a half revolution, when damping arises. However, the damping acts in dependence on the extension stroke speed of the piston 18, so that due to the discontinuous movement the damping acts with increasing dominance on the entire system by virtue of the kinematic design of the discontinuous transmission from the second half of the revolution to almost the end of the revolution, whereby in the end region a sufficiently strong damping takes place in order to safeguard the access barrier from over-swinging and to allow it come to a standstill in the region of its end position.

Figure 3 shows a diagram in which the plots of the piston speed are recorded against the rotational angle of the gearwheel 12 at the output side, in accordance with an ideal plot 51, a plot 50 according to the prior art solution and a plot 52 according to the invention. In view of the symmetry of the two gearwheels 11, 12 the curves 50, 51 and 52 are also symmetrical curves, the symmetry of which represents a point symmetry about the zero position in the case of rotation through  $\pi$  ( $\pi$ ). The ideal curve 51 exhibits in the region about the point 53 of symmetry a steep and substantially constant gradient, which signifies uniform damping in this region. At this point 53 of symmetry the system attains an unstable equilibrium in which the piston speed has a turning point. Due to the high change in speed the possibility of the access barrier remaining in its centre setting due to friction is avoided. The same applies to the curve 52 with gearwheels according to the invention. Merely the curve 50 with the same gearwheels, which reflects the prior art, has a too-small change in speed of the piston in gradient, which inter alia signifies retardations and accelerations leading to intermediate damping in the movement due to the damping behaviour of the piston 18. In addition, the peak of the damping or the piston speed in the case of the curve 52 with gearwheels according to the invention is displaced further in the

direction of the end position than in the case of the curve 50 with the same gearwheels, which leads to smoother running to the end position.

If people passing the access barrier do not drive the transmission, but a motor mounted at the output side, then the transmission according to the invention ensures an inverse curve 54 according to Figure 4, which results in a sine or cosine plot at the drive side or open sides of the access barrier. The design thus enables use of the same transmission for manual operation and motorised operation, wherein in the latter case the motor does not have to be subject to a complicated control procedure, but can be moved at constant rotational speed in order to ensure a suitable movement of the access barrier, thus a smooth running up and running down.

The arrangement according to Figure 5 shows a damping unit 10, the drive axle 13 of which is connected with a turnstile 20 by way of translation means 21. A turnstile 20 of that kind can be used with the same damping unit 10 as a revolving door or similar installation. In that regard, it is merely necessary to provide a different crank element 14 or, in the case of use of a crank disc, to select a different eccentricity in order to take into consideration the greater mass of a revolving door with respect to damping. Due to the pitch, which is shown here, at  $120^\circ$  a 1:3 translation has to be selected. Insofar as a turnstile 20 with, for example, only two or also with four blocking rakes is to be used then merely the translation has to be adapted thereto, thus a 1:2 translation in the case of a double division and a 1:4 translation in the case of a quadruple division. In the case of the selected 1:3 translation the output axle 16 is rotated three times for one full revolution of the turnstile 20, thus a damping maximum has to be overcome three times, namely on each passage through the turnstile 20.

According to the illustration in Figure 6 use of the invention for a swing door 30 is also provided. A rack rail 31, which engages directly in the drive wheel 13 and thus sets this in rotation, is provided in the region of the wall above the swing door 30. The size of the drive wheel 13 in this case has to be selected so that a complete swinging open corresponds with a full revolution of the drive wheel 13. The swing door 30 will thus be able to be initially swung open, in which case the drive wheel 13 rotates completely once. A damping in the region of the end position will also arise in opposite direction. In this regard it is to be noted that in order to achieve an ideal damping a full revolution is not executed, so that a revolution takes place quasi from damping maximum to damping

maximum. This appears practicable in each instance with a reciprocating movement, but this is not the case with a turnstile 20 used bidirectionally. It is also not necessary to then overcome any closing mechanism with force, but only to allow running into end position in order to, for example, automatically latch a pawl.

Finally, Figure 7 illustrates a further form of embodiment in which a sliding door 40 is realised. In correspondence with the previous statements a rack 41, which is mounted parallel to the wall, engages in translation means associated with the drive wheel 13, so that here, too, damping by the damping unit 10 is effected in the case of complete pushing open of the sliding door 40. Here, as well, damping therefore takes place in such a manner that the sliding door reaches the end position thereof under damping.

A damping unit for discontinuous damping of a rotational movement, which unit is usable particularly in the field of access barriers, is thus described in the foregoing. Through conversion of a continuous rotation into a non-continuous rotation, which is particularly suitable for damping, a damping of that kind can be carried out in selected regions of the rotational movement so that, in particular, damping which increases towards the region of the end position can be realised. An ideal course of damping is achieved by the use of gearwheels with unequal rolling curves, wherein the gearwheel at the output side is shortened in the direction of its eccentricity by comparison with a gearwheel at the drive side and is widened in the transverse direction relative thereto.

