Sept. 2, 1958 J. HÖVEL 2,850,002

DECOMPRESSION DEVICE

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FIG. 1

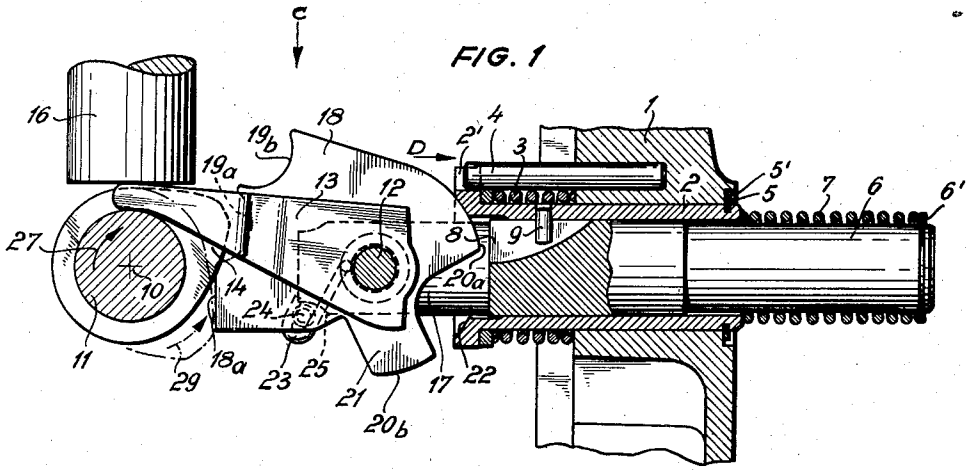



FIG. 2

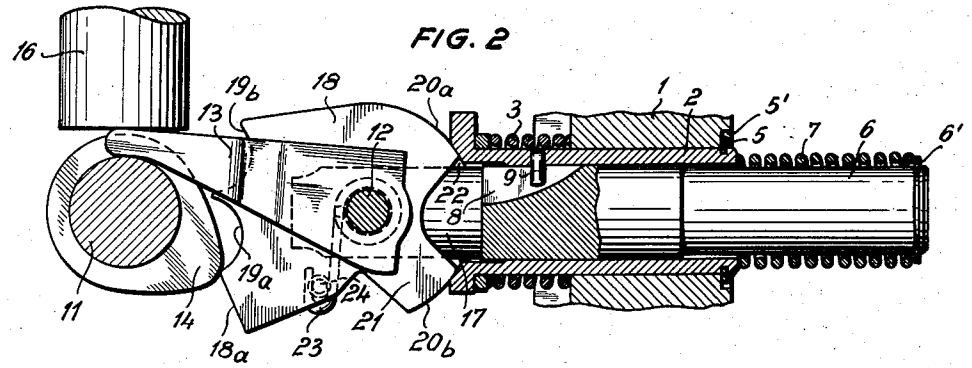
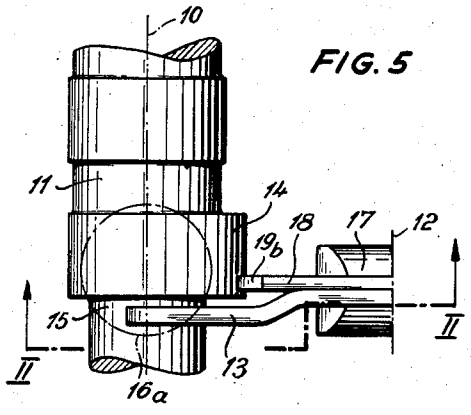



