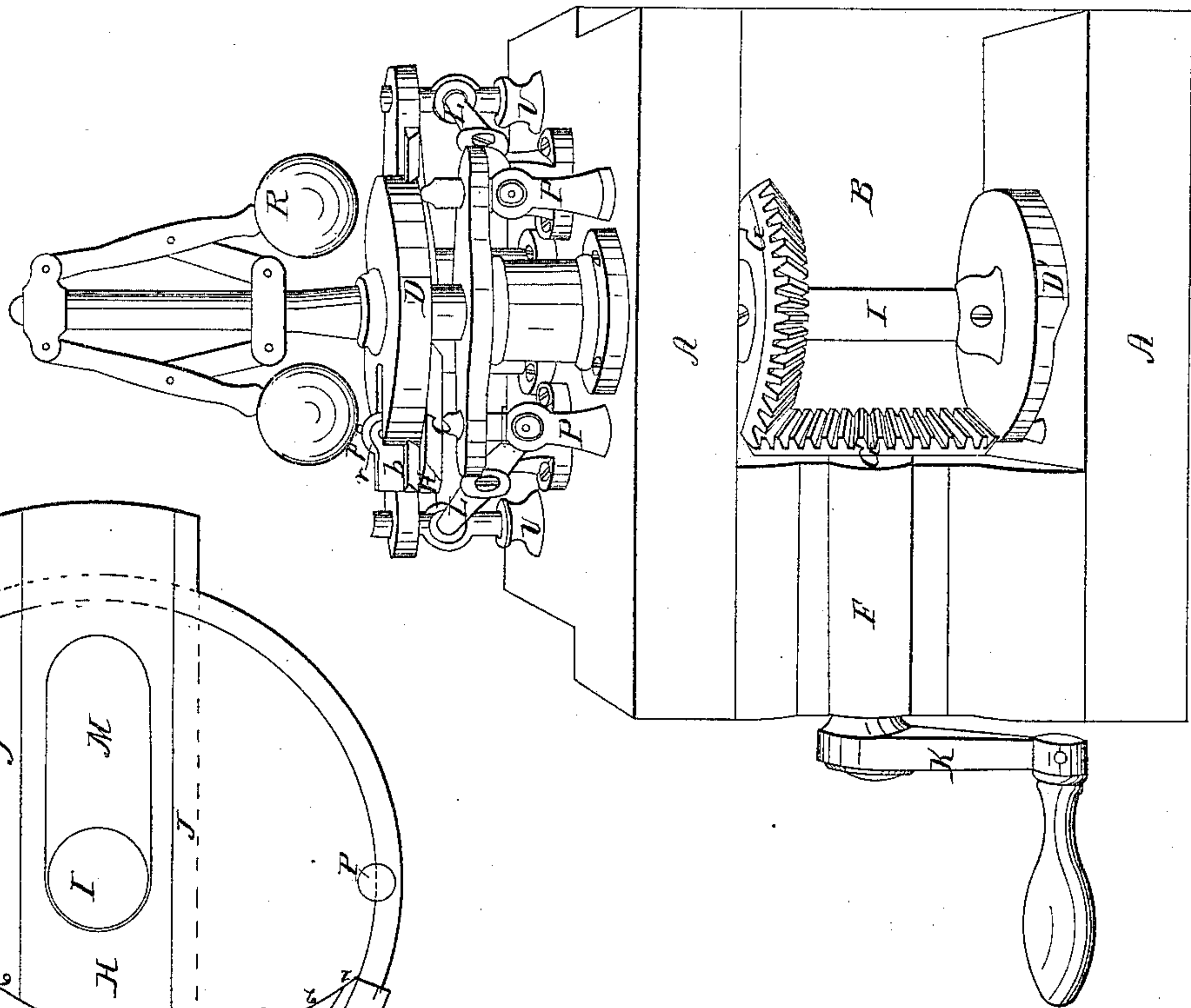


*T. Carynenter,*  
*Steam-Engine Valve-Gear.*

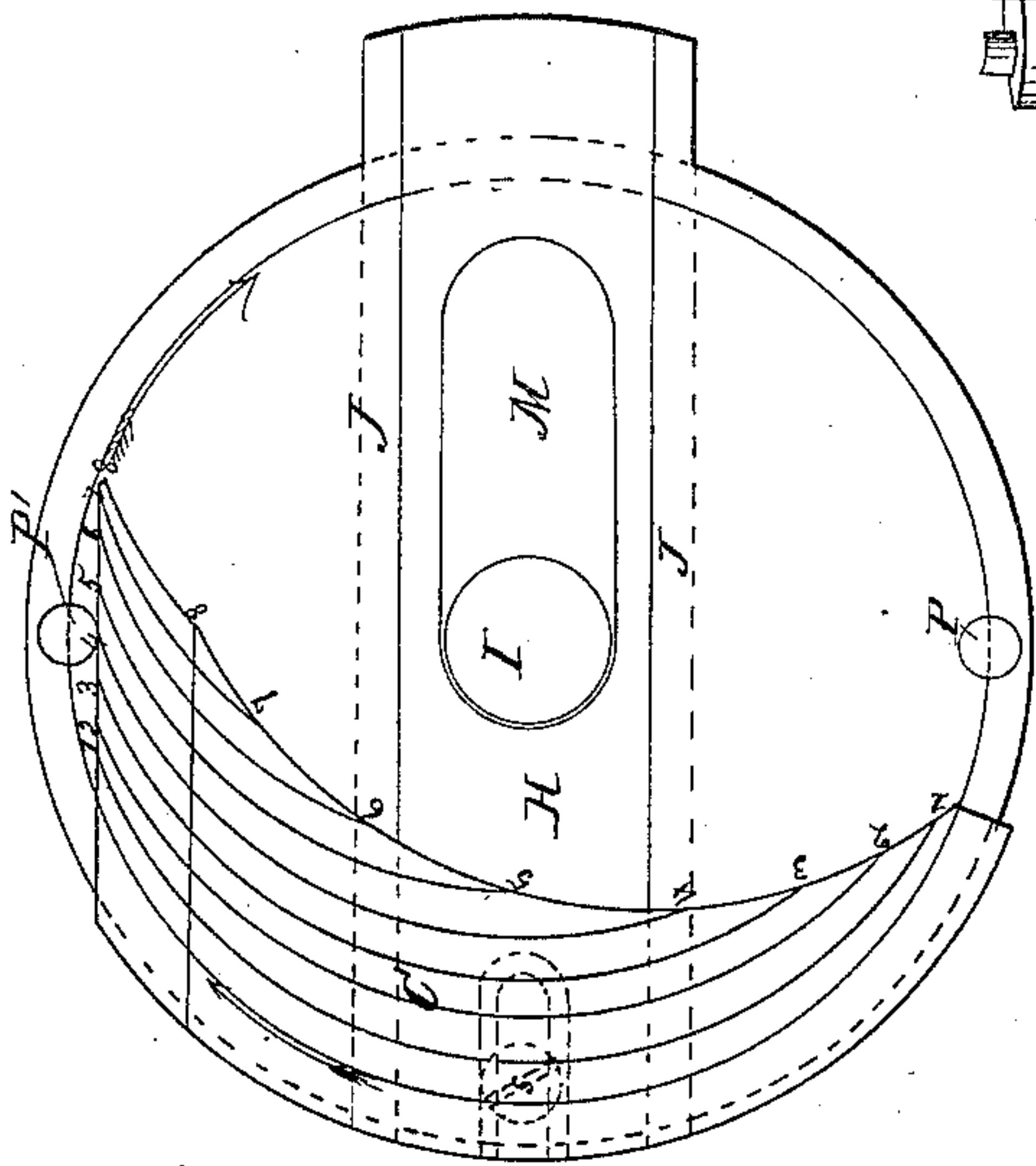
*N<sup>o</sup> 25,722.*

*Patented Oct. 11, 1859.*

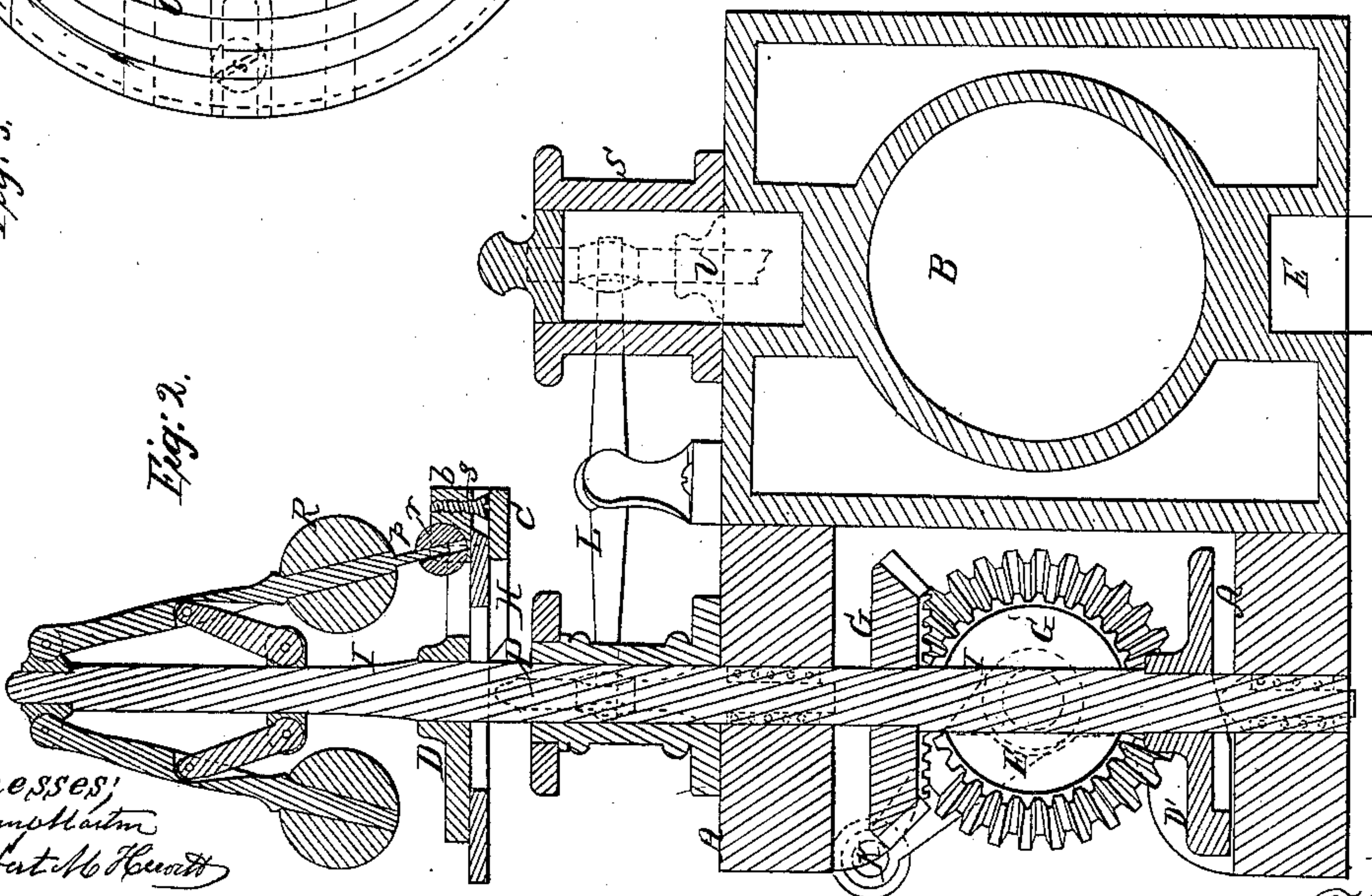
*Fig. 1.*



*Fig. 3.*



*Fig. 2.*



*Witnesses:*  
*Benjamin Hartman*  
*Albert H. Hewitt*

*Inventor:*  
*T. Carynenter*



# UNITED STATES PATENT OFFICE.

TISDALE CARPENTER, OF PROVIDENCE, RHODE ISLAND.

OPERATING THE VALVES OF STEAM-ENGINES.

Specification of Letters Patent No. 25,722, dated October 11, 1859.

*To all whom it may concern:*

Be it known that I, TISDALE CARPENTER, of Providence, in the county of Providence and State of Rhode Island, have invented  
5 certain new and useful Improvements in Devices for Operating or Working the Valves of Steam-Engines, of which the following is a full, clear, and exact description, in which—

Figure 1 is a perspective view showing  
10 the device for working the valves, and one form of attachment to the cylinder of a steam engine. Fig. 2, is a vertical cross section of the same, the regulator having been turned a quarter of a revolution. Fig. 3 is  
15 an enlarged plan view showing the device for producing the effect technically termed "cut off" in working the valves of steam engines.

