Injection Device

Technical Background

For the treatment of a multitude of illnesses, which are now widespread, such as diabetes, patients must inject themselves independently with the needed amount of an active substance/medicament, using a hypodermic syringe or a carpule. To make this safer and easier, a multitude of injection devices are known that incorporate a largely automatic sequence of insertion of the needle, injection of the active substance and withdrawal of the needle.

Prior Art

For the use of disposable hypodermic syringes, a number of devices for automatic injection of the active substance that is contained in the syringe are known; document WO 2007/033638, for instance, which forms the prior art, discloses an injection device which, while simple to operate, permits a fully automatic sequence of the above-described processes, using a two-chamber ampoule whereby a sequence of mixing, needle-insertion and injection is made possible.

Disclosure of the Invention

It is the object of the invention to improve an injection device in such a way that the handling comfort and safety for the patient is improved, while providing for a simple mechanical design.

The inventive injection device meets this object with the characteristics of claim 1.

It is the underlying idea of the invention that the previously seamless progression of the strokes with a fixed stroke duration in each case is now no longer predefined, but the user is instead enabled to individually design the duration of the stroke (and, hence, the speed of the respective associated process, such as e.g. the injection), as well as the transition of individual strokes (and thereby in particular pauses in the sequence of the movements.)

Preferred embodiments relate to the design of the component parts for adjusting the retention time and injection duration.

Brief Description of the Drawings

Two preferred exemplary embodiments of the injection device will now be explained with the aid of drawings, in which

Figure 1A shows a side view of a first exemplary embodiment of the injection device with the housing cover removed,

Figure 1B shows a section through the injection device of Figure 1 in its starting position in its center plane,

Figure 2A shows a side view of the injection device in the process of carrying out the mixing stroke,

Figure 2B shows a sectional view corresponding to Figure 2A,

Figure 3A shows a side view of the injection device during the puncture stroke,

Figure 3B shows a sectional view according to Figure 3A,

Figure 4A shows a side view of the injection device during the injection stroke,

Figure 4B shows a sectional view corresponding to Figure 4A,

Figure 5A shows a side view of a first exemplary embodiment of the injection device during the idle stroke,

Figure 5B shows a sectional view corresponding to Figure 5A,

Figure 6A shows a side view of a first exemplary embodiment of the injection device during withdrawal of the needle, and

Figure 6B shows a sectional view corresponding to Figure 6A,

Figure 7A shows a side view of the first exemplary embodiment of the injection device after completed withdrawal of the needle,

Figure 7B shows a sectional view corresponding to Figure 7A,

Figure 8A shows a side view of a first exemplary embodiment of the injection device during resetting of the mechanics (maximum retention time),

Figure 8B shows a sectional view corresponding to Figure 8A,

Figure 9A shows a side view of a first exemplary embodiment of the injection device during resetting of the mechanics (minimum retention time),

Figure 9B shows a sectional view corresponding to Figure 9A,

Figure 10A shows a side view of a second exemplary embodiment of the injection device with the housing cover removed,

Figure 10B shows a section through the injection device of Figure 1 in its starting position in its center plane 1,

Figure 11A shows a side view of a second exemplary embodiment of the injection device during the puncture stroke,

Figure 11B shows a sectional view corresponding to Figure 11A,

Figure 12A shows a side view of a second exemplary embodiment of the injection device during the injection stroke,

Figure 12B shows a sectional view corresponding to Figure 12A,

Figure 13A shows a side view of a second exemplary embodiment of the injection device during the idle stroke,

Figure 13B shows a sectional view corresponding to Figure 13A,

Figure 14A shows a side view of the second exemplary embodiment of the injection device during withdrawal of the needle,

Figure 14B shows a sectional view corresponding to Figure 14A,

Figure 15A shows a side view of the second exemplary embodiment of the injection device after completed withdrawal of the needle,

Figure 15B shows a sectional view corresponding to Figure 15A,

Figure 16A shows a side view of the second exemplary embodiment of the injection device during resetting of the maximum retention time mechanics,