FIG. 5

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DECOMPRESSION DEVICE

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FIG. 6

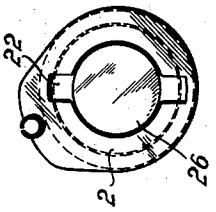


FIG. 3

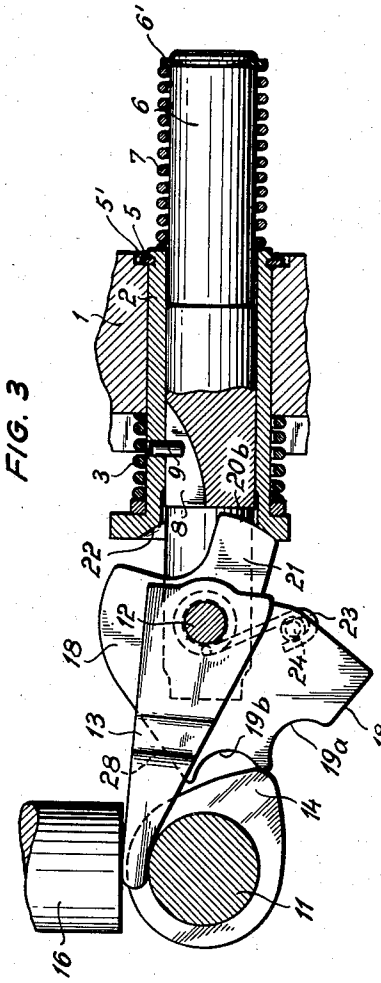


FIG. 4

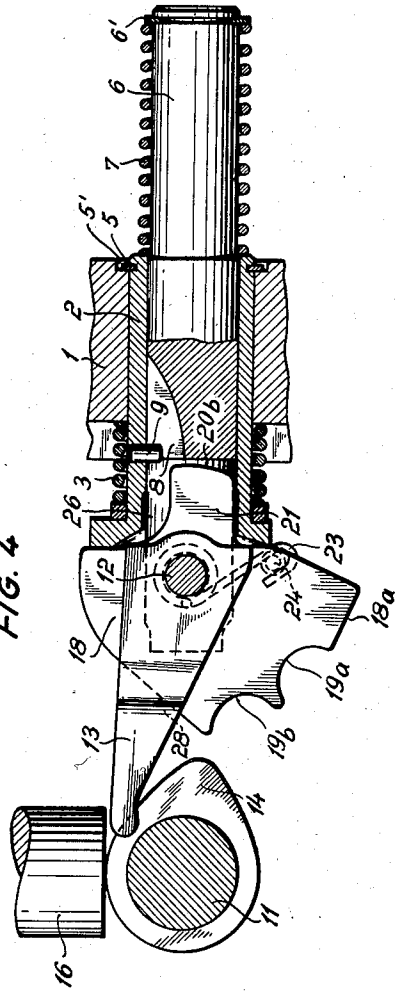


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FIG. 7

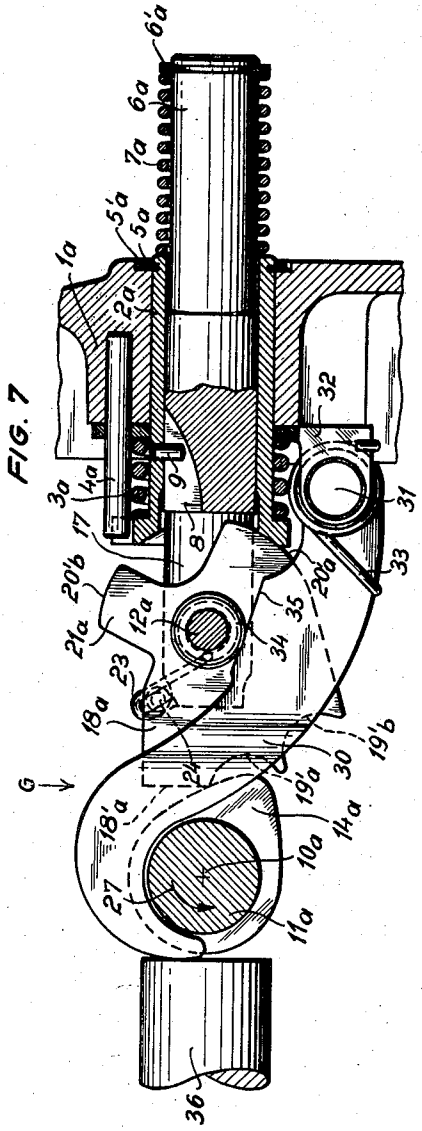


FIG. 8

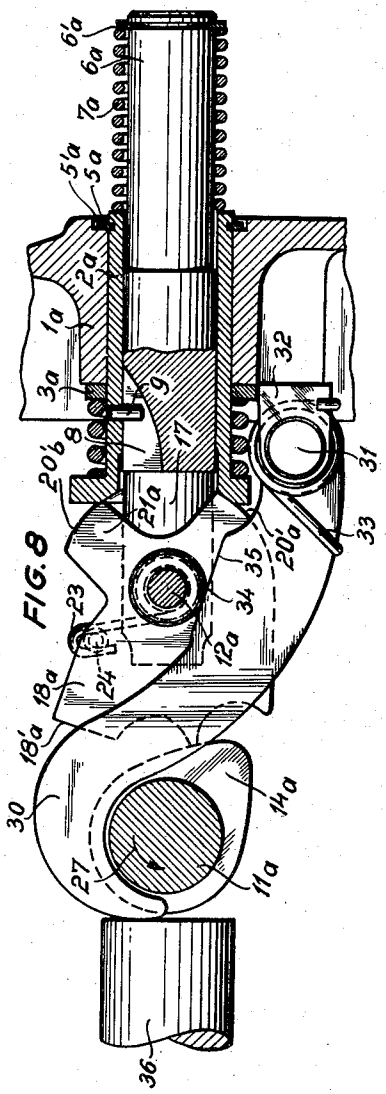


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FIG. 10

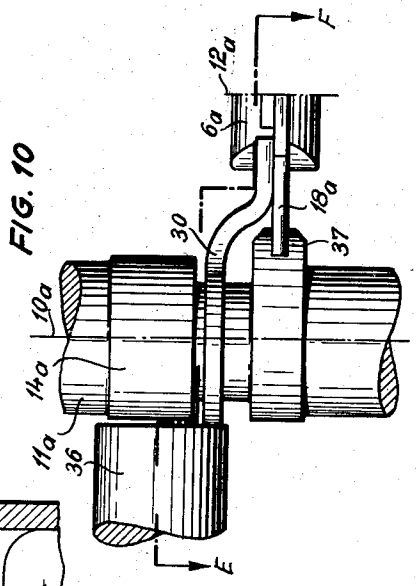
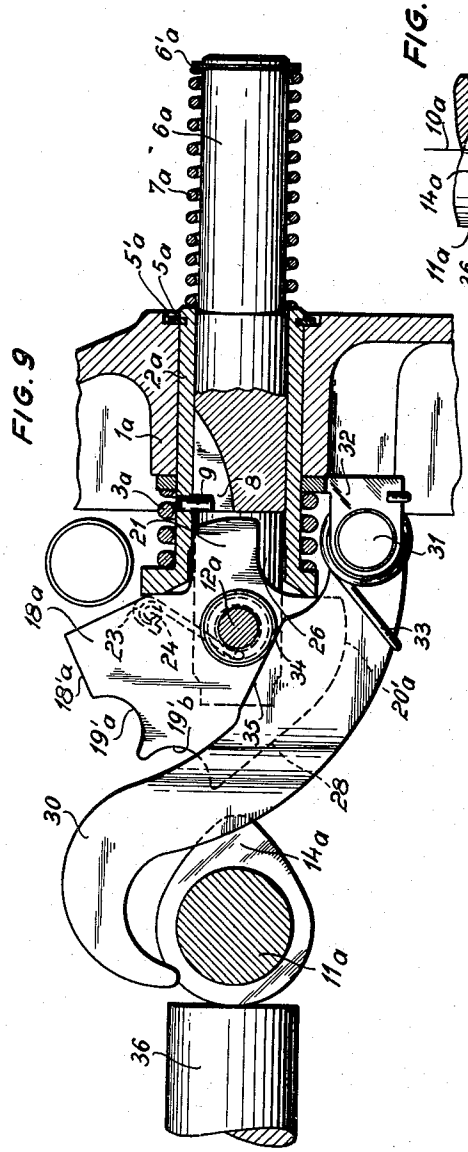



FIG. 9

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United States Patent Office 2,850,002 Patented Sept. 2, 1958



2,850,002

# DECOMPRESSION DEVICE

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Application December 27, 1955, Serial No. 586,412

Claims priority, application Germany December 30, 1954

14 Claims. (Cl. 123—182)

The present invention relates to a decompression device for internal combustion engines for use in connection with the starting of such engines.

With heretofore known devices of this type, during the first revolutions of the crank shaft of the engine, the inlet or outlet valve or also separate decompression valves pertaining to the individual cylinders are held open by lifting said valves up. Following a certain number of revolutions of the crank shaft during which the internal combustion engine is by means of a starter device brought up to a speed sufficient for obtaining the first ignition, the respective valves are automatically lowered or returned into their operative positions.

With the heretofore known devices of this type, rotatably journaled control shafts are provided which are perpendicular or parallel to the cam shaft and which prior to the starting of the internal combustion engine are manually turned into a position in which the valve opens through the intervention of a radial cam or face cam mounted on the control shaft which cam