The nature of my invention and improve-  
20 ments in devices for operating the valves of steam or gas engines consists in a graduated adjustable scroll shaped side cam so arranged that it may be set near to, or far  
25 from the center of motion, so as to vary and graduate the operation of the induction valves to the cylinders of steam or gas engines, so as to supply the quantity of steam  
30 required and then cut off the supply of steam or gas. Also in operating or traversing the said graduated cam, near to, or far  
35 from the center of motion while the engine is in motion by connecting it to a ball governor or regulator, so as to regulate or graduate, the supply of gas or steam, to the  
40 engine, and proportion it to the resistance or power required, and then cut off the supply of steam or gas, the graduated cam being so constructed as to open the valves and  
45 hold them wide open until the required supply of steam has passed, and then close the valves suddenly so as to cut off the further supply of steam to the cylinder, and thereby  
50 use the steam economically by supplying the steam through a port or valve that is wide open; until a sufficient quantity of steam has passed through to generate the power required, and then close the valve suddenly and cut off the supply at once.

That others skilled in the mechanic arts  
50 may make and use my invention I will now proceed to describe the manner in which I have carried it out.

In the drawings, A, represents a portion  
55 of the frame or bed-piece, to which the working parts of an engine are attached, B, is the cylinder, S, is the steam pipe through

which the steam is admitted to the cylinder, and E, is the exhaust pipe through which it is withdrawn.

V, V, are the induction valves, and P, P, 60 are puppets by which they are worked, by means of the connecting levers L, L.

In suitable bearings in the frame of the engine (which in this instance is a horizontal one) is placed an upright shaft I; which 65 shaft is connected by miter gears G, G, to the horizontal shaft F, which is terminated in the drawings and model by the crank K, but in the working engine is continued until it is connected to the main shaft of the en- 70 gine by a pair of wheels corresponding in size and nature to those just mentioned; consequently the upright shaft will at all times agree in speed with the main shaft of the engine. 75

Upon the upper portion of the shaft I, which is raised the required distance above the cylinder of the engine, is placed the commonly formed regulator R which is at- 80 tached to and revolved by it. Immediately beneath the regulator R is placed the disk D, (also permanently attached to the shaft) to which is connected the movable graduated scroll formed, side cam C.

This being the device by which the com- 85 bined action of working the valves and producing the cut off, is performed, I will now explain the manner in which it is constructed. The under surface of the disk hav- 90 ing been made perfectly true and at right angles to the shaft upon which it is placed, has a dovetailed groove J, cut directly across its center a slide H, of corresponding form and fitted to move easily in the groove, is placed therein and its motion back and 95 forth confined within certain limits by the slot M, through which the upright shaft I passes. At one end of this slide the above mentioned cam C, is permanently fixed in such a manner that its convex edge agrees 100 with and becomes concentric with the disk when the cam is carried as near to the center of the disk as the slide will permit.

On the upper side of the slide H, is at- 105 tached a small block b, which by means of a slot in the end of the slide and the corresponding indentations in the edges of the disk is made adjustable so that it may be fixed at a greater or less distance in proportion to the position of the cam C, from the 110 center of the disk D, (the object of this adjustability will be explained hereafter,) to



the inner end of this block is attached by its centers a small roll  $r$ , through which passes the pin  $p$ , which pin being a continuation of one of the arms of the regulator, thereby forms a continuous, as well as adjustable and easily movable connection between the regulator and scroll shaped cam C.

Under the disk D, and at opposite points of its circumference are the puppets P, P, supported in bearings so as to move freely up and down in a vertical direction, and in a cavity in the frame where their lower ends are placed, are spiral springs the tendency of which is to keep the puppets raised up against the under surface of the disk, which is the position when the valves V, are closed. There is also another disk D', of similar form placed on the lower part of the upright shaft I which by a similar system of levers and puppets work the exhaust valves of the engine; with the difference in its motion that as the exhaust valves are always required to be opened and closed at the same point in the revolution of the engine without regard to the speed at which it is running, so I am enabled to dispense with the adjustable scroll cam and supply instead a fixed side cam.

Having explained the form and construction of the devices employed in my invention, I will now explain the manner in which they operate to produce the effect of cutting off the steam from the cylinder of the engine at any desired point in its revolution, said point being governed entirely by the speed of the engine.