## REFERENCE NUMERAL LIST

|    |                                                  |
|----|--------------------------------------------------|
| 10 | damping unit                                     |
| 11 | gearwheel at drive side                          |
| 12 | gearwheel at output side                         |
| 13 | drive wheel                                      |
| 14 | crank element                                    |
| 15 | drive axle                                       |
| 16 | output axle                                      |
| 17 | gas compression spring                           |
| 18 | piston                                           |
| 20 | turnstile                                        |
| 21 | translation means                                |
| 30 | swing door                                       |
| 31 | rack rail                                        |
| 40 | sliding door                                     |
| 41 | rack                                             |
| 42 | translation means                                |
| 50 | curve with identical gearwheels                  |
| 51 | ideal curve                                      |
| 52 | curve with gearwheels according to the invention |
| 53 | point of symmetry                                |
| 54 | inverse curve                                    |
| 55 | plot of motor speed                              |

## PATENT CLAIMS

1. Damping unit for discontinuously damping a rotational movement of a drive wheel (13) rotatable about a drive axle (15), particularly a drive wheel (13) of an access barrier, by means of a discontinuous transmission which is constructed from two intermeshing eccentrically mounted non-circular gearwheels (11, 12) and which connects the drive wheel (13) with a damping element associated with an output axle (16), characterised in that the transmission comprises two gearwheels (11, 12) with unequal rolling curves, wherein one gearwheel (12), which is preferably mounted on the output axle (16), is shortened by comparison with the second gearwheel (11), which is preferably mounted on the drive axle (15), in the direction of its eccentricity and is widened in transverse direction relative thereto.
2. Damping unit according to claim 1, characterised in that the gearwheel (11) at the drive side has a substantially ovoid rolling curve.
3. Damping unit according to one of claims 1 and 2, characterised in that the damping element has two extreme settings, which include an end setting, wherein the gearwheels (11, 12) in these extreme settings of the damping element are oriented in the same sense and have a common axis of symmetry.
4. Damping unit according to any one of the preceding claims, characterised in that the gearwheels (11, 12) are produced by means of MIM or CIM technology.
5. Damping unit according to any one of the preceding claims, characterised in that the gearwheels (11, 12) have the same tooth numbers.
6. Damping unit for discontinuously damping a rotational movement of a drive wheel (13) rotatable about a drive axle (15), particularly a drive wheel (13) of an access barrier, by means of a discontinuous transmission which connects the drive wheel (13) with a damping element associated with an output axle (16), characterised in that the transmission is constructed as a geared n-bar linkage.
7. Damping unit according to any one of the preceding claims, characterised in that the damping element is a motorised drive which produces a preferably positionally-

dependent damping at the output axle (16).

8. Damping unit according to any one of claims 1 to 6, characterised in that the damping element is a damping cylinder, the piston (18) of which is eccentrically connected by the free end thereof with the output axle (16), preferably with interposition of a crank element (14).

9. Damping unit according to claim 8, characterised in that the crank element (14) is a crank disc with which fastening means, which are distributed over its circumference, of different eccentricities for eccentric fastening of the piston (18) are associated.

10. Damping unit according to one of claims 8 and 9, characterised in that the damping cylinder is a gas compression spring (17) which preferably damps only in the outward stroke of the piston (18).

11. Damping unit according to any one of claims 8 to 10, characterised in that a restoring element producing a restoring force in the direction of the closest end setting is associated with the damping cylinder.

12. Damping unit according to any one of the preceding claims, characterised in that the inverse function of the function of the rotational speed of the output axle has a cosine-shaped or sine-shaped plot depending on the rotational angle of the drive axle with constant rotation.

13. Damping unit according to any one of the preceding claims, characterised in that the discontinuous transmission is received in a housing which is preferably composed of two identical half shells and which is preferably filled with transmission oil.

14. Damping unit according to any one of the preceding claims, characterised in that the gearwheel (12) at the output side is formed integrally with the output axle (16) and the gearwheel (11) at the drive side is formed integrally with the drive axle (15).

15. Damping unit according to any one of the preceding claims, characterised in that the drive wheel (13) is connected with the access barrier by way of translation means, preferably translation means (21, 42) in the ratio of 1:4, 1:3 or 1:2.

16. Damping unit according to claim 15, characterised in that at least one of the drive axle (15) and the output axle (16) is constructed at least in a section as a splined shaft, wherein the number of teeth of the drive wheel (13) is preferably an integral multiple of the number of splines of the splined shaft section.

17. Damping unit according to one of claims 15 and 16, characterised in that an additional gearwheel is coaxially associated with the drive wheel (13) or the translation means (42) and engages in a rack (41).

18. Damping unit according to any one of claims 1 to 16, characterised in that the drive wheel (13) is constructed as a gearwheel in which a rack rail (31) engages.