acts upon any one of the actuating elements for the respective valve as for instance the tappet or the rocker arm. When thereupon the engine is cranked, the control shaft by means of a Geneva cross-like or similar step-wise actuating drive is moved by steps into its inoperative position in which the cam of the control shaft releases the actuating elements of the valve. The drive of the control shaft is effected by means of an abutment pin fixed to the cam shaft.

Heretofore known decompression devices of the above mentioned type have the drawback that one of the directions of rotation of the control shaft has to be blocked in order to prevent a rotation of the control shaft from the operative position into the wrong direction. Furthermore, an accidental starting of the decompression device while the engine is running may easily cause damage to the decompression device and also injure the operator. Moreover, if with the heretofore known decompression devices the operating lever should meet an obstruction, the entire decompression device will break.

It is, therefore, an object of the present invention to provide a decompression device for use in connection with the starting of internal combustion engines, which will overcome the above mentioned drawbacks.

It is another object of this invention to provide a decompression device as set forth in the preceding paragraph, which is fool-proof and cannot be actuated in a manner which might cause damage to the device.

It is still another object of this invention to provide a decompression device for use in connection with the starting of internal combustion engines, in which the manual actuation of the device can be effected in one direction only.

A still further object of this invention consists in the provision of a decompression device of the above mentioned type, in which the starting of the decompression device even when the engine is running will not cause any damage to the engine nor injury to the operator.



