July 23, 1946. W. J. ROULEAU 2,404,660

AIR COMPRESSOR

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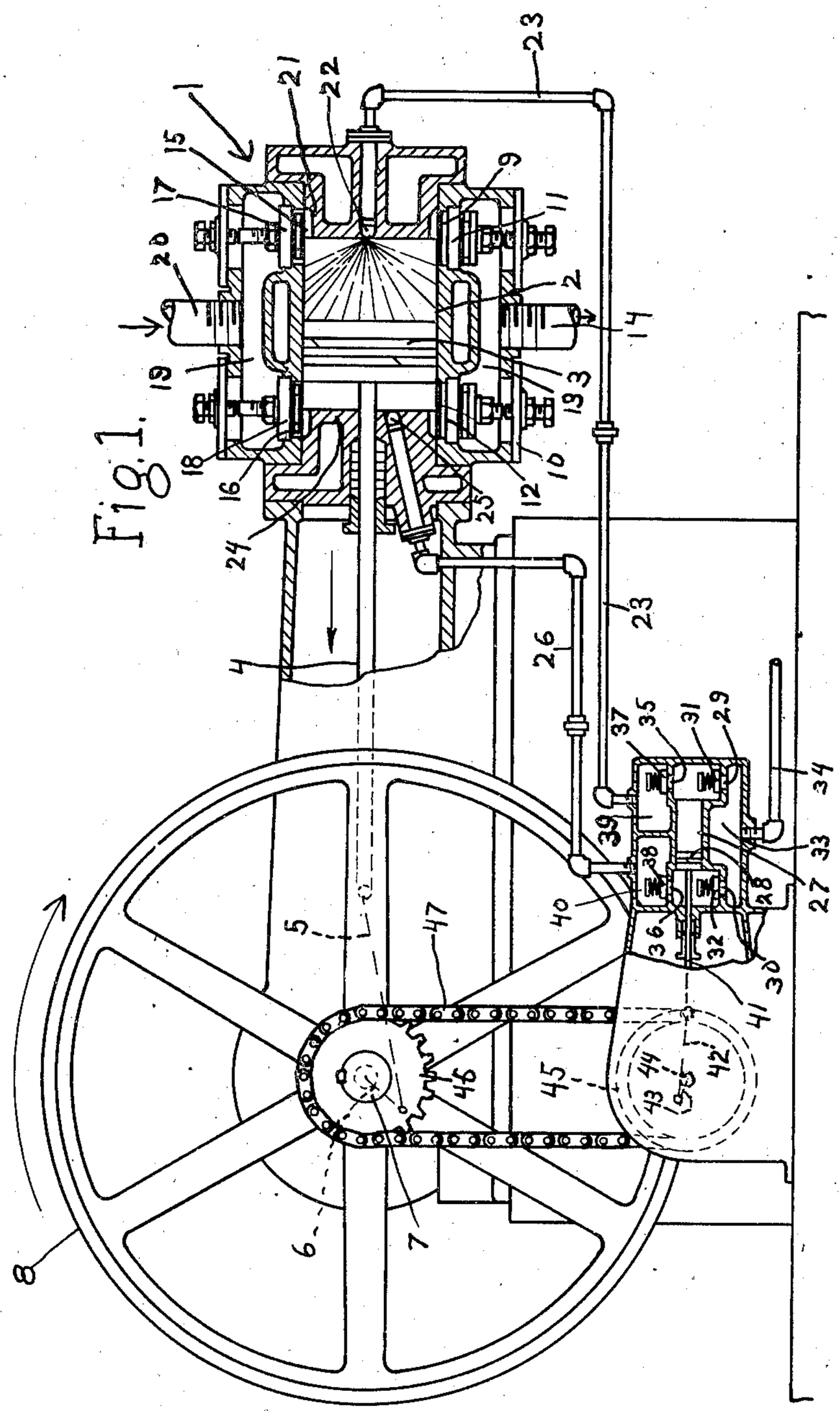
Fig. 1.



INVENTOR
Wilfred J. Rouleau.
PER HEARD, SMITH & TENNANT.
ATTORNEYS.

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Fig. 3.

