

(No Model.)

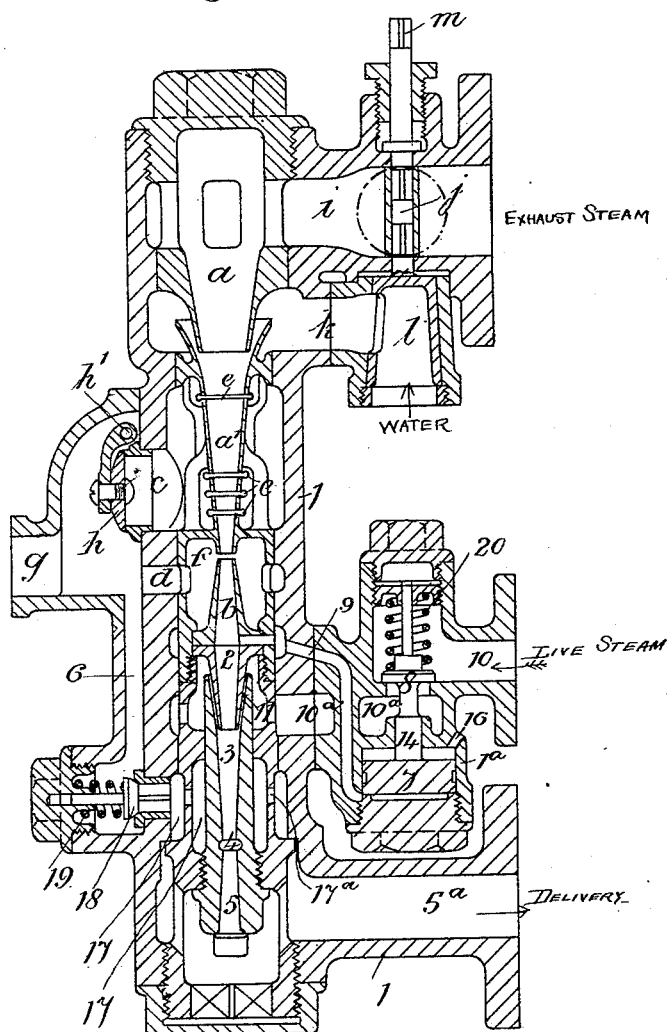
2 Sheets—Sheet 1.

H. HOLDEN & R. G. BROOKE.
INJECTOR.

No. 419,047.

Patented Jan. 7, 1890.

Fig 1.



Witnesses
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Arthur S. Bradbury

Inventors
Harry Holden.
Robert Grady Brooke

(No Model.)