It is also an object of this invention to provide a decompression device of the type above referred to, in which the decompression device will automatically remain ineffective if the actuating means for the decompression device should meet an obstruction.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawings, in which:

Figs. 1 to 6 show one embodiment of a decompression device according to the invention while Figs. 7 to 10 show another embodiment of the present invention.

More specifically, Figs. 1 to 4 show at the right side thereof a longitudinal section through the actuating bolt arranged perpendicular to the cam shaft, while the left portions of Figs. 1 to 4 illustrate a section along the line II—II of Fig. 5 but different stages of the decompression mechanism.

Fig. 5 is a partial view of Fig. 1 seen in the direction of the arrow C of Fig. 1.

Fig. 6 is a view of an individual part seen in the direction of the arrow D of Fig. 1.

Figs. 7 to 9 show on the right-hand sides thereof sections through the actuating bolt, while the left-hand sides of Figs. 7 to 9 represent sections taken along the line E—F of Fig. 10 but illustrate the different positions of the decompression mechanism.

Fig. 10 is a partial view of Fig. 7 seen in the direction of the arrow G of Fig. 7.

*General arrangement*

In contrast to the heretofore known decompression devices, the decompression device according to the present invention is, instead of having a rotatably adjustable control shaft, provided with a manually axially operable bolt which is displaceable against the thrust of a spring in a direction perpendicular to the cam shaft. The said bolt is displaceable in the casing in axial direction only but is not rotatable. This bolt, when being moved toward the cam shaft against the thrust of a spring, causes a wedge-shaped finger to move between the valve tappet and that cylindrical portion of the cam shaft which is located directly adjacent to the cam pertaining thereto whereby the tappet is lifted off from its cam. Naturally, the diameter of the tappet or its width in axial direction of the cam shaft must be wider than the width of the cam in order that it can be engaged by the wedge-shaped finger interposed between the respective tappet and that cylindrical portion of the cam shaft which is adjacent to the respective cam.

The bolt is provided with a locking or ratchet mechanism which becomes effective after a certain stroke of the bolt to thereby prevent the spring acting upon the bolt from returning the bolt to its starting position. This locking or ratchet mechanism is by means of an abutment provided on the circumference of the cam shaft, moved by steps until it becomes ineffective. Thereupon, the bolt by means of the spring is moved away from the cam shaft and withdraws the wedge-shaped finger from between the ratchet and the cam shaft, whereupon the valve is actuated in conformity with the design of the cam.

While with the heretofore known decompression devices one of the directions of rotation of the control shaft has to be blocked in order to prevent the control shaft from being turned in the wrong direction when the decompression device is to be made ineffective, the displacement of the bolt according to the present invention into ineffective position is possible only in one direction. Furthermore, if accidentally the decompression device according to the present invention were made effective while the engine is running, this would not do any harm

to the mechanism nor to the operator. Another advantage of the present invention consists in that if the control bolt were to meet some obstruction, the device would not break but the compression would be merely delayed until such obstruction has been eliminated. It should be noted that with the heretofore known decompression devices the control shaft is automatically actuated by the cam shaft, whereas according to the present invention the cam shaft moves the locking or ratchet mechanism only which locks the control bolt until the decompression mechanism has been made ineffective. In other words the return of the bolt to its inoperative position is effected solely by a spring associated therewith but not by the cam shaft. Provided that the construction and arrangement of the internal combustion engine will permit, the simplest construction of the decompression device according to the present invention, is obtained when the axis of the control bolt is offset relative to the axis of the valve tappet pertaining thereto by 90° about the cam shaft axis and when the wedge-shaped finger is directly connected to the control bolt. In order to compensate for any inaccuracies in the installation of the journalling of the bearings for the cam shaft and the control bolt, which inaccuracies might otherwise affect the position between the wedge-shaped finger and the valve tappet pertaining thereto thus affecting the decompression stroke, the wedge-shaped finger is preferably connected to the control bolt so as to be rotatable about an axis which is perpendicular to the axis of the bolt but parallel to the axis of the cam shaft.

With internal combustion engines in which the arrangement of the bolt relative to the valve tappet in the manner described above is not possible, in other words, where the axis of the bolt is to be offset with regard to the axis of the valve tappet by more than 90° about the axis of the cam shaft, the wedge-shaped finger is bent in such a way that it catches around the cam shaft in a hook-like manner. In this instance the wedge-shaped finger is not rotatably journalled on the bolt but about a stationary axis. The tilting of said finger is effected by means of a pin inserted into the bolt perpendicular to the axis of the bolt and through the intervention of a roller which, when the bolt is displaced, presses upon the edge of the finger.