Figure 16B shows a sectional view corresponding to Figure 16A,

Figure 17A shows a side view of the second exemplary embodiment of the injection device during resetting of the minimum retention time mechanics,

Figure 17B shows a sectional view corresponding to Figure 17A,

Figure 18A shows a side view of a first exemplary embodiment of a planetary gear with a rotation damping element,

Figure 18B shows a sectional view corresponding to Figure 18A,

Figure 18C shows a sectional view of the planetary gear without planetary carrier

Figure 18D shows a perspective view corresponding to Figure 18A with blocked planetary carrier,

Figure 18E shows a perspective view corresponding to Figure 18C without planetary carrier,

Figure 18F shows a view corresponding to Figure 18D with blocked planetary carrier,

Figure 19A shows a side view of a second exemplary embodiment of a planetary gear with two rotation damping elements,

Figure 19B shows a side view and a perspective view according to Figure 19A with a locked first blocking disk,

Figure 19C shows a side view and a perspective view corresponding to Figure 19B with a locked second blocking disk,

Figure 19D shows a perspective view corresponding to Figure 19B with a locked first blocking disk,

Figure 19E a perspective view corresponding to Figure 19D without planetary carrier/second blocking disk,

Figure 19F shows a section in the plane B-B of Figure 19A,

Figure 19G shows a first section in the plane A-A of Figure 19A, and

Figure 19H shows a second section in the plane A-A of Figure 19A.

Description of the Exemplary Embodiment

To inject the active substance, a two-chamber ampoule 111 is used. An ampoule of this type (Figure 1B) has two pistons 111A, 111B, resulting in two initially independent chambers 111C, 111D. Into the first, inner chamber 111C, which faces the cannula 112, powdered Betaferon, for example, is filled, and into the second, outer chamber 111D, a NaCl solution is filled.

If a ram 104 is now pressed against the outer piston 111B, the inner piston 111A is initially displaced as well, as the NaCl solution hydraulically transfers the force of the ram onto the inner piston 111A. As soon as the inner piston 111A has passed an overflow channel 111E in the form of a groove-like convexity in the outer wall of the ampoule 111, it comes to a standstill and the NaCl solution flows through this overflow channel 111E into the inner chamber 111C and mixes with the Betaferon. After the mixing process, the injection then takes place (after the puncture stroke) due to the continued movement of the ram 104.

Figure 1A shows a top view, Figure 1B shows a sectional view in the starting position of the injection device.

All the components are situated inside a housing 101 composed of two tub-shaped half-shells. The movable components are held inside the injection device so as to be displaceable parallel to the longitudinal axis of the needle. The components are assigned to each other as follows:

A two-chamber ampoule 111 is held in a receptacle 103. A ram 104, to the rearward end of which a control lever 105 is hinged, is held on a locking hook 102A of a spring-actuated first push-button 102. The receptacle 103 is held on a locking hook 116A of a spring-actuated second push-button 116.

Acting on the receptacle 103 is the end of a traction cable 114 that is deflected via a roller 109 mounted in a carriage 108 and connected to a tension spring 110 fixed to the housing 101. The tension spring 110 accordingly exerts a pulling force on the receptacle 103 in a direction away from the injection site. The receptacle 103 cannot slide in an axial direction, however, because it is held by the locking hook 116A on the second push-button 116.

The deflection of the traction cable 114 via the roller 109 creates a force on the carriage 108 toward the injection site. The carriage 108 remains in its position, however, because it rests against the ram 104 via a driving feature 118, which is mounted in the carriage 108 so as to be displaceable perpendicular relative to the injection device and which is actuated by a driving spring 119, and the ram 104 is held by the locking hook 102A on the first push-button 102.

Assigned to the control lever 105 is a first adjusting slider 107, in which a second adjusting slider 106 is displaceably supported. The adjusting slider 106 provides for the uncoupling of the carriage 108 from the ram 104. The adjusting sliders 106, 107 are designed as displaceably supported limit-stop elements for adjustment of the needle-insertion depth and injection volume, as will be explained further below.

