March 4, 1930. F. MÜLLER 1,749,152

STARTING MECHANISM FOR INTERNAL COMBUSTION ENGINES

Original Filed March 25, 1921

Fig. 1

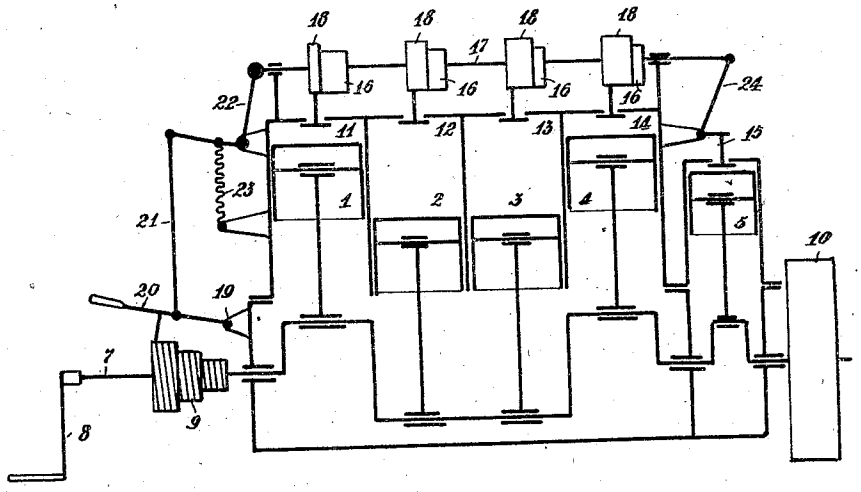
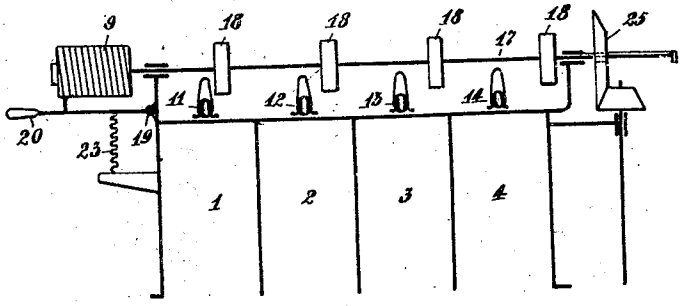


Fig. 2



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UNITED STATES PATENT OFFICE

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STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES

Original application filed March 25, 1921, Serial No. 455,575, now Patent No. 1,570,914, and in Austria May 4, 1918. Divided and this application filed July 15, 1925. Serial No. 43,855.

I have filed applications for this patent as follows: Austria, May 4, 1918, granted Dec. 12, 1921, No. 87,605; Sweden, June 28, 1920, not yet accepted; Norway, June 29, 1920, granted June 11, 1923, No. 37,805; France, July 9, 1920, granted May 9, 1921, No. 524,200; Germany, July 10, 1920, granted Oct. 17, 1922, No. 366,411; Denmark, July 13, 1920, granted Aug. 22, 1924, No. 33,615; Hungary, Sept. 11, 1920, granted Oct. 23, 1923, No. 84,926; Czechoslovakia, Oct. 9, 1920, granted June 25, 1923, No. 11,078; Switzerland, Oct. 9, 1920, granted Oct. 15, 1922, No. 97,307; Poland, Dec. 9, 1920, not yet accepted; Holland, Jan. 26, 1921, granted Apr. 16, 1924, No. 11,247; Belgium, Mar. 5, 1921, granted May 5, 1921, No. 294,486; Italy, Mar. 29, 1921, granted June 22, 1923, No. 56,262; Spain, Mar. 30, 1921, granted Sept. 19, 1921, No. 77,693; Great Britain, June 2, 1921, granted May 8, 1922, No. 179,839.

The present invention relates to a method of starting internal combustion engines comprising two or more cylinders in which the working cylinders are brought to the normal compression, not at the same time, but at different intervals separately or in groups. The invention consists in this that the transition to the compression pressure required for working is effected automatically. This application is a division of application S. No. 455,575, filed March 25, 1921, now patent No. 1,570,914.

On the drawings:

Fig. 1 is a diagrammatic layout of an internal combustion engine embodying the preferred form of this invention.

Fig. 2 is a fragmentary diagrammatic layout of a slightly modified embodiment of this invention.

In Figure 1 of the accompanying drawing a four-cylinder internal combustion engine with a single-cylinder air pump is shown by way of example. 1, 2, 3 and 4 are the working cylinders and 5 the pump cylinder. On one end of the crank shaft 7 there is a handle 8 and a three-step worm cone 9, which is keyed to the crank shaft so as to rotate with it, but is adapted to slide both ways on the shaft. At the other end of the crank shaft is the flywheel 10. The suction valves of the working cylinders are marked 11 to 14 and the suction valve of the air pump 15. The valves of the working cylinders are operated directly by the cams 16, which are mounted above them on the cam shaft 17, the driving means for which are not shown in the figure. The valve 15 of the air pump 5 is uncontrolled. Next to each cam 16 there is an auxiliary cam 18, which has a greater height than the cams 16 and is adapted, when in engagement, to keep the suction valves either open altogether or at least during the compression period. Above the worm cone there is a hand lever 20, which is pivoted on the pin 19 and is provided with a downwardly directed projection, which engages in the thread of the worm on the cone. The lever 20 is connected by a rod 21 a cranked lever 22, the other end of which is connected to the cam shaft 17 and is adapted to displace the said cam shaft with the cams and auxiliary cams mounted on it. The lever is pressed against the worm by the spring 23 in such a manner that the projection on the lever 20 engages the thread in the worm cone 9.

