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THREE PORT TWO CYCLE ENGINE.

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994,653.

Patented June 6, 1911.

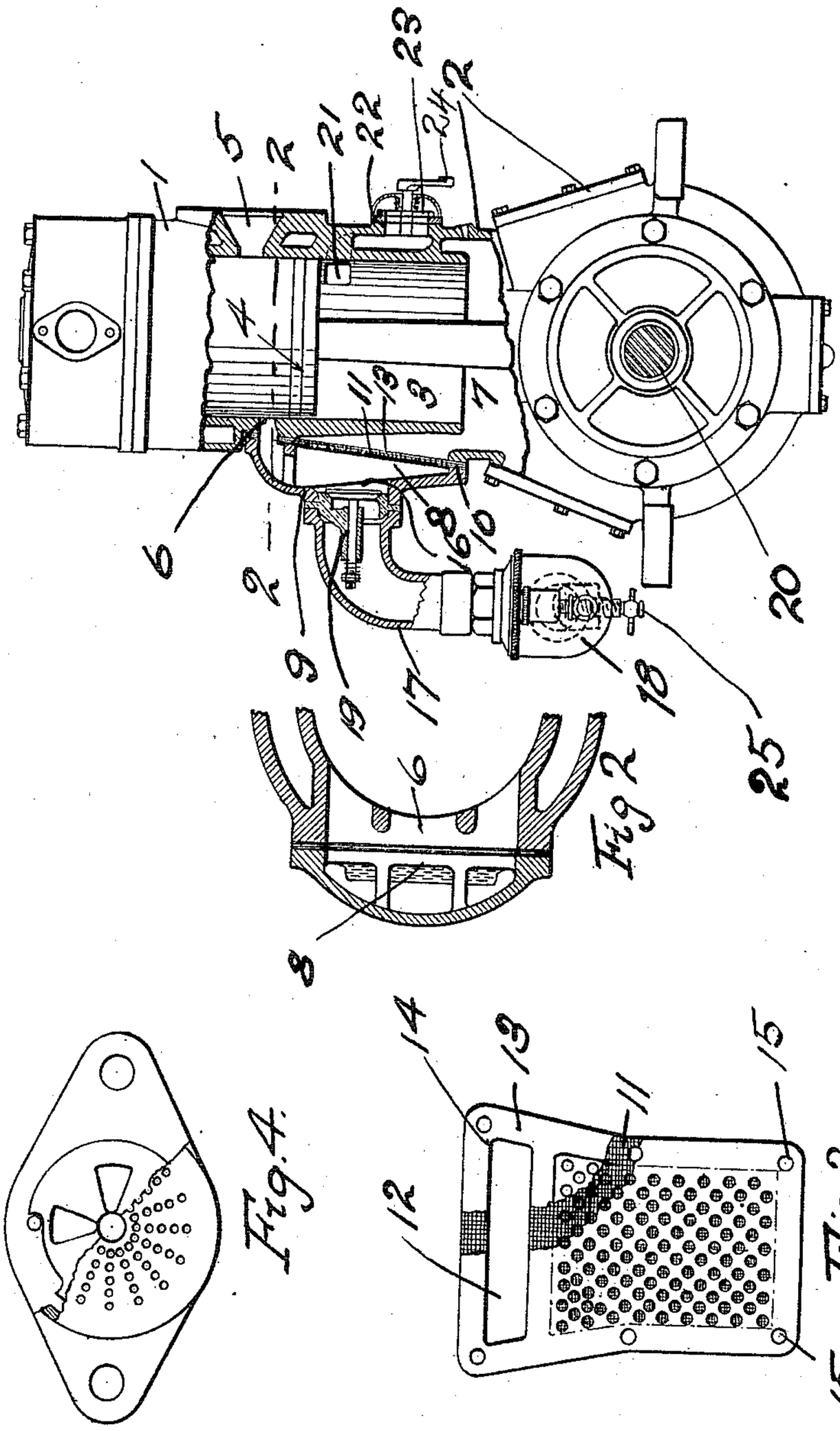

Fig 1

Fig 2

Fig 4

Fig 3

Witness

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THREE-PORT TWO-CYCLE ENGINE.

994,653. Specification of Letters Patent. Patented June 6, 1911.

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To all whom it may concern:

Be it known that I, CHARLES B. PAGE, a citizen of the United States of America, residing at the city of Baltimore, State of Maryland, have invented certain new and useful Improvements in Three-Port Two-Cycle Engines, of which the following is a specification.