*Structural arrangement*

Referring now to the drawings in detail and Figs. 1 to 6 thereof in particular, the arrangement shown therein comprises an engine casing **1** having journalled therein a sleeve **2** which is continuously urged toward the left with regard to Fig. 1 by means of a spring **3**. However, the sleeve **2** can be moved toward the right against the thrust of spring **3**. A pin **4** supported by the stationary engine casing **1** engages a notch **2'** in the flange of the sleeve **2** so as to prevent the sleeve **2** from effecting any rotation in either direction. It will be appreciated that actually the pin **4** and notch **2'** are located outside the plane of drawing but are shown in this plane only for purpose of clarity. The leftward movement of the sleeve **2** is limited by a spring ring **5** mounted in a groove of the sleeve **2** and arranged to abut a cutout **5'** in the engine casing **1**.

Mounted within the sleeve **2** is a control bolt **6**. The control bolt **6** is provided at its right-hand end with a groove which is engaged by a spring ring **6'**. Interposed between the spring ring **6'** and the adjacent end of the sleeve **2** is a spring **7** which continuously urges the bolt **6** into Fig. 4 position, i. e. into its outermost right-hand position. The bolt **6** is, however, movable toward the left against the thrust of spring **7**. A rotative movement of bolt **6** within the sleeve **2** is prevented by a pin **9** extending into an axial groove **8** provided in the bolt **6**. The front end of the bolt **6** carries a shaft **12** upon which is tiltably mounted a wedge-shaped finger **13**. The shaft **12** is parallel to the axis **10** of the cam shaft **11**. As will be evident from Figs. 1 to 3, when the control bolt **6** moves toward the cam shaft **11**, the finger **13** will slide between the valve tappet **16** and that cylindrical portion of the cam shaft **11** which is directly adjacent to the cam **14** normally cooperating with the tappet **16**.

Also rotatably mounted on the shaft **12** is a ratchet disc **18** which is movable in a slot **17** of the bolt **6**. This ratchet disc has that portion of its circumference which is adjacent the cam shaft **11**, provided with recesses **19***a* and **19***b* adapted to be engaged by the cam **14** when the bolt **6** occupies its innermost position. The rear circumferential portion **20***a* of the ratchet disc **18** and the circumferential portion **20***b* of a nose **21** pertaining to the ratchet disc are arched along circles having their center of curvature located on the axis of rotation of the ratchet disc, said axis of rotation coinciding with the axis of the shaft **12**. The sleeve **2** has a cutout **22** with an arched bottom the center of curvature of which bottom is likewise located on the axis of rotation of the ratchet disc **18**. As will be seen from Fig. 6, however, the width of this cutout is somewhat greater than the width of the ratchet disc **18**. A bending spring **23** continuously urges the ratchet disc **18** to turn in clockwise direction. The bending spring **23** is centered at the shaft **12** of the ratchet disc **18** and is connected on one hand with a bent end of the bolt **6** and on the other hand to a pin **24** which is inserted into the ratchet disc **18**. The pin **24** acts as abutment for the ratchet disc **18** inasmuch as it rests against an abutment surface **25** of the bolt **6** as is clearly shown in Fig. 1.

*Operation*

Operation of the device is as follows: prior to the starting of the internal combustion engine, the decompression device occupies its rest position shown in Fig. 4. In this rest position, the bolt **6** due to the spring **7** occupies its right-hand outermost position. The wedge-shaped finger **13** is withdrawn from between the cam shaft **11** and the valve tappet **16**. The ratchet disc **18** is held in the position shown in Fig. 4 by means of the nose **21** against the thrust of the bending spring **23**, said nose extending into the guiding bore **26** of the sleeve **2** for the control bolt **6**. The circumferential portion of the ratchet disc **18** with the ratchet cutouts **19***a* and **19***b* is in this position outside the range of movement of the cam **14**.

Prior to starting the internal combustion engine, the decompression device is put into action by displacing the bolt **6** from the outside, for instance manually against the thrust of the spring **7**. As soon as during this displacement, the nose **21** of the ratchet disc **18** leaves the guiding bore **16**, the ratchet disc **18** due to the bending spring **23** jumps into the position shown in Fig. 1 and determined by the pin **24**. The wedge-shaped finger **13** then occupies a position between the cam shaft **11** and the valve tappet **16** and lifts the valve tappet **16** to such an extent that the respective valve pertaining thereto is open. During the first revolution of the cam shaft in the direction indicated by the arrow **27**, the cam **14** enters the ratchet cutout **19***a* of the disc **18** and moves the latter in counter-clockwise direction into the position shown in Fig. 2. In this position, similar to the starting position, the ratchet disc **18** is locked against the thrust of the bending spring **23**. This locking is effected by the friction between the arcuate circumferential portions **20***a* and **20***b* and the arcuate bottom of the cutout **22** in the sleeve **2**. The force for producing this friction is furnished by the spring **7** which tends to pull the control bolt **6** and thereby the disc **18** outwardly, i. e. toward the right with regard to the drawings. This locking arrangement simultaneously prevents spring **7** from withdrawing finger **13** from between the tappet **16** and cam **14**. The position of the bolt **6** and thus of the wedge-shaped finger **13** is not changed during the advancing movement of the disc **18**. Inasmuch as the shape of the cam **14** is not in conformity with the cutouts **19***a* and **19***b*, the depth of the cutouts **19***a* and **19***b* is so selected that the cam **14** when carry-

ing out its rotative movement will when engaging the cutouts **19***a*, **19***b* hit the bottom of said cutouts. The minor increase required in this connection in the distance between the cam shaft axis **10** and the axis of rotation of the ratchet disc **18** is obtained by the displacement of the bolt **6** together with the sleeve **2** against the thrust of the spring **3**.

