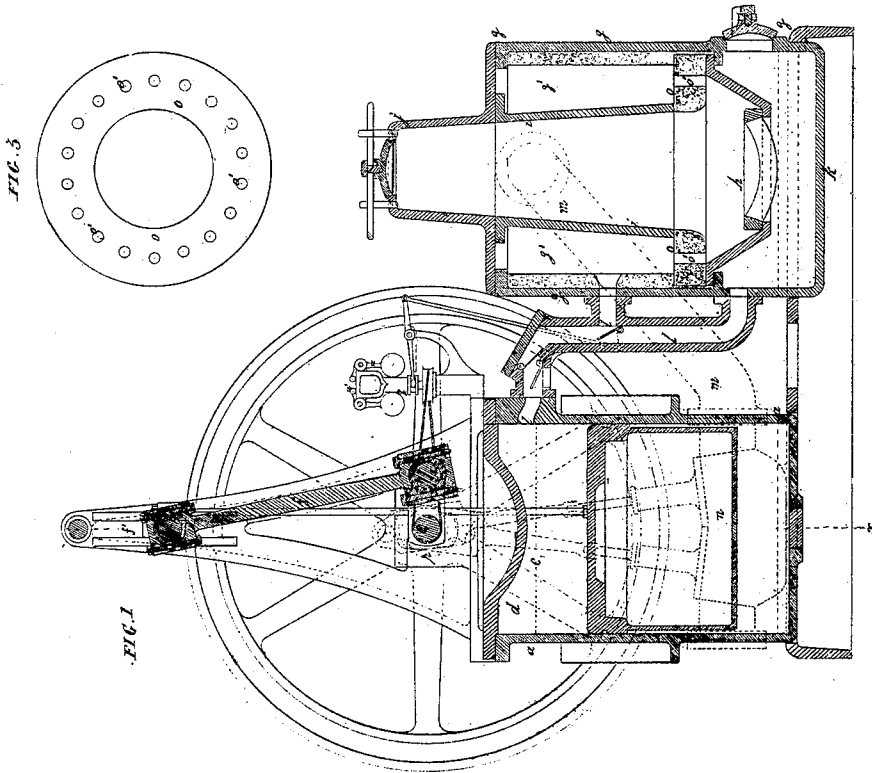
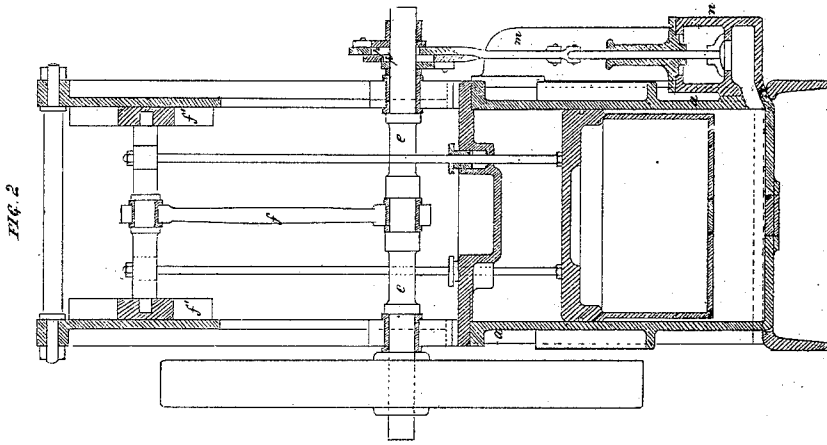


F. H. WENHAM.
HOT AIR ENGINE.

No. 81,853.

Patented Sept. 1. 1868.



Witnesses
H. H. Palmer
George H. Ketchum

Inventor
Francis Herbert Wenham

United States Patent Office.

FRANCIS HERBERT WENHAM, OF LONDON, ENGLAND, ASSIGNOR TO ANDREW SHANKS.

Letters Patent No. 81,853, dated September 1, 1868.

IMPROVEMENT IN HOT-AIR ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, FRANCIS HERBERT WENHAM, of London, England, have invented certain new and useful "Improvements in Heated-Air Engines;" and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying sheet of drawings, forming a part of this specification.

The said invention consists chiefly in such a construction and arrangement of the parts of the engine, that in a single cylinder the piston is acted on in both directions, that is, the stroke of the piston in one direction is produced by the heated air from the furnace, while in the other direction the piston is impelled by the expansion of a body of air which is retained and compressed above the piston.