A pull-back handle 117, which is connected to a pull rod 115, serves to create this starting position. The pull rod 115 is actuated by a pull-back spring 120.

When the first push-button 102 is actuated, this causes the locking hook 102A to move out of engagement, the ram 104 is released and moves toward the puncture site until the front edge of the control lever 105 comes to rest against the receptacle 103. This causes the outer piston 111B of the ampoule 111 to be activated, it moves forward and carries out a mixing stroke H0. This mixing stroke serves for mixing of the NaCl solution with the Betaferon, as described above (Figure 2A, Figure 2B). A window in the housing 101 makes it possible to monitor the mixing of the Betaferon with the NaCl solution.

Since the free end of the control lever 105, on the other hand, slides on the second adjusting slider 107 and rests on it, it cannot yield in a downward direction by pivoting at this location; the pulling

force of the tension spring 110 toward the puncture site is therefore transferred from the carriage 108 via the ram 104 to the receptacle 103. The receptacle 103 remains in its position, however, because it is locked in place by the locking hook 116A of the push-button 116.

When the second push-button 116 is now actuated, this causes the locking hook 116A to move out of engagement and the receptacle 103 is released; this causes the ram 104 and the receptacle 103 to jointly move toward the puncture site under the action of the tension spring 110. The needle is inserted (Figure 3A, 3B), the injection stroke H1 is carried out (Figure 4A, 4B.)

Once the desired insertion depth is reached, the control lever 105 is able to pivot downward (arrow in Figure 4A), since it is no longer prevented from doing so by the first adjusting slider 107 because of its recessed upper surface. Consequently, force is no longer transferred from the ram 104 to the receptacle 103, the receptacle 103 remains in its position and only the ram 104 continues to move toward the injection site, i.e. injection of the medication takes place, the injection stroke H2 is carried out.

Once the driving feature 118 that is displaceably mounted in the carriage 108 reaches the ramp 106A of the second adjusting slider 106 (Figure 4B), the driving feature 118 is pulled downward and the carriage 108 is thus uncoupled from the ram 104, i.e. at this point in time the injection is complete (Figure 5B).

In Figure 5, a toothed rack 140, which is mounted by means of a first adjusting screw 130 in the housing between a front and rear end position so as to be able to be freely displaced by the user, is shown in its frontal end position, in which the retention time is set to the maximum (maximum duration of the idle stroke HX).

Once the injection is complete, the toothed rack 140 strikes the second adjusting slider 106, the carriage 108 continues to move jointly with a damping element 150 that is connected to the carriage 108, relative to the toothed rack 140, toward the puncture site, thereby causing the idle stroke HX to occur, during which the needle remains in the puncture site. The relative movement between the toothed rack 140 and the damping element 150 during the idle stroke HX causes the damping element 150 to become operative. Once the carriage 108 strikes the second adjusting slider 106, the idle stroke HX is complete.

If the toothed rack 140 is not in its frontal end position it strikes the second adjusting slider 106 at a later point in time and the duration for which the damping element 150 is effective is accordingly shorter as well, as is the retention time (duration of the idle stroke HX).

If the retention time is set to the minimum value, the toothed rack 140 strikes the carriage 108 only after completion of the idle stroke HX and is not displaced relative to the carriage 108 and damping element 150; the damping element 150 has no effect and therefore does not influence the retention time.

The carriage 108 now rests against the second adjusting slider 106. Since the second adjusting slider 106 is held form-fittingly on the housing 101 via the first adjusting slider 107, the pulling force of the tension spring 110 (which is fixed to the housing 101) now acts via the roller 109 on the receptacle 103, causing the same to be pulled back and consequently causing the needle to be pulled out of the puncture site (Figure 6A, 6B), the retraction stroke H3 is carried out.

By folding down the pull-back handle 117, which is connected to the pull rod 115, and by pulling out the pull rod 115, the carriage 108 and all other elements are pulled back into their starting position (Figure 8A, 8B).