It will be seen by reference to the enlarged plan view Fig. 3 of the scroll cam and disk, that the cam is represented as being carried as near to the center of the disk as the slide will allow, that being the position in which it is naturally placed by the gravity of the balls of the regulator when the engine is at rest, or moving so slowly as not to expand them by centrifugal force. Now suppose the disk to be revolving in the direction of the arrow (see Fig. 3) it would carry the cam C, over the ends of the puppets P P', in the line designated by the arrow, consequently the puppet P', is pushed down and its corresponding valve open during such part of a revolution as is contained between 1, and 1', which is equivalent to nearly the entire stroke of the engine thereby admitting steam at its full pressure during all the time that it will be available in moving the engine.

As the engine moves faster the centrifugal force expands the balls of the regulator and as they move outward from the center, they carry the slide and its attendant cam until it brings the line 2 in the same position concentrically with the disk as the line marked by an arrow. It will now be seen that although in its revolution it will strike

the puppet P', at the same point on the disk to open the valve, it will release it a little sooner or that it will drop off at 2', and so on in the same manner the faster the engine runs: and the greater the expansion of the balls of the regulator the farther is the cam C removed from the center, the puppet dropping off and closing the valve at shorter and shorter intervals, as the points 3' 4' 5' 6' 7' 8' are reached and placed in position concentric with the circumference of the disk.

If the speed of the engine should be so great as to still expand the regulator beyond this last point the cam C, would be carried out so far as to revolve in a circle greater in extent than the points of the puppets and of course would then have no effect upon them, and so reduce the speed of the engine by giving it no steam at all until the balls of the regulator are collapsed sufficiently to bring the cam C, again toward the center.

Again it will be seen by examining the outline of the cam C, that on account of the concavity of its inner edge the lines 1, 2, 3, 4, 5, 6, 7, 8, although made with equal radius drop off at greater distances near the center of the concave edge than they do at its extremities; the effect of which is to make the engine more sensitive to the regulator at this point, which can be made to coincide with the point on the cam corresponding to the average speed intended to be maintained, for it is evident that the greater the distance between any two points (as 5', and 6', compared with 1', and 2', which are between lines radially equal) so the less the regulator will have to expand or contract to sensibly shorten or lengthen the period which the valve is kept open.

I now come to the block b, before mentioned which in the present instance forms the connection between the regulator and the slide which was before stated to be adjustable. The object of this adjustment is to enable the engineer readily to change the point at which the average speed of the engine cuts off the steam: thus a given speed of the regulator causes it to expand to a given extent. This expansion carries the cam C, out so that the line 4 (for example,) is in contact with the puppets P, P', corresponding to a little more than half stroke, at which the average speed of the engine cuts off. Now if the screw s, which holds the block b, is loosed and the block moved on the slide H, toward the center of the disk D, and made fast, then the same speed and consequently the same expansion of the regulator which has been maintained before would carry the cam C, out to a greater distance and the engine would cut off at a lesser part of the stroke; or vice versa if the block b, was moved outward from the center the cam would be carried a lesser distance, and the



engine would cut off later or at a greater portion of the stroke, thereby making the engine not only automatic when arranged to run at a given speed with a given pressure of steam, but also capable of having that automatic ability to regulate itself, extended over a great range of variable conditions at the will of the engineer. I would also remark that it is not a necessity that the adjustable block *b*, should be attached to the regulator in the precise manner shown in the model; but that it may be attached by properly jointed rods to the center slide of the regulator or in any other way that may be convenient to the builder.

When the cam is used without a regulator, a set screw may be put in the disk *D*, to hold the slide *H*, so that the cam may be released and adjusted by hand when the engine is stopped. It will also be understood that this plan of working the valves of steam engines is not confined to a horizontal engine alone, nor to any peculiar form of valve, but may be easily adapted to an

upright engine, or to most of the forms of the steam valves in common use.

I believe I have described and represented the improvements which I have made so as to enable any person skilled in the art to make and use them I will now state what I desire to secure by Letters Patent, to wit.

What I claim as my invention and improvements in devices for operating the induction valves of steam or gas engines, so as to supply and graduate the steam or gas in proportion to the power or resistance to be overcome, and cut off the steam or gas when it is no longer required, is—

The adjustable graduated scroll shaped side cam, so arranged, as to be traversed and adjusted by a regulator or governor while the engine is in motion substantially as described; or adjusted and fixed or set by hand while the engine is stopped.

TISDALE CARPENTER.

Witnesses:

HENRY MARTIN,

ALBERT M. HEWITT.