This invention relates to two-cycle internal combustion engines in which the charge of air or gas and air is compressed behind the piston, either in the crank case or other compression chamber. In some engines of this type, air is admitted to the compression chamber by means of an opening controlled by a check valve and in others by means of a port in the wall of the engine cylinder which is uncovered by the piston in its extreme forward position. The first of these devices is subject to the defect that there is a loss of pressure due to the action of the spring, *i. e.*, a vacuum has to be maintained inside the crank case to hold the check valve open and the full displacement of the piston is not filled with air at atmospheric pressure. In this way, the charge which is drawn into the compression chamber and thence into the working cylinder is caused to be less than a full charge. There is also a loss of energy in maintaining the vacuum necessary to overcome the resistance of the check valve. The second type, known as the three-port engine, has the defect that it is difficult to start; the engine must be turned almost a complete revolution before a charge is ready to be exploded, and in this operation a high vacuum must be created in the compression chamber before the third port is uncovered. The third port is also objectionable for the reason that if there is any leakage around the crank or piston or through any other channel into the compression chamber, the vacuum therein is largely destroyed before the third port is opened and the carbureted air drawn in when the fuel is thus supplied is not sufficient to turn the engine.

The two-port type, *i. e.*, the type having an opening leading into the compression chamber controlled by a check valve, has the advantage that it is easily started by rocking the crank; in this way, a charge is gradually admitted and compressed to starting pressure. A second advantage of the two-port type is that it will run under adverse conditions, as when there is considerable leakage into the compression chamber. The three-port type has the advantage that the compression chamber is entirely filled with air at atmospheric pressure and there is no check valve, the resistance of which has to be overcome, and no consequent loss of power from this source.

In the engine which embodies my invention, the features of the two types are so combined as to secure the advantages of both and substantially eliminate the defects inherent in each. To accomplish this result and otherwise increase the efficiency and convenience of operation of internal combustion engines is the object of my invention. My engine is of the rear compression type and the crank chamber is supplied with air by two inlet openings. The air admitted at one of these openings passes, first, through the usual carbureter where it becomes mixed with hydrocarbon. Exit of air or gas at this point is prevented by means of a puppet valve, as in the two-port type of engine described. The other opening is in the wall of the cylinder. It is normally covered by the piston and is uncovered thereby in the extreme forward position of the piston. This opening corresponds to the third port of the three-port engine.

The two-port admission to the compression chamber, *i. e.*, that controlled by the check valve, makes it possible to fill the chamber and start the engine by means of a slight rocking. If leaks from the outside air into the compression chamber occur, the engine will still be operative, as the carbureted air is admitted through the check valve and the action of the piston always creates a vacuum which will open the check valve and draw in a sufficient charge through the carbureter during the return stroke of the piston. The third port, when opened, admits air freely to the compression chamber at atmospheric pressure, whereby it is made possible to fill this chamber and deliver a full charge to the combustion chamber at each stroke.

The use of two admission passages to the compression chamber introduces a new set of conditions for which provision must be made. With this and other ends in view, I

have rearranged and modified various details and features of my engine as hereinafter set forth.

Throttling to reduce speed or power can be accomplished most conveniently by varying the volume of air supplied to the carbureter. If this be done, however, the air admitted by the third port so dilutes the mixture that combustion is slow and continues until the transfer passage is open to the compression chamber. In this way, back-firing takes place. To overcome this difficulty, I use a screen, sometimes known as a "back-fire arrester" in the transfer passage. To avoid the necessity of machining this screen to fit the passage, for unless the passage is completely screened, back-firing will not be prevented, I introduce the screen as a gasket between the transfer passage cover and the cylinder body. In this way, all possibility of leaks around the screen is eliminated and the operation of fitting the screen is greatly cheapened and simplified. Throttling may be very efficiently accomplished by closing the third port. For this purpose, as well as for regulating the amount of free air to be admitted to the compression chamber, a shutter valve has been placed in the passage leading to the third port.

A difficulty frequently encountered in the use of screens as back-fire arresters is that they become clogged with lubricating oil splashed up by the crank from the base in which it generally collects in a pool. If some measures are not taken to overcome this tendency, the power of the engine will be so reduced that the screens will have to be taken out and cleaned, thus causing great loss of time and annoyance to the operator. For this reason, I so place my screen and carbureter that heavily carbureted air and atomized hydrocarbon are thrown upon the screen. In this way the lubricant is dissolved and not allowed to collect on the screen.

So much of a two-cycle internal combustion engine as is necessary to illustrate the operation of my invention is shown in the accompanying drawings.

Figure 1 is an elevation of the engine, certain portions of the engine being broken away and exposed parts shown in central sectional elevation. Fig. 2 is a fragmentary horizontal section on the line 2—2 Fig. 1, showing the admission port, transfer passage and a plan view of a part of the screen and a section through the frame of the latter. Fig. 3 is a view of the back-fire arresting screen and its frame, detached. Fig. 4 is a view of the shutter valve which closes the third port.