With the next revolution of the cam shaft **11**, the cam **14** enters the cutout **19***b* and rotates the ratchet disc **18** into the position shown in Fig. 3. During this rotation, the position of the bolt **6** and thus of the wedge-shaped finger **13** still remains the same. The ratchet disc **18** is locked due to the fact that the circumferential surface **20***b* of its nose **21** is pressed against the arcuate surface of the cutout **22**. During the next following revolution of the cam shaft **11**, the cam **14** hits upon the outer surface **28** of the ratchet disc **18** and rotates the same in counter-clockwise direction by a further distance. Now the nose **21** of the ratchet disc **18** arrives in front of the mouth of the guiding bore **26** so that the abutment effect of the ratchet disc **18** for the bolt **6** is eliminated. Consequently the bolt **6** together with the wedge-shaped finger **13** and the ratchet disc **18** is returned to its starting position of Fig. 4 by the spring **7**. The operation of the valve tappet **16** is now effected in conformity with the design of the cam **14**.

The diameter of the valve tappet **16** is shown in Fig. 5 by a dot dash line and is designated with the reference numeral **16***a*. As will be evident from Fig. 5, the diameter of the valve tappet **16** is greater than the width of the cam **14** in axial direction. This arrangement makes it possible to crank the front portion of the finger **13** so as to allow the same to catch beneath the tappet **16**.

The yieldable journalling of the sleeve **2** has the advantage that the decompression device according to the invention cannot be damaged when the internal combustion engine is cranked in the wrong direction. The wrong direction of rotation is indicated in Fig. 1 by the arrow **29**. In this instance the cam **14** hits upon the plane front edge **18***a* of the ratchet disc **18** and moves the same together with the bolt **6** and sleeve **2** toward the outside against the thrust of spring **3**.

Referring now to the embodiment shown in Figs. 7 to 10, the arrangement illustrated therein is very similar to that described in connection with Figs. 1 to 6 and, therefore, similar parts in the arrangement of Figs. 7 to 10 have been designated with the same numerals as in the embodiment of Figs. 1 to 6 however, with the additional character *a*. The arrangement of Figs. 7 to 10 differs from that of Figs. 1 to 6 primarily in that the ratchet disc **18***a* has been inserted into the bolt **6***a* so that the nose **20***a* points upwardly. The wedge-shaped finger **30** has the shape of a hook and is journalled in a bearing yoke **32** so that its axis of rotation **31** is parallel to the cam shaft axis **10***a*. This bearing yoke is slipped over the sleeve **2***a* and is pressed by means of the spring **3***a* against the casing **1***a* of the internal combustion engine. The wedge-shaped finger **30** is continuously acted upon by a coiled bending spring **33** which continuously urges the finger **30** to move in clockwise direction with regard to Fig. 7. The bearing shaft **12***a* of the ratchet disc **18***a* carries a roller **34** which is engaged by the edge **35** of the wedge-shaped finger **30**. When the bolt **6***a* is moved inwardly, i. e. toward the left with regard to Fig. 7, the roller **34** tilts the finger **30** in counter-clockwise direction with regard to Fig. 7 so that the tip of the hook-shaped finger passes beneath the valve tappet **36** and lifts the valve. The sections **20'***a* and **20'***b* in the arrangement of Figs. 7 to 10 correspond to the sections **20***a* and **20***b* in the arrangement of Figs. 1 to 6. All other parts in the arrangement of Figs. 7 to 10 correspond to those of the arrangement of Figs. 1 to 6.

*Operation of the embodiment of Figs. 7 to 10*

The arrangement of Figs. 7 to 10 operates in the same manner as that described in connection with Figs. 1 to 6. However, the intermediate position corresponding to that of Fig. 3 and appearing between Fig. 8 and Fig. 9 positions has not been shown. Furthermore, in contrast to the operation of the device of Figs. 1 to 6, with the arrangement of Figs. 7 to 10, the movement of the ratchet disc **18***a* is not effected by the cam **14***a* of the valve tappet **16** but by a small auxiliary cam **37** (Fig. 10) which is congruent to the cam **14** and is ground simultaneously therewith. As will be evident from Fig. 10, also the finger **30** has its front end offset.

The arrow **27** in Fig. 7 indicates the direction of rotation of the cam shaft **10***a* which direction of rotation is opposite to that of cam shaft **10** of Figs. 1–5.