During the process of pulling back the carriage/damping element into the starting position, the toothed rack 140 strikes the frontal first limit-stop surface 130A of the adjusting screw 130. While the carriage 108 with the damping element 150 continue to move away from the puncture site the toothed rack 140 is held in position by the adjusting screw 130, i.e. the toothed rack 140 moves, relative to the carriage 108/damping element 150, into the selected starting position.

The position of the surface 130A can be changed by means of the adjusting screw 130, and thereby the distance by which the toothed rack 140 is displaced relative to the carriage 108/damping element 150.

Figure 8A/8B shows the adjusting screw 130 in the position that produces the maximum retention time. Figure 9A/9B shows the adjusting screw 130 in the position that produces the minimum retention time. Between these two positions the retention time may be adjusted continuously.

Once the mechanism has been moved back into the starting position, the carpule can now be removed.

The injection volume and needle insertion depth can be adjusted as follows:

The first adjusting slider 107 is mounted in the housing 101 so as to be axially displaceable, in the present example with 2 locking positions (10 and 12 mm, set to 10 mm in the example). These locking positions are assigned to the puncture stroke H1, since the axial position of the adjusting

lever 107 determines the distance traveled until the control lever 105 uncouples the ram 104 from the receptacle 103 (Figure 2A).

Mounted inside the first adjusting slider 107 in a manner so as to also be axially displaceable is the second adjusting slider, in the present example with 4 locking positions (1.0; 0.75; 0.5; 0.25; in the example set to 1.0 mm). These locking positions are assigned to the injection stroke H2, since the axial position of the adjusting slider 106 determines the distance traveled until the ram 104 is uncoupled from the carriage 108 (Figures 5A,5B) and withdrawal of the needle takes place.

If a needle insertion depth of 12 mm, for example, is now to be set, the first adjusting slider 107 must be displaced by 2 mm toward the puncture site, relative to the depicted state, to the new locking position on the housing 101. Since the second adjusting slider 106 is interlocked in position 1.0 with the first adjusting slider 107, the same now also moves by 2 mm toward the puncture site, i.e. setting a different needle insertion depth has no impact on the injection volume setting. Likewise, adjusting the injection volume has no impact on the needle insertion depth; the settings of the puncture stroke H1 and injection stroke H2 are independent from each other.

The second exemplary embodiment shown in Figures 10-17 proceeds from an injection device as described in the first exemplary embodiment, however, not for use with a carpule but with a hypodermic syringe, i.e. a mixing stroke does not take place. The basic concept of this exemplary embodiment is that the injection duration and/or retention time can be set by the patient.

The design and interaction of the components explained in connection with the first exemplary embodiment are identical in their functions, so that only the additional components will be described below based on their functions:

Setting the duration of the injection stroke:

Upon actuation of the first push button 202, the locking hook 202A moves out of engagement and the receptacle 203 is released; this causes the ram 204 and the receptacle 203 to jointly move toward the puncture site under the action of the tension spring 210. The needle is inserted (Figure 11A and 11B), the puncture stroke is carried out.

Upon completion of the puncture stroke a locking mechanism 221, which is subjected via a slotted hole inside a guide means 222 to a force acting in the direction of the receptacle (triggered by a spring 223), is able to pivot into the recess in the receptacle 203. This locking mechanism is supported in the first adjusting slider 207 and is therefore independent from the selected needle insertion depth. The receptacle 203 is fixed in the inserted position via the locking mechanism 221.

Once the desired insertion depth is reached, the control lever 205 is able to pivot downward (arrow in Figure 12A), since it is no longer prevented from doing so by the first adjusting slider 207 because of its recessed upper surface.

Consequently, force is no longer transferred to the ram 204.

Figure 11A shows the state of the injection device at the maximum injection duration setting, i.e. a toothed rack 241 makes contact simultaneously with the end of the puncture stroke with a limit stop 206B of the second adjusting slider 206.

If the injection duration is set to a smaller value, the toothed rack 241 strikes the limit stop 206A at a later point in time.