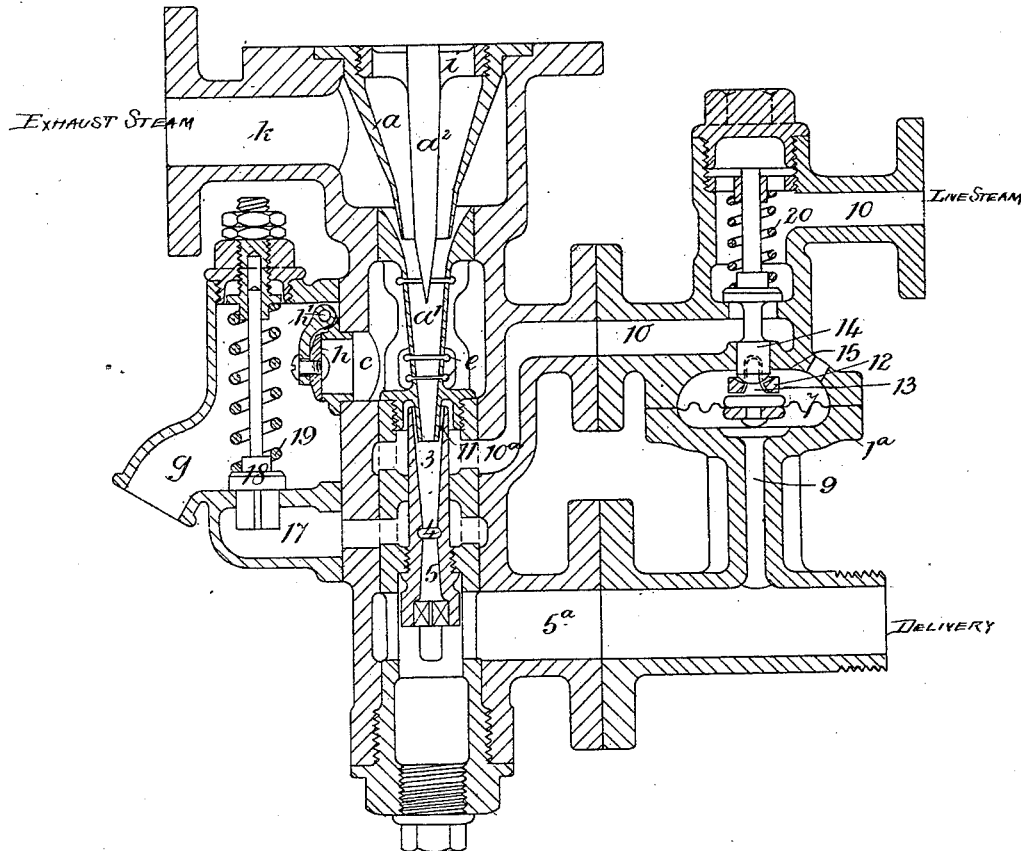
2 Sheets—Sheet 2

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Patented Jan. 7, 1890.

Fig. 2.



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UNITED STATES PATENT OFFICE.

HARRY HOLDEN AND ROBERT GRUNDY BROOKE, OF SALFORD, COUNTY OF LANCASTER, ASSIGNORS TO GEORGE FREDERICK GLASS HOOPER, OF WESTMINSTER, ENGLAND.

INJECTOR.

SPECIFICATION forming part of Letters Patent No. 419,047, dated January 7, 1890.

Application filed August 31, 1887. Serial No. 248,403. (No model.)

To all whom it may concern:

Be it known that we, HARRY HOLDEN and ROBERT GRUNDY BROOKE, subjects of the Queen of Great Britain and Ireland, both residing at Salford, in the county of Lancaster, Kingdom of Great Britain and Ireland, have invented Improvements in Injectors, of which the following is a specification.

This invention has reference to injectors or apparatus of the kind described and claimed in the specification of an application for Letters Patent of the United States filed June 17, 1887, Serial No. 241,670, in which both exhaust or low-pressure steam and high pressure or live steam are used to impart velocity to water, the jet of water produced by the exhaust or low-pressure steam in an exhaust-injector having subsequently imparted to it an increased velocity and consequent penetrating power by high-pressure or live steam in a supplementary injector, the supply of such high-pressure or live steam being automatically controlled for starting and stopping the supplementary injector by pressure of water produced by the action of the exhaust or low-pressure steam. According to this invention the exhaust or low-pressure injector and the high-pressure or live-steam injector (hereinafter respectively called "the exhaust-injector" and "the supplementary injector") are combined in one apparatus, forming a compound injector.

In the accompanying two sheets of drawings, Figure 1 is a vertical section of a compound injector according to this invention. Fig. 2 is a similar view illustrating a modified construction.

In Fig. 1, 1 is a casing containing the exhaust and supplementary injectors.

First considering the exhaust-injector, *a* is the steam-cone; *a'*, the water-nozzle and combining-cone; *b*, the delivery-cone, and *c* and *d*, overflow-passages. The passages *c* and *d* are in communication, respectively, with the overflow-openings *e* in the cone *a'* and the overflow-space *f* between the said cone *a'* and the cone *b*, and with an outlet-passage *g*. *h* is a valve hinged at *h'*. It normally closes the overflow-passage *c* by the action of its

weight, but will nevertheless move from its seat to allow of the overflow from *e* escaping to the outlet *g*.

i is a passage for exhaust-steam. It is in communication with the interior of the steam-cone *a*, and is controlled by a throttle or other suitable valve *j*. *k* is a passage for water. It is in communication with the nozzle *a'*, and, by way of the interior of a plug valve or cock *l* with a water-supply. The valves *j* and *l* are connected, as shown, so that when the valve *j* is turned by its spindle *m*, to admit or to cut off the supply of exhaust-steam to or from the cone *a*, the valve *l* will simultaneously admit or cut off the supply of water to or from the nozzle *a'*.