A comparison of the arrangement shown in Figs. 1 to 6 with that of Figs. 7 to 10 will show that the same type of structural elements have been employed to a great extent. This has the advantage that the arrangement according to the invention, by using the same type of elements and by installing the same in a different way while exchanging a few parts, can easily be adapted to different designs of engines and can be employed for both directions of rotation of the cam shafts. This fact is highly beneficial with regard to the stocking up of parts for engines of different series. Furthermore, due to the fact that a great number of the same parts can be used for the embodiment of Figs. 1 to 6 and for the embodiment of Figs. 7 to 10, the cost of production is considerably reduced.

It is, of course, understood that the present invention is, by no means, limited to the specific constructions shown in the drawings but also comprises any modifications within the scope of the appended claims.

What is claimed is:

1. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, lifter means carried by said control member and arranged in response to the movement of said control member into said operative position to move between said valve element and said cam shaft thereby moving said valve element away from said cam shaft to thereby prevent actuation of said valve element by said cam shaft, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

2. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, spring means continuously urging said control member into its ineffective position, lifting means carried by said control member and arranged in response to the movement of said control member into said operative position to enter between said cam shaft and said valve element to move the latter away from said cam shaft thereby preventing actuation of said valve element and control means including locking means associated

with said control member and arranged in cooperation with said spring means and is responsive to the movement of said control member into its operative position to maintain said control member in said operative position, said control means including a rotatable element arranged for actuation by said cam means when said control member occupies its operative position, said control means being adapted in response to a certain number of rotations of said cam shaft following the first actuation of said rotatable element by said cam means to make said locking means ineffective thereby allowing said spring means to return said control member into its ineffective position while simultaneously withdrawing said lifting means from between said cam shaft and said valve element.

3. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said cam shaft, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, ratchet means supported by said control member and being rotatable about an axis substantially parallel to the axis of rotation of said cam shaft, said ratchet means being movable into the range of said cam means in response to the movement of said control member into its operative position and when in range of said cam means being successively rotatable thereby by certain angles respectively in response to a plurality of rotations of said cam means, lifting means carried by said control member and arranged in response to the movement of said control member into said operative position to enter between said cam shaft and said valve element for moving the latter away from said cam shaft to thereby prevent actuation of said valve element, and means associated with said control member and responsive to a certain rotation of said lifting means to automatically withdraw said lifting means from between said valve element and said cam shaft to thereby allow the latter to actuate said valve element while simultaneously returning said control member to its ineffective position.

4. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, the direction of movement of said control member being substantially perpendicular to the axis of movement of said valve element, a substantially wedge-shaped lifting finger carried by said control member and tiltable about an axis substantially parallel to the axis of rotation of said cam shaft, said finger being arranged in response to the movement of said control member into said operative position to enter between said cam shaft and said valve element thereby moving said valve element away from said cam shaft and preventing the same from actuating said valve element, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps through a certain angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said certain angle for returning said control member to its inoperative position while simultaneously withdrawing said lifting finger from between said valve element and said cam shaft to thereby allow said valve element to return to its normal position for actuation by said cam shaft.

5. A device according to claim 1, in which said lifter means is tiltable about an axis transverse to the direction of movement of said control member and parallel to the axis of rotation of said cam shaft.

6. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, the direction of movement of said control member and the direction of movement of said valve element forming with each other an angle greater than 90°, stationary supporting means arranged adjacent said control member, a stud supported by said stationary supporting means, a lifting member tiltably supported by said stud and having a hook-shaped end, spring means associated with said lifting member and continuously urging said hook-shaped end of said lifting member into ineffective position out of engagement with said valve element, roller means supported by said control member and operable in response to the movement of said control member into operative position to engage said lifting member and to force said hook-shaped end between said cam shaft and said valve element while moving the latter away from said cam shaft thereby preventing said cam shaft from actuating said valve element, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously moving said roller means into a position to allow said spring means to lift said hook-shaped end out from between said cam shaft and said valve element to thereby allow normal actuation of said valve element by said cam shaft.

7. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a stationary casing, guiding means slidably mounted in said casing, yieldable means continuously urging said guiding means in the direction toward said cam shaft, a control bolt movable in said guiding means in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, that end of said bolt which is adjacent said cam shaft being provided with an axial slit having its open sides confined to a considerable extent by said guiding means when said bolt is in its ineffective position, stud means extending transverse through said slit and in a direction parallel to the axis of rotation of said cam shaft, a control disc rotatably supported by said stud means and provided with a nose adapted when said bolt is in its ineffective position to extend into that portion of said slit the open sides of which are confined by said guiding means, said disc also being provided with cutouts adapted to be moved into the range of said cam means for successive engagement with said cam means during successive rotation of said cam means, spring means associated with said disc and arranged in response to the movement of said bolt into operative position to move said nose out of said slit while moving said cutouts into the range of said cam means, said disc being provided with arcuate edge portions having their center of curvature located on the axis of said stud means, said guiding means being provided with an arcuate surface corresponding to the arcuate edge portions of said disc, wedge-shaped finger means tiltably supported by said bolt

