

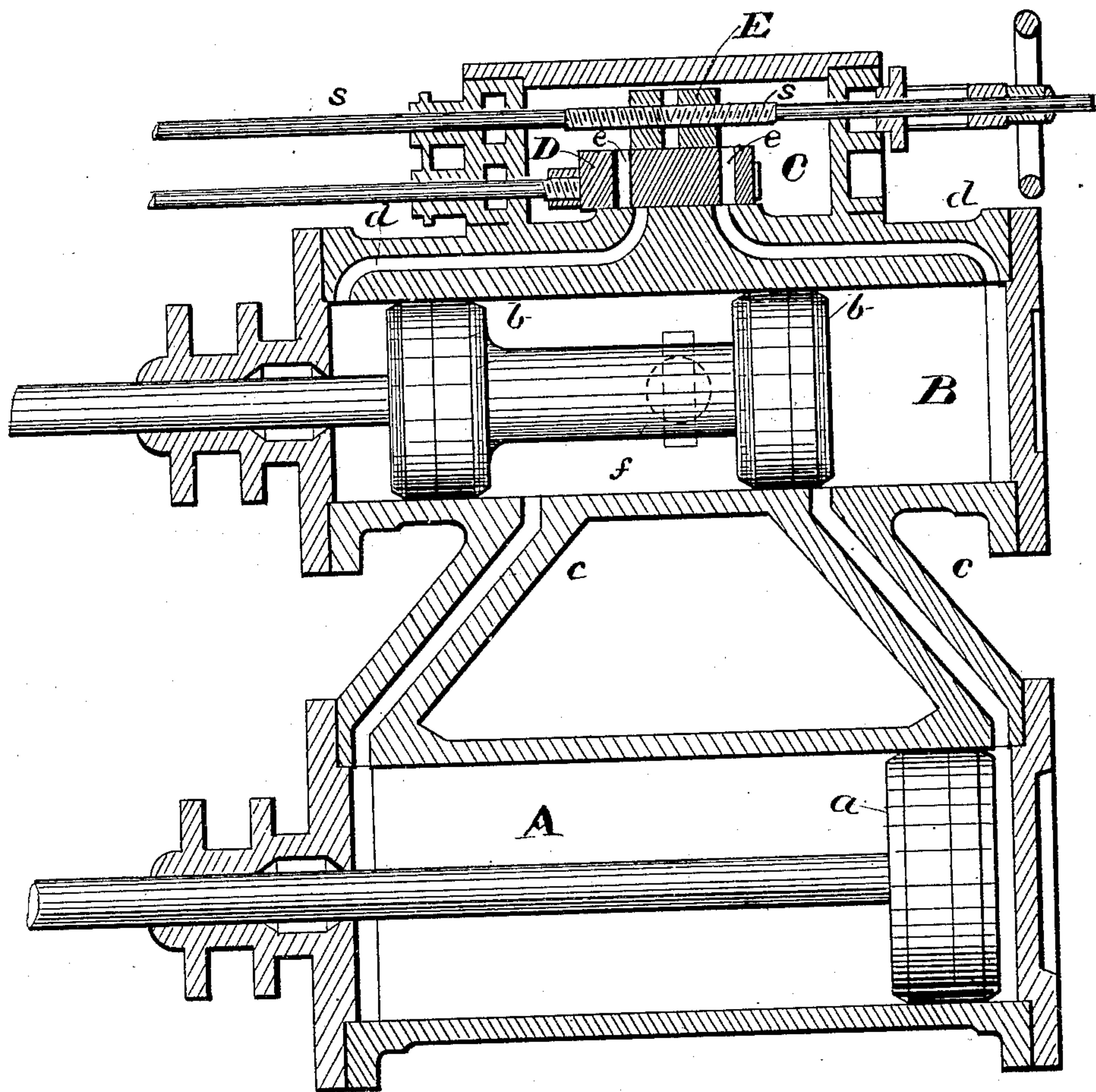
(No Model.)

J. F. KRIEGER & J. H. EICKERSHOFF.

COMPOUND STEAM ENGINE.

No. 318,003.

Patented May 19, 1885.



WITNESS:

W. B. Gallagher
Abram May

John F. Krieger
John H. Eickershoff
INVENTORS

BY
Leut Hosen
ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN F. KRIEGER AND JOHN H. EICKERSHOFF, OF CINCINNATI, OHIO.

COMPOUND STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 318,003, dated May 19, 1885.

Application filed February 20, 1885. (No model.)

To all whom it may concern:

Be it known that we, JOHN F. KRIEGER and JOHN H. EICKERSHOFF, citizens of the United States, residing at Cincinnati, Ohio, have invented new and useful Improvements in Compound Steam-Engines, of which the following is a specification.

Our invention relates to that class of double or compound engines in which the smaller or high-pressure cylinder acts as a valve-chest and its piston as a governing-valve for the larger or expansion cylinder and piston, its object being to improve their construction and the efficiency and economy of their operation.

As heretofore constructed, the form of engine to which our improvements are applied not only exhausted from the expansion-cylinder between the piston-heads constituting the double piston of the primary or high-pressure cylinder, but also exhausted the residual live steam from the primary-cylinder through an ordinary and separate exhaust-cavity and governed port of a D-valve and seat. At each stroke, therefore, of the primary piston there was a loss of the residual live steam employed in driving said piston. Moreover, a cut-off valve was applied by means of a supplemental valve-chest in order to enable the engine to be worked "expansively" as a true compound-engine; but such was practically defeated by reason, among others, of the loss of steam-pressure in the large opening afforded by the intermediate steam-chest. These defects involved a serious loss of economy and efficiency in the operation of such engines, which it is the object of our invention to remedy.