In the supplementary injector 2 is the water-nozzle; 3, the combining-cone; 5, the delivery-cone, and 5^a the delivery-passage. 6 is a passage in communication with the overflow 4 and with the outlet *g*. 7 is a piston that works in a chamber formed in a casing 1^a, which for convenience is made separate from but secured to the casing 1. Instead of a piston 7, a diaphragm may be used in the manner hereinafter described, and as described and shown in the hereinbefore-mentioned former specification. 8 is a valve connected to and operated by the piston 7, (or diaphragm.) 9 is a passage in communication with the interior of the delivery-nozzle *b*, (or with a chamber that may be situated between the said nozzle and water-nozzle 2, or in any other convenient place,) and with the space beneath the piston 7, (or diaphragm.) 10^a is a passage for steam from the passage 10 to an annular space 11 between the water-nozzle 2 and combining-nozzle 3. It is arranged to surround the passage 9. 14 is a pin or spindle connecting the piston 7 with the valve 8, and serving to guide these parts vertically. 16 is a leak-hole to prevent accumulation of pressure on top of the piston 7 (or diaphragm) in case of leakage past the pin or spindle 14 or past the piston 7. 17 are overflow-chambers connected by passages 17^a. They are situated between the overflow-opening 4 and the overflow outlet-passage 6. 18 is a valve weighted as required

by an adjustable spring 19. It serves for controlling the outlet from the chambers 17. The valve 8 may or may not be provided with a spring, according to circumstances. In the example shown it is provided with a spring 20.

The action of the compound injector is as follows: When the spindle *m* is turned to open the valves *j* and *l*, exhaust-steam and water are simultaneously admitted through the respective passages *i k* to the steam-cone *a* and water-nozzle and combining-cone *a'*, and the exhaust-injector thereby started. The pressure of water that will then be set up in the delivery-cone *b* and water-nozzle 2 will be transmitted to the piston 7 (or diaphragm) by way of the passage 9, and will be sufficient to lift said piston (or diaphragm) against the pressure of steam (and of the spring 20, if used) on valve 8. The valve 8 will thus be lifted, and high-pressure or live steam will pass through passage 10^a and space 11, and, mingling with the water-jet passing through the nozzle 2, will impart to it the required additional velocity. If the exhaust-injector be stopped by closing the valves *j* and *l*, the pressure below the piston 7 (or diaphragm) will cease, the valve 8 will be closed against its seat, and the high-pressure or live steam automatically cut off from the supplementary injector.

The overflow from the exhaust and supplementary injectors that takes place before these injectors are fairly at work escapes to the outlet *g* through the openings and passages *e f c d* and 17 16, respectively.

In the modified arrangement shown in Fig. 2 the exhaust-steam cone *a* is fitted with a spindle *a'*, and the exhaust-delivery cone *b*, overflow-space *f*, passage *d*, and supplementary water-nozzle 2 (shown in Fig. 1) are dispensed with, the exhaust combining-nozzle *a'* entering the combining-nozzle 3 of the supplementary injector and constituting the water-nozzle thereof, through which the water passes direct from the one to the other; also, in lieu of a piston, a diaphragm 7 is employed, which carries a ring 12, of metal or other suitable material, that surrounds a guide-pin 13, fixed to the diaphragm and entering a recess in the pin or spindle 14, (that serves as a piston,) attached to the valve 8. The ring 12 serves to limit the movement of the diaphragm 7, and also as a valve to prevent steam pass-

ing the piston 14 by seating itself against a faced surface 15, the arrangement being similar to that described in the hereinbefore-mentioned former specification. The pressure of water set up in the delivery-cone 5 and passage 5^a of the supplementary injector by the exhaust-injector is transmitted through the passage 9 to the under side of the diaphragm 7 for actuating the same. In other respects the construction and action of this modified arrangement of compound injector are similar to those hereinbefore described with reference to and shown in Fig. 1, and is similarly lettered. It will be obvious that instead of the exhaust and supplementary injectors having a common overflow-outlet *g* they may each have a separate outlet; also, that the piston 7 (or diaphragm) may be actuated by fluid-pressure set up by the exhaust-injector in a chamber or space other than those hereinbefore referred to.

What we claim is—

In a compound injector, the combination of a casing 1, an exhaust-injector having a steam-cone *a*, a water-nozzle and combining-cone *a'*, a delivery-cone *b*, overflow-passages *c d* and openings *e f*, outlet *g*, hinged valve *h*, passages *i* and *k* and combined valves *j* and *l* for controlling said passages, a supplementary injector having a nozzle 2, combining-cone 3, overflow-opening 4, overflow chamber or chambers 17, valve 18 and passage 6, delivery-cone 5 and delivery-passage 5^a, a chamber or space in the compound injector, wherein fluid-pressure is set up when the exhaust-injector is at work, a passage 9 in communication with said chamber or space and with one side of a piston 7, (or diaphragm,) a casing 1^a, a valve 8, with or without spring 20, passages 10 10^a and space 11 for high-pressure or live steam, and a leak-hole 16, all substantially as herein described, for the purposes specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HARRY HOLDEN.

ROBERT GRUNDY BROOKE.

Witnesses:

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