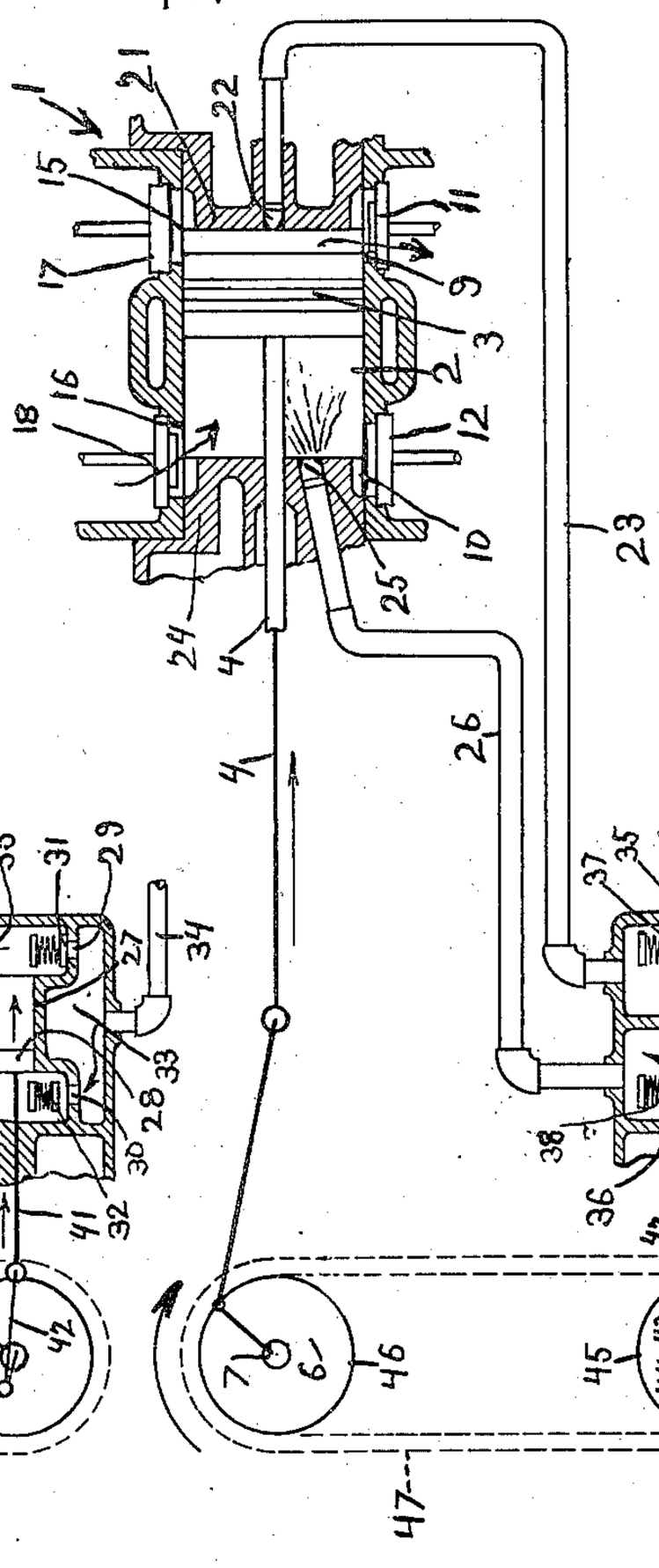
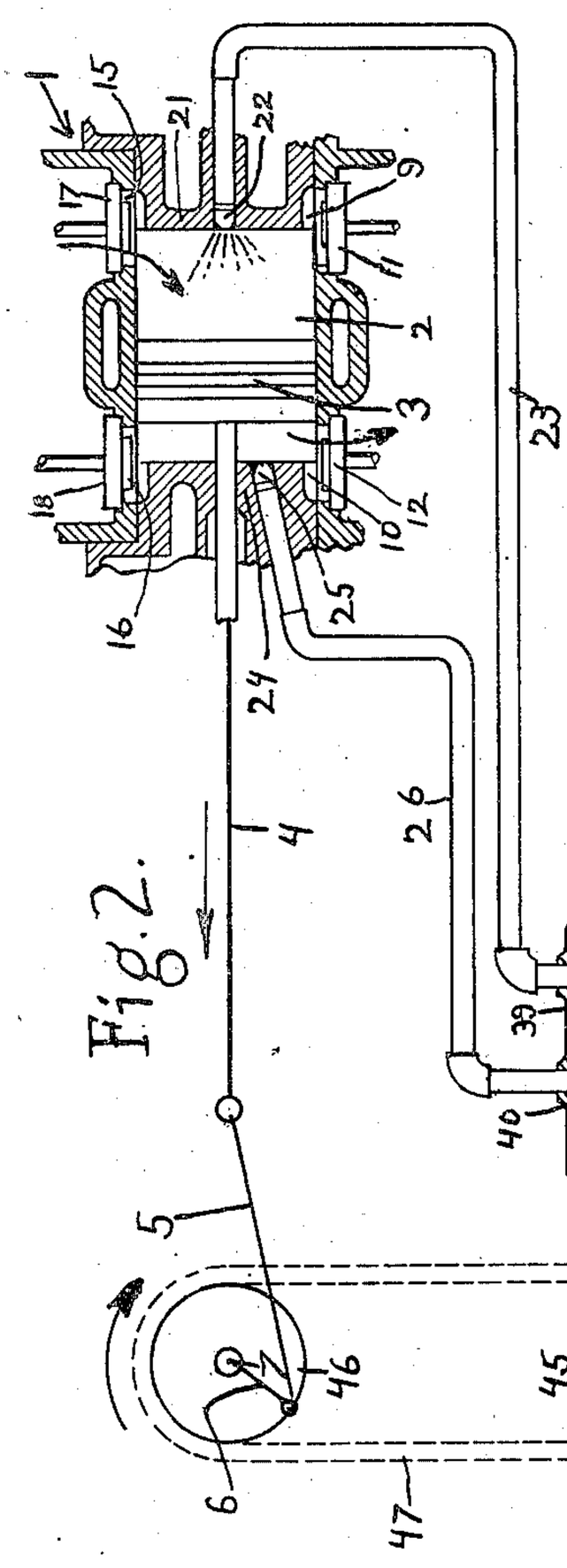