After the ram 204 is uncoupled from the receptacle 203, the receptacle 203 remains in its position and the ram 204 continues to move toward the puncture site. Starting from the point in time at which the toothed rack 241 strikes the limit stop 206B of the second adjusting slider 206, the same remains stationary relative to the ram 204 and to a damping element 251 and the injection stroke is accordingly slowed by the damping element 251. The injection duration is therefore dependent upon the distance along which the damping element 251 is effective, and this distance is adjustable by the patient by means of an adjusting screw 231. Injection of the medication takes place, the injection stroke is carried out.

Once the driving feature 218 that is displaceably supported in the carriage 208 reaches the ramp 206A of the adjusting slider 206 (Figure 12b), the driving feature 218 is pulled downward and the carriage 208 is accordingly uncoupled from the ram 204, i.e. at this point in time the injection is complete (Figure 13b).

Setting the retention time:

In Figure 13B the toothed rack 240 is shown in its frontmost position, i.e. the retention time is set for the maximum. Once the injection is complete the toothed rack 240 strikes the second adjusting slider 206, the carriage 208 continues to jointly move with the damping element 250 relative to the toothed rack 240 toward the insertion site. The relative movement between the toothed rack 240 and damping element 250 during the idle stroke HX causes the damping element 250 to take effect. Once the carriage 208 strikes the second adjusting slider 206, the idle stroke HX is complete.

If the toothed rack 240 is not in its frontmost position (shorter retention time) it strikes the second adjusting slider 206 at a later point in time and the distance along which the damping element 250 is effective is accordingly smaller, and so is the retention time.

If the retention time is set to the minimum value, the toothed rack 240 strikes the carriage 208 only after completion of the idle stroke HX and is not displaced relative to the carriage 208 and damping element 250, the damping element 250 has no effect and does not influence the retention time.

At the end of the idle stroke, the incline of the carriage 208 strikes a ramp 222A of a guide means 222 and releases the locking mechanism between the receptacle 203 and adjusting slider 206 (Figure 14A).

The carriage 208 now rests against the second adjusting slider 206. Since the second adjusting slider 206 is held form-fittingly on the housing 201 via the first adjusting slider 207, the tension spring 210 (which is fixed to the housing 201) now acts via the roller 209 on the receptacle 203, causing the same to be pulled back and thus pulls the needle out of the puncture site (Figure 15A,15B), the retraction stroke H3 is carried out.

By folding down the pull-back handle 217 that is connected to the pull rod 215, and pulling out the pull rod 215, the carriage 208 and all other elements are pulled back into the starting position (Figures 16A, 16B).

During the process of pulling back the carriage 208/damping element 250 and ram 204/damping element 251 into the starting position, the toothed rack 240 strikes the surface 230A of the adjusting screw 230, and the toothed rack 251 strikes the surface 231A of the adjusting screw 231. While the carriage 208/damping element 250 or ram 204/damping element 251 continue to move away from

the puncture site the toothed rack 240 is held in position by the adjusting screw 230 and the toothed rack by the adjusting screw 231, i.e. the toothed racks 240/241 move relative to the damping elements 250/251 into the selected starting position.

The position of the limit-stop surfaces 230A/231 can be changed by means of the adjusting screws 230/231. The distances by which the toothed racks 240/241 move relative to the damping elements 250/251 is adjustable by the patient.

Figures 16A/16B show the adjusting screws 230 and 231 in the position that produces the maximum retention time/injection duration.

Figures 17A/17B show the adjusting screws 230 and 231 in the position that produces the minimum retention time/injection duration. Between these two positions, the retention time (duration of the idle stroke HX) and injection duration (duration of the injection stroke H2) may be adjusted continuously, independently from each other.

After the mechanism has been moved back into the starting position, the syringe 211 can now be removed.

In the described exemplary embodiments it is accordingly possible for the user, so as to adjust the duration of the injection stroke by means of an appropriate design of the damping element, to adjust the duration of the effect of the damping element within a stroke by displacing the associated toothed rack, so that a portion of the stroke proceeds undamped, the remaining portion damped.

