No. 733,686. PATENTED JULY 14, 1903.

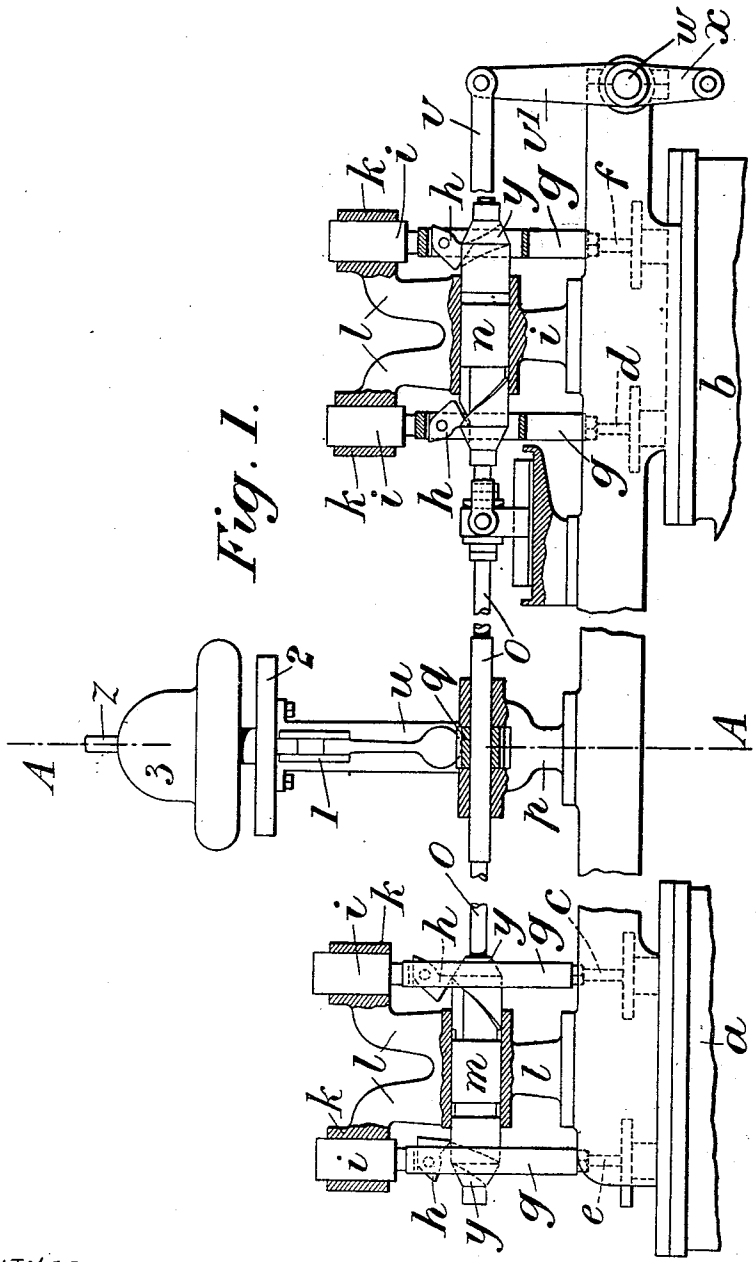
G. THORNLEY.

TRIP EXPANSION VALVE GEAR FOR MOTIVE FLUID ENGINES.

APPLICATION FILED FEB. 17, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

F. W. Wright.

E. W. Collins

INVENTOR

GEORGE THORNLEY

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Fig. 3.

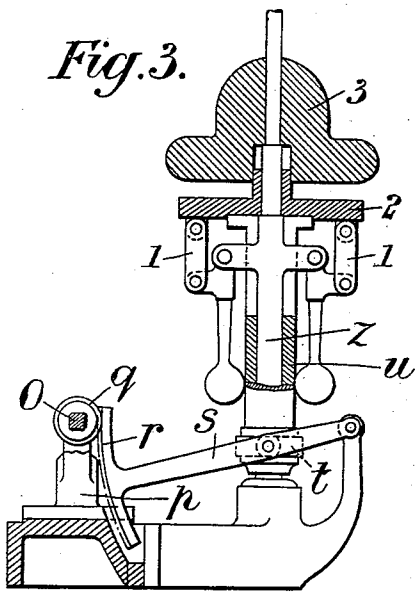


Fig. 2.