Fig. 2.



INVENTOR
Wilfred J. Rouleau
by Hazard Smith & Tennant
Attorneys

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AIR COMPRESSOR

Wilfred J. Rouleau, Quincy, Mass.

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4 Claims. (Cl. 230—208)

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This invention relates to compressors for compressing air and other gas, and especially to that type of compressor that is constructed to deliver atomized liquid to the cylinder for the purpose of absorbing the heat of compression.

In the operation of an air compressor having a reciprocating piston, the compression of the air in the cylinder occurs during the first part of the compression stroke, and before the piston has traveled through its entire stroke, the maximum pressure has been reached and the exhaust valve opens to permit the discharge of the compressed air from the cylinder, such discharge occurring during the last portion of the compression stroke.

The heat of compression is developed while the pressure in the cylinder is increasing, and no additional heat of compression is developed after the maximum pressure has been reached and while the compressed air is being delivered from the cylinder.

It is one of the objects of my present invention to provide an air compressor in which the atomized liquid is delivered to the cylinder during that portion only of the compression stroke in which heat of compression is being generated, that is, during that portion only of the compression stroke in which the pressure is increasing, and in which the delivery of atomized liquid to the cylinder will be cut off or terminated as soon as the maximum pressure has been reached and will remain cut off during the time that the piston is completing its stroke and is forcing the compressed air out of the cylinder.

If atomized liquid is delivered to the cylinder in sufficient quantity to absorb the heat of compression as it is developed, any additional atomized liquid that is delivered to the cylinder after development of the heat of compression ceases and during the time when the compressed air is being forced from the cylinder will be wasted.

With my invention the delivery of the atomized liquid to the cylinder of the compressor is so controlled that it is delivered while the heat of compression is being developed, and its delivery ceases as soon as the maximum pressure in the cylinder has been reached.

In order to give an understanding of my invention, I have illustrated in the drawings a selected embodiment thereof which will now be described after which the novel features will be pointed out in the appended claims.

In the drawings:

Fig. 1 is a view, partly in elevation and partly in section, of a compressor embodying my invention.

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Figs. 2 and 3 are diagrammatic views illustrating the operation of the compressor.

In the drawings 1 indicates generally a compressor for compressing air or other gases embodying my invention, said compressor having the usual cylinder 2 in which operates a reciprocating piston 3. The piston is shown as connected by a piston rod 4 and connecting rod 5 to a crank 6 on the power-driven shaft 7, the latter being equipped with the usual fly wheel 8. The cylinder 2 herein shown is a double acting cylinder, it having two inlet ports 15, 16 controlled by inlet valves 17 and 18, which open into an inlet manifold 19 having an intake pipe 20 leading thereto. The cylinder is also provided with the two outlet ports 9, 10 which are controlled by outlet valves 11, 12 respectively, said valves opening into an outlet manifold 13 which communicates with a delivery pipe 14.

The parts thus far described are such as are commonly found in air compressors and form no part of my present invention.

Situated in the cylinder head 21 is an atomizer 22 adapted to deliver atomized liquid into the cylinder 2, said atomizer being supplied with liquid through a supply pipe 23. The other cylinder head 24 is also equipped with an atomizer 25 which is adapted to deliver atomized liquid into the cylinder on the left hand side of the piston 3, said atomizer 25 being supplied with liquid through the supply pipe 26.