The capacity of the cylinder must be such that the air required to fill the same is more than the quantity required to be supplied to the furnace at each stroke of the piston. I prefer to construct the engine with a vertical cylinder, of such length that a space is left above the piston, when the same is at the end of its upward stroke, and a large portion of the air in the cylinder, instead of being forced into the furnace at each stroke of the piston, is retained and compressed into this space, and, by its subsequent expansion, acts upon the piston in its downward stroke. The action of the piston, throughout its upward and downward stroke, is thus equalized, and the engine will work much more advantageously than when the power is exerted only on one side of the piston, as has hitherto been the case in heated-air engines of a single cylinder.

Description of the Drawings.

Figure 1 is a longitudinal section of my improved engine and furnace.

Figure 2 is a section on the line $x x$, fig. 1.

Figure 3 is a plan of part of the furnace.

Like letters indicate the same parts in all of the figures.

I make the upper end of the cylinder, a , of such capacity that, when the piston reaches the top of the stroke at c , a space, d , is left, in which the portion of air not required may be compressed, and consequently will not enter the furnace, and by its subsequent expansion will assist the down stroke of the piston. This space may be formed between the piston and cylinder-cover, or the air may be compressed in a side-passage or reservoir.

In this engine I prefer carrying the crank-shaft, e , in bearings bolted to the top of the flange of the cylinder, and working the crank by the connecting-rod, f , with the guides f' for the piston-rods above, similar in form to that known as the steerable-engine.

The stove g has a partition near the grate h . Above this is a feeding-tube or hopper, i , bolted to the lid of the stove, where it is closed and made air-tight by a metal stopper, j . There is a similar stopper, k , beneath the grate, for the removal of ashes. The hopper i descends to within about three inches of the grate, and should contain enough fuel for several hours work. The fuel descends by its own weight as it is burned, and all products of combustion having to pass through previously-ignited fuel, the smoke is thus consumed. The air-passage, l , leading from the top of the cylinder, enters the furnace both above and below the grate h . There is an inner loose ring within the stove, forming an annular space, and the stove is lined with fire-brick, which prevents the outside from being overheated. Cold air may be admitted into this annular space, to further prevent overheating. Every stroke of the piston discharges the air from its upper side, through the passages l , into the stove. The expanded air is conveyed by a pipe, m , from the top of the stove to the valve-chest n , where it is admitted beneath the piston, which is forced upward by its pressure.

The disk o , which is shown detached in fig. 3, is formed of fire-clay. This disk is placed over the furnace, and is supported on the flange of the fire-pan, its central aperture being equal in diameter to the bore of the fuel-hopper i , whose lower end rests on the said disk. The bottom edge of the hopper is thus protected from the direct heat of the fire. Holes or perforations, o' , are formed through the outer portion of the disk, and lead from the grate into the annular space g' of the stove. A jet of pure flame rises through each of these perforations at every stroke of the engine, and at the same time the fire is kept from rising above its proper height.

The valves, through which the air enters and leaves the cylinder, are of the puppet kind. Both the inlet and exhaust are worked direct from the crank-shaft by cams *p*. The looped upper ends of the valve-rods embrace the shaft, and are provided with rollers running on the said cams.

The speed of the engine may be regulated by connecting the governor with a valve set in the air-pump passage or cover, or more or less cold air may be sent into the upper or lower space in the stove *g* by a throttle-valve, worked by the governor, which valve will open or close either the upper or lower passage, and thus regulate the combustion of the fuel, according to the power required to work the engine.

What I claim, and desire to secure by Letters Patent, is—

1. The cylinder *a*, constructed as herein set forth, whereby a portion of air admitted into the cylinder is retained and compressed above the piston at each upward stroke of the same, substantially as set forth.
2. The arrangement of the furnace *g*, with the hopper *i* and grate *h*, constructed with reference to the cylinder *a*, substantially as herein set forth.
3. The fire-clay disk *o*, constructed and fitted in the furnace, substantially as and for the purposes set forth.

FRANCIS HERBERT WENHAM. [L. S.]

Witnesses:

THOS. T. WALMER,

GEORGE HASLITINE, 8 Southampton Buildings, London, W. C., England.