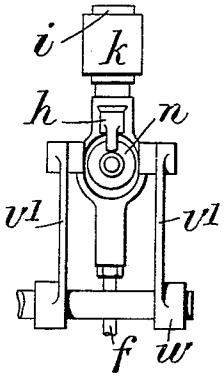


Fig. 4.

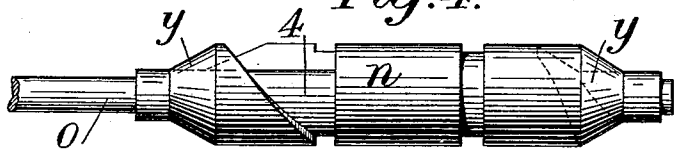
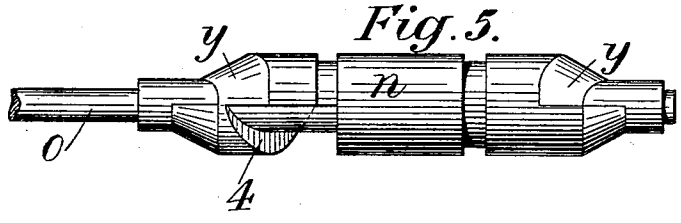


Fig. 5.



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No. 733,686. Patented July 14, 1903.

UNITED STATES PATENT OFFICE.

GEORGE THORNLEY, OF BURTON-UPON-TRENT, ENGLAND.

TRIP-EXPANSION VALVE-GEAR FOR MOTIVE-FLUID ENGINES.

SPECIFICATION forming part of Letters Patent No. 733,686, dated July 14, 1903.

Application filed February 17, 1903. Serial No. 143,803. (No model.)

To all whom it may concern:

Be it known that I, GEORGE THORNLEY, engineer, a subject of the King of Great Britain and Ireland, residing at Waterloo Engineering Works, Burton-upon-Trent, in the county of Stafford, England, have invented certain new and useful Improvements in Trip-Expansion Valve-Gear for Motive-Power Engines, of which the following is a specification.

My invention relates to the trip-expansion gear for which British Letters Patent No. 18,689, dated the 5th day of October, A. D. 1893, were granted to me. The trip-operating device described in the specification of the said Letters Patent consists of a longitudinally-reciprocating conical-ended body, the conical ends as the said body is moved longitudinally acting on the trip-levers to open the valves, the said body being so shaped at the rear of the conical ends that the time during which the valves remain open depends upon the position to which the said body has been turned, and so the point of cut-off of the motive fluid is varied. According to my present invention I provide each of the said ends with a conical helix or equivalent formation, such that when the engine is running and the said body is partially rotated the said body will give through the trip-levers the required amount of lead to the valves.

This invention is especially adapted for application to winding-engines, and when such engines are at rest all the valves are closed and the reversing-lever is in mid-position, so that by throwing the lever over in one direction or the other the engine is started in the desired direction, and thereafter the governor will partially rotate the aforesaid body, so as to give to the valves the required amount of lead. The governor I preferably make with a counterweight in parts, one part normally carried by the governor and a part above supported on a rest, so that the governor has a small counterweight to lift at first and afterward it takes up the additional part of the weight.

In order that my invention may be clearly understood, I will further describe the same with reference to the accompanying drawings, of which—

Figure 1 represents in side elevation, partly in section, an arrangement of trip-operating mechanism according to my invention. Fig. 2 is an elevation of the right-hand end of Fig. 1. Fig. 3 is a vertical section of the governor on the line A A, Fig. 1; and Figs. 4 and 5 are side views of one of the trip-operating devices drawn to a larger scale.