The engine, as illustrated in Fig. 1, includes a cylinder 1 and a crank case 2. These two members are formed of a single casting. The crank case is closed and with the rear end 3 of the cylinder forms the compression chamber. The usual piston 4 is mounted in the cylinder to slide in the direction of its axis and transmit its motion of reciprocation to the crank shaft 20, whereby the latter is rotated. The cylinder is provided with the usual exhaust port 5 and admission port 6 to be opened and closed by the piston as it covers and uncovers them in its travel. The cylinder is connected to the compression chamber 7 by means of a transfer passage 8. This passage is formed partly in the cylinder walls and partly in a separate casting 9 which will be known as the transfer passage cover. The neighboring surfaces 10 of the cover 9 and the cylinder casting are flat and cross the passage diagonally at an acute angle to the direction of its length. A screen 11 of fine mesh is cut to the shape and size of the flat surfaces 10. This screen is provided with an aperture 12 corresponding to the admission port 6. Two plates 13 perforated as shown and cut away at 14 to register with the opening 12 are placed one on each side of the screen. The plates are bored at 15 to register with corresponding holes in the castings and the plates and screen combined as just described are placed between the cover casting and the cylinder casting, and suitable bolts are placed in the holes 15 and tightened to secure the cover to the cylinder. It will thus be seen that the screen with its supporting plates 13 forms a gasket between the cover casting and the cylinder, and it is so placed in the transfer passage that leakage along the passage and past its edges cannot occur. It will also be observed that this method of placing the screen involves no difficult fitting and machining of the edges of the screen. The transfer passage cover 9 is apertured at a point near the center of its lateral face at 16 and an inlet passage 17 in which is placed a carbureter 18 leads from the outside air to this opening. A puppet valve 19 opening toward the transfer passage is placed in the opening 16, and a suitable throttle valve 25 is placed in the passage beyond the carbureter. Just in the rear of the piston 4 in its forward position is an aperture 21 hereinafter known as a third port in wall of the cylinder. This aperture leads directly from the outside air at 22 to the compression chamber. A shutter valve 23, operated by means of a crank 24, may be operated at will to determine the effective cross-section of the passage or to close the latter.

In the operation of the engine, at the beginning of each forward stroke of the piston 4, the pressure in the compression chamber is reduced owing to the increase in volume. When the pressure within is suffi-

ciently reduced below the atmosphere, the puppet valve 19 is opened and the outside air rushes in through the carbureter 18, taking up a charge of fuel and passes into the compression chamber by way of the transfer passage 8 and through the screen 11. As the piston continues to advance, this inflow of hydrocarbon vapor and air with a certain amount of hydrocarbon atomized, *i. e.*, in the form of spray continues. Spraying of the fuel is caused by the rush of air through the carbureter. When the piston reaches its forward position, as shown in Fig. 1, the third port 21 is opened. It will be noted that in order to maintain the valve 19 open, pressure in the compression chamber must be less than that of the atmosphere. When the third port 21 is uncovered, the outside air rushes in to fill this vacuum and in so doing mixes with the carbureted air already admitted. In the absence of direct communication with the outside air, as through the third port 21, there must always be a partial vacuum in the chamber 7 when the piston 4 is in its forward position. At this point, combustion takes place and the piston moves backward on its working stroke. As the exhaust port 5 is passed by the front surface of the piston and opened, combustion has been substantially completed and the burned gases are released. As the piston moves to the extremity of its backward stroke, the admission port 6 is uncovered and the mixture in the crank case which is now under compression rushes through the transfer passage 8, passing through the aperture in the screen 11, and enters the combustion chamber. The piston has now completed its working stroke and moves forward again, closing, first, the admission passage 6, then the exhaust passage 5, and compresses the charge in the forward end of the cylinder.

To regulate the speed and power of engines of this type, it is customary to throttle the mixture, that is, to vary the amount of air admitted to the carbureter by operating the valve 25. When this is done, the richness of the gas in the compression chamber 7 is varied, owing to the fact that while the amount of mixture introduced changes in response to the position of the throttle, the amount of air admitted at the third port 21 is constant. For this reason, the mixture is weakened when the power is reduced. This weak mixture burns slowly and frequently causes back-firing, as above described; *i. e.*, owing to the fact that combustion has not ceased when the transfer passage 8 is opened. For this reason, the back-fire arresting screen is an important feature of my engine.

To prevent gumming of the screen by lubricating oil, I have so placed the inlet in the carbureter that heavily carbureted air and atomized hydrocarbon are continually discharged on the screen during the operation of the engine. This dissolves any lubricating oil which may become spattered on the screen and keeps it clear so that it does not offer any unnecessary obstruction to the passage of the gases.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a two-cycle internal combustion engine, a rear compression chamber, a piston closed port for admitting air to the compression chamber, means for throttling air admitted to said port, a transfer passage, an inlet in the transfer passage, a carbureter connected with the inlet, and a screen in the transfer passage opposite the inlet to prevent back firing.

2. In a two-cycle internal combustion engine of the rear compression type, a transfer passage, a cover for the transfer passage, the passage being partly in the cover and partly in the cylinder casting, and the two castings being joined on a plane crossing the passage on a long diagonal, a back-fire arresting screen in the passage, also crossing the same on a long diagonal and secured as a gasket between the cover and the cylinder casting.

Signed by me at Baltimore, Maryland, this 17th day of November 1908.

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Witnesses:

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