To this end our invention consists in a construction dispensing entirely with the D-exhaust valve and its exhaust-port, substituting therefor an admission-valve by which the high-pressure exhaust is entirely avoided, and the residual live steam, after supplying the expansion-cylinder, instead of being exhausted independently from the high-pressure cylinder is retained therein as a cushion for the high-pressure piston and afterward utilized in the expansion-cylinder; and it consists, further, in the combination, with such admission-valve, a cut-off valve applied within the valve-chest directly to said admission-

valve, thereby not only dispensing with the extra valve chest and ports and avoiding the loss of power incident to filling the valve-chest with steam of high initial pressure after each closure of the cut-off valve, but also perfectly regulating the relative expansion and distribution of steam in both cylinders.

Mechanism embodying our invention is illustrated in the accompanying drawings, forming part of this specification, which represents longitudinal sections of both cylinders in a common axial plane, showing their pistons, connecting steam-passages, and the valves and admission-ports.

In these drawings, A designates the secondary or expansion cylinder; *a*, its piston; B, the primary or high-pressure cylinder; *b b*, its double piston; *c c*, the connecting steam-passages between the cylinders; C, the valve-chest located upon the primary cylinder, and *d d* the steam-admission ports opening from the valve-chest C into the cylinder B.

The governing-valve D for the ports *d d* is of rectangular form, without exhaust-cavity, having parallel faces above and below, and provided with vertical apertures *e e*, corresponding with the port-openings, but separated by a greater interval, extending through both faces of the valve near its extremities.

Upon the upper face of the valve D is fitted a two-part cut-off valve, E, adjustable in length upon a stem, *s*, engaging its parts by right and left screw-threads, respectively, said stem projecting rearward through the valve-chest C, and being there provided with a manipulating hand-wheel, *g*, engaging a suitable spline or groove upon the stem.

The parts thus described are provided with the ordinary connections and operating mechanism, which we have not deemed it necessary to exhibit or describe, as they are not materially concerned in our improvements except as stated.

The operation is as follows: In the travel of the primary or high-pressure piston it uncovers the ports *c*, through which the steam, having completed its work in driving the primary piston *b*, now enters the expansion-cylinder A and acts upon the piston *a*, the two pistons and their crank-connections being relatively so arranged as to counteract the dead-centers

each of the other. When the piston *b* on its return-stroke again passes a port *c*, the induction-valve *D* being closed the partially-spent steam is not allowed to escape, but is cushioned behind the piston *b* and compressed ultimately to near its initial pressure, and again utilized in connection with the new supply of live steam upon opening the admission-port *d* for a repetition of the stroke. The exhaust ultimately takes place solely from the expansion-cylinder between the heads *b* of the primary piston by a port, *f*, opening at mid-length of the primary cylinder.

It will readily be perceived that by suitably proportioning the admission valve and ports and by proper adjustment of the cut-off valve the live steam is not only economized with reference to the ordinary loss occurring in the admission-ports, but its effective power may be most economically realized by permitting a partial expansion in the primary cylinder, to be afterward completed in the secondary cylinder, while no steam is exhausted from the engine until it has done its work in both cylinders; also, that by the direct application of the cut-off valve to the admission-valve all loss of steam occurring through a supplemental chest is avoided.

An incidental advantage of this construction is that by proper adjustment of the cut-off valve the engine may be started by admitting live steam to both cylinders, and afterward, as it gathers force and momentum, the valve may be readjusted to operate the engine as a true compound engine.

It will be obvious that some of the advantages herein enumerated may be attained without using any cut-off valve, the admission-valve *D* being given sufficient lap to secure the desired compression, and such modification we conceive to be within the spirit of our invention.

We claim as our invention and desire to secure by Letters Patent of the United States—

1. In a compound engine, the combination of high and low pressure cylinders, the former carrying a double piston operating as a controlling induction and eduction valve for the latter, an exhaust-port opening from the high-pressure cylinder between the pistons thereof, and an induction-valve arranged to govern the admission of steam to the high-pressure cylinder, whereby the steam is solely exhausted from the engine, first from the high-pressure into the low-pressure cylinder, and then back and outward through the sole exhaust-port between the pistons of the high-pressure cylinder, as set forth.

2. In a compound engine of the class described, the combination of the high-pressure and low-pressure cylinders and their pistons and connecting-ports, having its sole exhaust from the high-pressure cylinder into the low-pressure cylinder, and from thence outward between the high-pressure pistons, with an induction-valve governing the high-pressure cylinder, arranged to retain the residual or unexhausted steam in the high-pressure cylinder as a cushion for its piston, substantially as set forth.

3. In a compound engine of the class described, having its sole exhaust from the high into the low pressure cylinder, and from thence outward through the high-pressure piston, an adjustable cut-off valve, arranged as described, in combination with the induction-valve, high and low pressure cylinders, connecting-ports, and single exhaust-port *f*, substantially as and for the purpose set forth.

In testimony whereof we have hereunto set our hands in the presence of two subscribing witnesses.

JOHN F. KRIEGER.
JOHN H. EICKERSHOFF.

Witnesses:

L. M. HOSEA,
R. D. GALLAGHER.