Alternatively, a damping element may be used whose damping characteristics can be adjusted by the user to thereby vary the duration of the stroke.

Combinations of such measures for generating a desired process characteristic (speed profile) of a stroke are possible as well.

To implement these alternatives for a user-defined adjustment of the speed/duration of a stroke, for instance of the injection stroke, a rotation damping element of a commercially available type may be used in the described exemplary embodiments.

Advantageously, a rotation damping element may be used, such as the one described in DE 20 2006 017 578.3 U1. With the latter, it is possible to set a basic damping, permitting an even more flexible adaptation of the progression profile of a stroke to the individual requirements of a user.

If the desired variation of the duration of the respective stroke is already attainable via the adjusting range of this basic damping provided by a rotation damping element according to DE 20 2006 017 578.3 U1, the adjustment of the associated toothed rack by means of its associated adjusting screw may be dispensed with, if appropriate, and the same may then remain in the position in which it permits the maximum stroke duration.

Figures 18 and 19 show two exemplary embodiments of a damping element in which the coupling of the toothed rack, as the stroke-determining component, to one/two rotation damping element(s) is effected by means of a planetary gear that is designed, by means of a locking element, as an On/Off switch for the rotation damping element. The components are supported and/or held in a housing 311,411.

The first exemplary embodiment shown in Figures 18A-18F is designed as follows:

The annulus gear 301 and the planetary carrier 302 of a planetary gear 300 are supported freely rotating on the shaft 303. The sun gear 305 is rigidly press-fitted to the shaft 303 and thus acts as a drive for the rotation damping element 304 connected to the shaft 303.

The planetary carrier 302 is rigidly connected via three axes 309 to the three planet gears 310. They rotate about the sun gear 305 via a toothing. The annulus gear 301 is driven via the toothed rack 306. A blocking slide 307 is able to prevent the planetary carrier 302 from turning by engaging into its toothing. Depending on the position of the blocking slide 307, the respective gears are operated in the following modes:

- The planetary carrier 302 is not blocked (Figures 18C,E):

The blocking slide 307 is not blocking the planetary carrier 302. The annulus gear 301 rotates, causing the planet gears 310 to rotate about the sun gear 305, thereby effecting a rotation of the planetary carrier 302. The sun gear 305, accordingly, is not moving and the rotation damping element 304 is therefore not driven. This means that an idle movement takes place, i.e. the stroke of the injection device that is coupled to the toothed rack 306 proceeds undamped with maximum speed and therefore in the shortest amount of time.

- The planetary carrier 302 is blocked (Figures 18A,B,D,F):

The blocking slide 307 engages into the planetary carrier 302. The annulus gear 301 rotates because of the linear movement of the toothed rack 306. The annulus gear 301 drives the planet gears 310. Since the planetary carrier 302 is fixed in its position, the individual planet gears 310 cannot rotate about the sun gear 305. The planet gears 310 accordingly drive the sun gear 305. Since the same is connected via the shaft 303 to the rotation damping element 304, the same is being driven. This

means that a damping takes place, i.e. the stroke of the injection device that is coupled to the toothed rack 306 proceeds at a reduced speed/over a longer duration.

If two rotation damping elements with different damping values that are placed in series are operated in this manner, a plurality of combinations are possible:

1) None of the two blocking slides is depressed → idle movement, no stroke damping,

2) only one blocking slide is depressed → only the associated rotation damping element is damping, stroke damping based on the selected rotation damping element,

3) both blocking slides are depressed → both rotation damping elements are damping, maximum damping of the stroke.

The second example shown in Figures 19A-19H expands upon the first example and is designed as follows:

Two shafts 403A and 403B are provided. The first shaft 403A serves as a drive for the first rotation damping element 404A. Rigidly disposed on, e.g. pressed onto the first shaft 403A is a first blocking disk 408A. The annulus gear 401 rotates freely on the first shaft 403A. Additionally, the sun gear 405 is rigidly connected to the first shaft 403A. The drive is effected via the toothed rack 406, which drives the annulus gear 401.