Referring to Fig. 1, *a b* are the valve-chests of a winding-engine, *c d* the rods of the inlet-valves, and *e f* the rods of the exhaust-valves. Each valve-rod carries a frame *g*, to which is pivoted a trip-lever *h*. The frames *g* carry at their upper ends weights *i*, which tend to maintain the valves closed, the weights sliding in guides *k* in brackets *l*, secured to the engine-frame. In each of the brackets *l* is a bearing in which the trip-lever-operating devices *m* and *n* are fitted to slide and partially rotate. The devices *m* and *n* are connected together by a rod *o*, supported in a forked bracket *p*, in the arms of which bracket it is free to slide and also to partially rotate. On a square or equivalently-shaped portion of the rod *o o* and between the arms of the bracket *p* is mounted a pinion *q*, through which the rod *o* is free to slide, but which pinion *q* when partially rotated imparts partial rotation to the said rod. The pinion *q* gears with a segmental rack *r* on a lever *s*, connected by trunnions to a ring *t*, engaged by collars on the sleeve *u* of the governor, so that by variations in the speed of the engine the governor will impart partial rotation through the rack *r* and pinion *q* to the trip-lever-operating devices *m* and *n*. The rod *o* of the trip-operating devices *m* and *n* is connected by links *v* to arms *v'* on a rock-shaft *w*, mounted in bearings in the frame of the engine and carrying an arm *x*, connected by suitable reversing-gear to the eccentrics on the engine-shaft. When the winding-engine is at rest, the whole of the valves are closed and the reversing-lever is in mid-position, the trip-levers then occupying the positions shown on the right-hand side of Fig. 1.

By moving the reversing-lever from its mid-position in one direction or the other the trip-lever-operating devices *m* and *n* will be moved longitudinally in their bearings in the brackets *l*. The end *y* of each of the operating devices, adjacent to the inlet-valve rods *c* and *d*, is of helical-conical form, so that the distance to which the devices are moved

longitudinally by the eccentrics before the conical end comes into contact with the trip-lever carried on the inlet-valve rod will depend upon what part of the helical portion on the end of the operating device is in the track of the trip-lever, the lead of the valve depending upon the circumferential position of the trip-operating devices in the brackets *l*, and this will vary according to the speed of the engine. As the speed of the engine increases the devices will receive through the governor a corresponding increasing motion of partial rotation in the brackets *l*, and the farther they are rotated from their normal position (shown in Fig. 1) the less lost longitudinal motion of the devices will take place before the conical portion commences to act on the trip-lever to open the valve. When the trip-lever *h* carried on the rod of one of the inlet-valves is operated by one of the operating devices *m* or *n* to open the said inlet-valve at one end of the cylinder, the other operating devices act on the trip-lever *h* carried on the rod of the exhaust-valve at the opposite end of the cylinder, so as to open the said exhaust-valve. The ends of the devices which operate the trip-levers of the exhaust-valves are shaped similarly to the ends which effect the opening of the admission-valves, so that at the same time that the inlet-valve is opened at one end of the cylinder the exhaust-valve at the opposite end of the cylinder will be opened. The sleeve *u* of the governor slides on the rod *z* and is slotted at its upper end, through which slots project arms from the rod *z*, to which arms are hinged the governor-balls, which are also connected by links 1 to a weight 2, connected to the upper end of the sleeve *u*.

Fitted to slide on a reduced upper end of the rod *z* is another weight 3, which is normally held out of contact with the weight 2 by a shoulder on the rod *z*.

Up to a certain speed at which the engine is running the weight 2 only will be raised by the centrifugal action of the governor-balls; but when this speed is exceeded the load to be raised by the governor is increased by the weight 2 coming into contact with the weight 3, so that should the load on the engine be suddenly removed the governor will cause the inlet-valves to close or partially close and cut off or reduce the admission of motive fluid.

The cylindrical portion of each of the trip-lever-operating devices *m n* has at the rear of the helical ends which effect the opening of the inlet-valve a helical recess 4, similar to that described in the specification heretofore referred to, by which helical recess the period of cut-off is varied according to the speed of the engine.

I claim as my invention—

Trip-expansion valve-gear for reversible motive-fluid engines, comprising a governor, a reversing-lever, valves, trip-levers and a longitudinally-reciprocating body having helical conical ends such that when the engine is at rest, and the reversing-lever is in mid-position, all the valves are closed, and means operated by the governor when the engine is running to partially rotate the said body to give the desired amount of lead to the valve through the trip-levers, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE THORNLEY.

Witnesses:

HARRY BURTON,

EDWARD DAVIS.