Before starting the engine the worm cone 9 is displaced on the shaft 7 until the projection on the lever 20 is pressed by the spring 23 into the outermost thread of the largest step on the cone. By this means the cone is prevented from moving freely in the axial direction. In this position of the hand lever 20 the cam shaft 17, with the cams 16 and the auxiliary cams 18 mounted on it, is displaced by the rod 21 and the cranked lever 22 in such a manner that all the auxiliary cams come in contact with the valve spindles 11 to 14 and that the valves are kept open during the compression period in the cylinders as well. The same takes place in consequence of the action of the cranked lever 24 on the suction valve 15 of the air pump 5. On the engine being turned by means of the handle 8, the cone 9 will wind itself axially to the left by one thread at each revolution. On arriving at the end of the largest step of the cone the projection on the hand lever 20 will be released and will drop, owing to the action of the spring 23, into the thread on the middle step

of the cone. By this sudden movement the cam shaft 17, with the cams and auxiliary cams mounted on it, will be suddenly displaced in such a manner that at the valve 11 of the working cylinder 1 the auxiliary cam 18 will come out of engagement and the valve will be controlled by the cam 16. As the auxiliary cams of the other three working cylinders are made wider by a suitable amount than that of the cylinder 1, cylinder 2 will only come into operation after the projection on the hand lever 20 has left the thread on the middle step of the cone and cylinders 3 and 4 after it has left the thread on the smallest step of the cone. The valve 15 of the auxiliary cylinder 5 can be released by the cranked lever 24 at the same time as the suction valve of the first cylinder is released by a suitable proportioning of the lever.

In Fig. 2:—1, 2, 3 and 4 are the working cylinders of a four-cylinder internal combustion engine and 11, 12, 13, 14 the air escape valves, the plugs of which are fitted with short levers. Above the cylinders is an auxiliary shaft 17, which is rotated by a bevel wheel 25 and is adapted to be displaced axially. The bevel wheel 25 is keyed or otherwise mounted on the shaft 17 so that shaft may be displaced axially without movement of the bevel wheel 25. Suitable means may be provided for moving the bevel wheel 25 in the direction of the shaft 17. On the auxiliary shaft 17 there are mounted, for instance, circular stop members 18 for operating the levers of the cock plugs, the said stops being mounted at different distances from the levers in such a manner that, on the auxiliary shaft being axially displaced, only one of the air escape cocks 11, 12, 13 or 14 will be operated at one time. On the left hand end of the auxiliary shaft 17 a cylindrical worm 9 is fixed, in the thread of which a projection on a hand lever 20 mounted below the said worm is adapted to engage. The lever 20 is pivoted on a pin 19 and is pressed against the worm by the spring 23.

Before starting the engine the worm with the stop members is displaced towards the right and the projection on the lever 20 placed in the thread of the worm. On the engine being started, the bevel wheel 25 is rotated by a second bevel wheel, for instance from the crank shaft of the engine, thus causing the shaft 17 to be displaced to the left, along with the stop members 18, by means of the worm. On this movement of the shaft taking place, the lever of the valve plug 11 will first come in contact with the stop member 18, thus causing the air escape cock 11 to close and the cylinder 1 to be put in operation with suitable compression. By continuing this procedure the air escape cocks of the cylinders 2, 3 and 4 are separately closed one after another at suitable intervals. If desired the shaft 17 may be stopped from rotating after all of the working cylinders of the engine have been brought to their normal compression by movement of the bevel gear 25 to the left away from the engagement with its driving pinion with which it is normally engaged.

When starting by means of worm or screw gear it is obvious that for effecting this purpose a conical worm may be used in place of a stepped worm, although the use of the former in place of stepped worms without suitable additional arrangements would have the disadvantage that the closing of the air escape members will not take place suddenly, but gradually, and consequently with a throttling and less of work.

What I claim is:

1. In an internal combustion engine, a number of working cylinders, and means for automatically bringing the working cylinders to their normal compression conditions in a consecutive manner during engine starting comprising air escape means for the cylinders normally closed during operating conditions but adapted to be open to initiate the engine starting operation, mechanism for automatically consecutively closing the air escape means for the various cylinders, and engine driven means for operating said mechanism.

2. In an internal combustion engine, a number of working cylinders, and means for automatically bringing the working cylinders to normal compression conditions in a consecutive manner during the engine starting, comprising air escape means for the cylinders normally closed during operating conditions but adapted to be opened to initiate the engine starting operation, mechanism for automatically consecutively closing the air escape means for the various cylinders and rotatable engine driven means producing rectilinear movement for operating said mechanism.

3. An internal combustion engine comprising a number of working cylinders, air escape means for each cylinder, an engine driven rotatable screw, and rectilinearly movable means operated by said screw for automatically consecutively closing the air escape means for the various cylinders during the starting of said engine.

4. An internal combustion engine comprising a number of working cylinders, air escape means for the various cylinders, rotatable engine driven mechanism, means operated by said mechanism for automatically consecutively closing the air escape means for the various cylinders during the starting operation of said engine, and a device for manually engaging said mechanism with said last named means.

5. An internal combustion engine comprising a number of working cylinders, an auxiliary pump cylinder associated therewith,

air escape means for the working cylinders, compression relieving means for the pump cylinder, rotatable engine driven means for automatically consecutively closing the air escape means for the various working cylinders, and an operating device connected to said means for automatically closing the compression relieving means of the pump cylinder simultaneously with the closing of the air escape means of the last working cylinder that is brought to normal compression.

In witness whereof I have hereunto signed my name.

FRIEDRICH MÜLLER.