The second shaft 403B serves as a drive for the second rotation damping element 404B. Rigidly disposed on the second shaft 403B is a second blocking disk 408B. The second blocking disk 408B serves as the planetary carrier, since the three planet gears 410 are connected freely rotating via the three axes 409. The planet gears 410 are driven via the annulus gear 401 and drive the respective gears in dependence upon the position of the blocking slides 407A,407B of the blocking device.

The following functions are thus created:

- The first blocking disk 408 is blocked (Figure 19C):

The blocking device blocks, via its first blocking slide 407A, the rotation of the first blocking disk 408A and thereby the rotation of the first shaft 403A. The annulus gear 401 rotates, due to the linear movement of the toothed rack 406, and drives the planet gears 410.

Since the first shaft 403A cannot rotate, the sun gear 405 is fixed in its position. The planet gears 410 can therefore move about the sun gear 405, thereby driving the planetary carrier/second blocking disk 408B. Since the same is connected via the second shaft 403B to the second rotation damping element 404B, the second rotation damping element 404B is being driven. A damping therefore takes place via the second rotation damping element 404B. (The second blocking disk 408B rotates without effect.)

- The second blocking disk 408B is blocked (Figures 19B,D,E):

The blocking device blocks, via its second blocking slide 407B, the rotation of the second blocking disk 408B and accordingly the rotation of the second shaft 403B. The annulus wheel 401 rotates due to the linear movement of the toothed rack 406 and drives the planet gears 410. Since the planet carrier (= second blocking disk 408B) is fixed in its position, the planet gears 410 cannot move about the sun gear 405. The planet gears 410 accordingly drive the sun gear 405. Since the same is connected via the first shaft 403A to the first rotation damping element 404A, the same is being driven. A damping of the stroke accordingly takes place via the first rotation damping element 404A. (The first blocking disk 408A rotates without effect.)

The components described under Figures 17 and 18 with the designations "toothed rack 306,406 / planetary gear set 300,400 / rotation damping element 304,404A,404B" may be used in the two exemplary embodiments of the injection device depicted in Figures 1 through 16 in lieu of the component with the designations "toothed rack 140,240,241 / damping element 150,250,251" that is shown there.

By connecting the blocking slides to actuation means outside the housing in a suitable manner, a damping element can be activated or selected by the user, so as to, for example, achieve a slower injection stroke.

The patient is thereby given an added adjusting option for individually designing the progression profiles of the strokes of "his" injection device.

Reference Numerals

housing	101,201
first push-button	102,202
locking hook	102A,202A
receptacle	103,203
ram	104,204
control lever	105,205
first adjusting slider	107,207
second adjusting slider	106,206
ramp	106A,206A
limit stop	206B
carriage	108,208
roller	109,209
spring	110,210
carpule	111
syringe	211
hypodermic cannula	112,212
traction cable	114,214
pull rod	115,215
second push-button	116
locking hook	116A
pull-back handle	117,217

driving feature	118,218	
driving spring	119,219	
pull-back spring	120,220	
blocking mechanism for receptacle		221
guide means for blocking mechanism		222
ramp	222A	
spring	223	
first adjusting screw	130,230	
second adjusting screw	231	
first limit-stop surface	130A,230A	
second limit-stop surface	231A	
first toothed rack	140,240	
second toothed rack	241	
first damping element	150,250	
second damping element	251	
planetary gear	300,400	
annulus gear	301,401	
planetary carrier	302,402	
shaft	303,403A,403B	
rotation damping element	304,404A,404B	
sun gear	305,405	
toothed rack	306,406	
blocking slide	307,407A,407B	

blocking discs	408A,408B
axes	309,409
planetary gears	310,410
housing	311,411

What is claimed is:

1. An injection device for accommodation and activation of a carpule (111) or hypodermic syringe (211) with an injection needle, and incorporating components whose relative movement effects the sequence of injection of the active substance, for which purpose a receptacle (103, 203), into which the carpule/syringe (111, 211) is insertable and in which it is fixable, is supported inside a housing (101, 201), and said receptacle (103, 203) is displaceable by means of a carriage (108, 208), and mounted in the receptacle (103, 203) in a manner so as to be displaceable is a ram (104, 204), which actuates the piston(s) (111A,111B; 211) of the carpule/syringe, and wherein a traction cable (114, 214) is provided for carrying out the puncture stroke, injection stroke and a retraction stroke, which is deflected by means of a roller (109, 209) that is mounted on the carriage (108), one end of which is connected to the receptacle (103, 203) and the other end of which is connected to a tension spring (110, 210), the latter being supported on the housing (101, 201), wherein automatically and/or manually activated devices between the housing (101, 201), receptacle (103, 203), ram (104, 204) and carriage (108, 208) control their alternating coupling to the traction cable (114, 214) and thereby the progression of puncture stroke, injection stroke and retraction stroke, characterized in that the devices include at least one means for adjustment of the progression profile of at least one of the strokes by the user.

2. An injection device according to claim 1, wherein the traction cable (114, 214) pulls the receptacle (103,203) with the carpule/syringe and pulls the injection needle out of the puncture site via the carriage (108,208) and roller (109,209) during the retraction stroke following the injection stroke, characterized in that the duration of a movement-free state of the carpule/syringe between the injection stroke and retraction stroke (idle stroke HX), during

which the injection needle remains in the insertion site, is adjustable at the housing (101,201) by means of at least one first means.

3. An injection device according to claim 1, wherein devices are provided for coupling the ram (104, 204) to the receptacle (103, 203), which couple the ram (104, 204) to the receptacle (103, 203) for carrying out the puncture stroke and uncouple it for carrying out the injection stroke, characterized in that the duration between the beginning and end of the movement of the ram (104, 204) in the receptacle (103, 203) and thereby the duration of the injections stroke (H2) is adjustable by means of at least one second means.

4. An injection device according to claim 2 or 3, characterized in that the first and/or second means includes a displaceably supported toothed rack (140,240,241).

5. An injection device according to claim 2 or 3, characterized in that the first and/or second means includes at least one damping element (150,250,251) that is actuatable from an associated toothed rack (140,240,241).

6. An injection device according to claims 4 and 5, characterized in that the duration of the effect of the damping element (150,250,251) is adjustable at the housing via a portion of the associated stroke (HX,H2) by means of positioners (130,230,231) that effect the displacement of the associated toothed rack (140,240,241) between two end positions.

7. An injection device according to claim 6, characterized in that the damping element has a damping characteristic that is adjustable at the housing.

8. An injection device according to claim 5, characterized in that the damping element is a rotation damping element (304,404A,404B) having a gear wheel on its shaft that is acted upon by a toothed rack (140,240,241).

9. An injection device according to claim 8, characterized in that there is disposed between a rotation damping element and its toothed rack a gear mechanism.

10. An injection device according to claim 9, characterized in that the gear mechanism is a planetary gear (300), whose sun gear (305) is rigidly connected to the shaft (303) of the rotation damping element (304), whose annulus gear (301), which is freely rotatable on the shaft (303) and in which planet gears revolve, intermeshes with the toothed rack, and whose planetary carrier (302), which freely rotates on the shaft (303), can be put into engagement with a user-activated blocking slide (307), wherein the same prevents the rotation of the planetary carrier (302).

11. An injection device according to claim 10, characterized in that two rotation damping elements (404A,404B) are held on shafts (403A,403B) that are disposed concentrically to each other, wherein the first shaft (403A) is rigidly connected to a first blocking disk (408A) and to the sun gear (405), and the annulus gear (401) freely rotates about this first shaft (403A), wherein the second shaft (403B) is rigidly connected to the planetary carrier that is designed so as to form the second blocking disk (408B), and that a user-adjustable blocking element can alternatively block the rotation of one of the two blocking discs (408A,408B).

12. An injection device according to claim 1, characterized in that when a carpule (111) is used, the puncture stroke is preceded by a mixing stroke.