In the operation of an air compressor of this type, the air or gas in the cylinder will be subjected to an increase in pressure as the piston moves from one end to the other of its stroke, and when the piston has traveled through part of its stroke in either direction, the maximum pressure to which the air is to be compressed has been reached, and when this maximum pressure has been reached, the outlet valve 11 or 12 will open and the air at this maximum pressure will be forced out of the cylinder into the outlet manifold 13 and will thus be delivered through the delivery pipe 14.

As stated above the compressing of the gas develops heat of compression but the development of such heat of compression ceases when the maximum pressure has been reached, and during the latter part of the stroke in either direction when the compressed air is being delivered from the cylinder, there will be no development of heat of compression.

In accordance with my present invention, I

have provided means whereby atomized liquid will be delivered from the atomizer 22 during that portion only of the compression stroke toward the right in which the heat of compression is being developed, the delivery of atomized liquid from said atomizer 22 ceasing as soon as the maximum pressure in the cylinder has been reached. Similarly, during the compression stroke toward the left, the atomizer 25 will be operative to deliver atomized liquid into the cylinder during that portion only of the compression stroke in which the pressure of the air is increasing and heat of compression is being developed, such delivery of atomized liquid from the atomizer 25 ceasing as soon as the maximum pressure has been reached and the valve 12 opens to permit discharge of the compressed air from the cylinder.

Various ways of controlling the delivery of atomized liquid from the atomizers 22, 25 so that they will function as above set forth may be employed without departing from my invention. I have, however, shown in the drawings a simple construction adapted for this purpose and which comprises a pump cylinder 27 having a pump piston 28 operating therein. This pump cylinder is a double-acting cylinder and is provided with two inlet ports 29, 30 controlled by the usual spring-pressed inlet valves 31, 32. These inlet ports 29, 30 communicate with an inlet manifold 33 which is supplied with liquid through a supply pipe 34. The pump is also provided with two outlet ports 35, 36 controlled by outlet valves 37, 38. The outlet valve 35 opens into a chamber 39 with which the supply pipe 23 communicates, and the outlet valve 38 opens into a chamber 40 with which the supply pipe 26 communicates. This pump piston 28 is operatively connected to the shaft 7 of the compressor so that the pump operates synchronously with the compressor. When the pump piston 28 moves to the right from the position shown in Fig. 1, the water or other liquid will be forced through the outlet valve 35 and pipe 23 to the atomizer 22 and the latter will thus be operative to deliver atomized liquid to the right hand end of the compression cylinder.

On the other hand when the pump piston 28 moves toward the left, it will operate to force liquid through the outlet valve 38, chamber 40 and pipe 26 to the atomizer 25 thus causing the latter to deliver atomized liquid to the left hand end of the compressor cylinder 2.

The relation between the pump piston 28 and the compressor piston 3 is such that during that portion only of the compression stroke of the piston 3 toward the right in which the air is being compressed the pump piston 28 will be moving to the right and thus forcing atomized liquid into the right hand end of the compressor cylinder. By the time that the maximum pressure in the cylinder 2 has been reached and the valve 11 is ready to open, the pump piston 28 has reached the end of its stroke to the right with the result that further delivery of atomized liquid from the atomizer 22 will cease and no atomized liquid will be delivered during the remainder of the stroke to the right of the compressor piston 3 and while the compressed air is being delivered through the outlet port 9.

Similarly during the first part of the movement of the compressor piston 3 to the left in Fig. 1, the pump piston 28 will be moving to the left and thus forcing water through the atomizer 25 with the result that atomized liquid will be