and operable in response to the movement of said bolt into operative position to enter between said valve element and said cam shaft for moving said valve element away from said cam shaft to prevent actuation of said valve element by said cam shaft, said disc being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means and engagement of the latter with said cutouts through a predetermined angle while said disc is temporarily held at the end of each step in its respective position by frictional engagement of said arcuate edge portions with the arcuate surface of said guiding means until said nose is in alignment with said slit, and additional spring means associated with sad bolt and automatically returning said bolt to its ineffective position when said nose following the movement of said disc through said predetermined angle faces said slit.

8. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, stud means carried by said control member and having its axis parallel to the axis of rotation of said cam means, wedge-shaped lifter means tiltably mounted on said stud means and arranged in response to the movement of said control member into said operative position to move said valve element away from said cam shaft to thereby prevent actuation of said valve element by said cam shaft, control disc means rotatably mounted on said stud means and arranged for actuation by said cam means in response to said control member occupying its operative position, said control disc means being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control disc means through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

9. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, yieldably mounted guiding means serving as bearing and guiding means for said control member, lifter means carried by said control member and arranged in response to the movement thereof into said operative position to move said valve element away from said cam shaft to thereby prevent actuation of said valve element by said cam shaft, a control disc supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control disc being movable by said cam means in steps through a predetermined angle by a plurality of successive revolutions of said cam shaft, said control disc and said guiding means having arcuate surface areas of the same diameter arranged for frictional enagement with each other at the end of each of said steps for frictionally maintaining said control disc in its respective position, and means responsive to the movement of said control disc through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

10. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, lifter means carried by said control member and arranged in response to the movement of said control member into said operative position to move said valve element away from said cam shaft to thereby prevent actuation of said valve element by said cam shaft, stud means extending through said control member and having its axis parallel to the axis of rotation of said cam shaft, a control disc rotatably mounted on said stud means and arranged for actuation by said cam means in response to said control member occupying its operative position, spring means associated with said control disc and arranged continuously to urge said control disc to rotate into position for engagement with said cam means, abutment means associated with said control member to limit said last mentioned rotative movement of said control disc, said control disc being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means in a direction opposite to said rotative movement by said spring means, and means responsive to the movement of said control disc through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

11. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, lifter means carried by said control member and arranged in response to the movement of said control member into said operative position to move between said valve element and said cam shaft to thereby prevent actuation of said valve element by said cam means, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

12. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for actuating said valve element, said valve element protruding laterally beyond said cam means, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, lifter means carried by said control member and arranged in response to the movement of said control member into said operative position to move between said laterally protruding portion of said valve element and the adjacent cam shaft portion to move said valve element away from said cam means to thereby prevent the latter from actuating said valve element, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps

through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft.

13. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: first cam means fixedly connected to said shaft for actuating said valve element, second cam means fixedly connected to said shaft for rotation therewith and located laterally of said valve element and said first cam means, a control member movable in a direction perpendicular to the axis of rotation of said cam shaft from an ineffective position into an operative position and vice versa, wedge-shaped lifter means carried by said control member and arranged in response to the movement of said control member into said operative position to move said valve element away from said first cam means to prevent the latter from actuating said valve element, control means supported by said control member and arranged for actuation by said second cam means in response to said control member occupying its operative position, said control means being movable in steps through a predetermined angle by a plurality of successive revolutions of said second cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously withdrawing said lifter means from between said valve element and said cam shaft and withdrawing said control means from engagement with said second cam means.

14. In a device for moving a valve element of an internal combustion engine away from the rotatable cam shaft normally cooperating therewith, for decompressing said engine while it is being started, the combination of: cam means fixedly connected to said shaft for rotation therewith, a casing, a sleeve yieldably mounted in said casing, a control member movably mounted within said sleeve and movable in a direction perpendicular to the axis of rotation of said cam shaft from an inoperative position into an operative position and vice versa, supporting means mounted on said sleeve, stud means supported by said supporting means, a hook-shaped lever tiltably supported by said stud means, spring means associated with said lever continuously urging said lever away from said valve element and said valve shaft, roller means supported by said control member and arranged in response to the movement of said control member into operative position to engage and move the hook-shaped end of said lever between said cam shaft and said valve element while simultaneously lifting said valve element away from said cam shaft to thereby prevent said cam shaft from actuating said valve element, control means supported by said control member and arranged for actuation by said cam means in response to said control member occupying its operative position, said control means being movable in steps through a predetermined angle by a plurality of successive revolutions of said cam means, and means responsive to the movement of said control means through said predetermined angle for returning said control member to its inoperative position while simultaneously allowing said spring means to withdraw said lever from between said valve element and said cam shaft so as to allow normal actuation of said valve element.



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