delivered to the left hand end of the cylinder 2. By the time, however, that the maximum pressure has been developed in the compressor cylinder 2 on the left hand side of the piston, the pump piston will have reached the end of its stroke to the left and delivery of atomized liquid from the atomizer 25 will, therefore, cease, and no atomized liquid will be delivered from said atomizer during the remainder of the stroke of the piston 3 to the left and while the compressed air is being delivered through the discharge port 10. The pump piston 28 is provided with the usual piston rod 41 which is connected by a connecting rod 42 with a crank 43 on a shaft 44. This shaft 44 and also the shaft 7 are provided with sprocket wheels 45, 46 of the same diameter that are connected by the sprocket chain 47 so that the crank 6 of the compressor and the crank 43 of the pump are rotating synchronously. The crank 43 of the pump, however, is located somewhat in advance of the crank 6 of the compressor as shown in the diagrammatic views 2, and 3, the arrangement being such that the crank 43 of the pump arrives at a dead center position somewhat in advance of the crank 6 of the compressor. In Fig. 2 and also in Fig. 1, the crank 43 of the pump has just passed its dead center position to the left, and the pump piston has just begun its movement toward the right. At this time the compressor piston 3 is still traveling toward the left, and the maximum pressure at the left hand end of the cylinder has been reached and the compressed air is being delivered through the outlet valve 12. Air is also being admitted to the right hand end of the compressor cylinder through the inlet port 15. The continued movement of the pump piston to the right will force liquid through the atomizer 22 so that atomized liquid will be delivered to the right hand end of the compressor cylinder during the latter part of the suction stroke, and this delivery of atomized liquid will continue during the final part of the movement of the compressor piston 3 to the left and while said piston moves to the right to compress the air in the right hand end of the cylinder. However, by the time the maximum pressure has been developed in the right hand end of the cylinder 2, the pump piston 28 will have completed its stroke to the right, and further delivery of atomized liquid from the atomizer 22 will cease. This is the condition illustrated diagrammatically in Fig. 3.

During the remainder of the stroke of the compressor piston 3 to the right, the compressed air will be delivered through the discharge port 9 and the pump piston 28 will begin its reverse movement toward the left so that while the compressed air is being discharged from the right hand end of the cylinder, the atomizer 25 will become active to deliver atomized liquid to the left hand end of the compressor cylinder during the final portion of the compressor piston stroke to the right. Said atomizer 25 will continue active during that portion of the movement of the compressor piston 3 to the left in which the air is being compressed, but by the time the piston 3 reaches the position shown in Figs. 1 and 2 in which the maximum pressure has been developed at the left of the piston and the compressed air is being discharged through the outlet port 10 the pump piston 28 will have reached the end of its stroke to the left and will have begun its movement to the right, thereby rendering the atomizer 25 inoperative and the atomizer 22 operative.

It will, therefore, be seen that with my device each atomizer is operative to deliver atomized liquid to the cylinder during that portion only of the compression stroke in which the heat of compression is being developed, each atomizer becoming inoperative when the maximum pressure has been reached and the compressed air is being delivered from the compressor cylinder.

While I have illustrated one mechanism adapted to accomplish this end, yet I do not wish to be limited to the construction shown as other mechanical devices might be employed for so moving the pump piston relative to the compressor piston as to insure the delivery of the atomized liquid during the portion only of the compression stroke in which heat of compression is being developed.

I claim:

1. An air compressor comprising a cylinder, a reciprocating piston operating therein, an atomizer for delivering atomized liquid into the cylinder, a reciprocating pump for forcing liquid through said atomizer, and means to operate said pump in timed relation with the compressor but out of step therewith and in such relation thereto that the compression stroke of the pump terminates considerably prior to that of the compressor, whereby said pump will become inoperative to deliver atomized liquid into the compression cylinder during the latter part of the compression stroke of the compressor piston in which the compressed gas is being delivered from said compressed cylinder.

2. An air compressor comprising a cylinder having inlet and outlet ports, a piston in said cylinder, means to deliver atomized liquid to the compressor cylinder during the first part of the compression stroke of said piston, and means

operating automatically to render said first-named means inoperative during the final portion of said compression stroke, whereby the delivery of atomized liquid to the compressor cylinder will cease during the time that the compressed gas is being delivered from said cylinder.

3. An air compressor comprising a cylinder, a reciprocating piston operating therein, a crank shaft having connections therefrom to said piston for operating the latter, an atomizer for delivering atomized liquid into a cylinder, a pump for forcing liquid through said atomizer, said pump having a reciprocating piston, a crank shaft for operating said pump piston, means connecting the two crank shafts so that they rotate at the same speed but out of step with each other with the crank of the pump crank shaft considerably in advance of that of the compressor crank shaft, whereby the pump piston will reach the end of its pressure stroke and will hence cease to force liquid through the atomizer during the latter portion of the compression stroke of the compressor and while the compressed gas is being discharged from the compressed cylinder.

4. An air compressor comprising a cylinder having inlet and outlet ports, a piston in said cylinder, means to deliver atomized liquid to the compressor cylinder during the final portion of the inlet stroke and the first part of the compression stroke of said piston, and means operating automatically to render said first-named means inoperative during the final portion of said compression stroke, whereby the delivery of atomized liquid to the compressor cylinder will cease during the time that the compressed gas is being delivered from said cylinder.

WILFRED J. ROULEAU.