

No. 765,689.

PATENTED JULY 26, 1904.

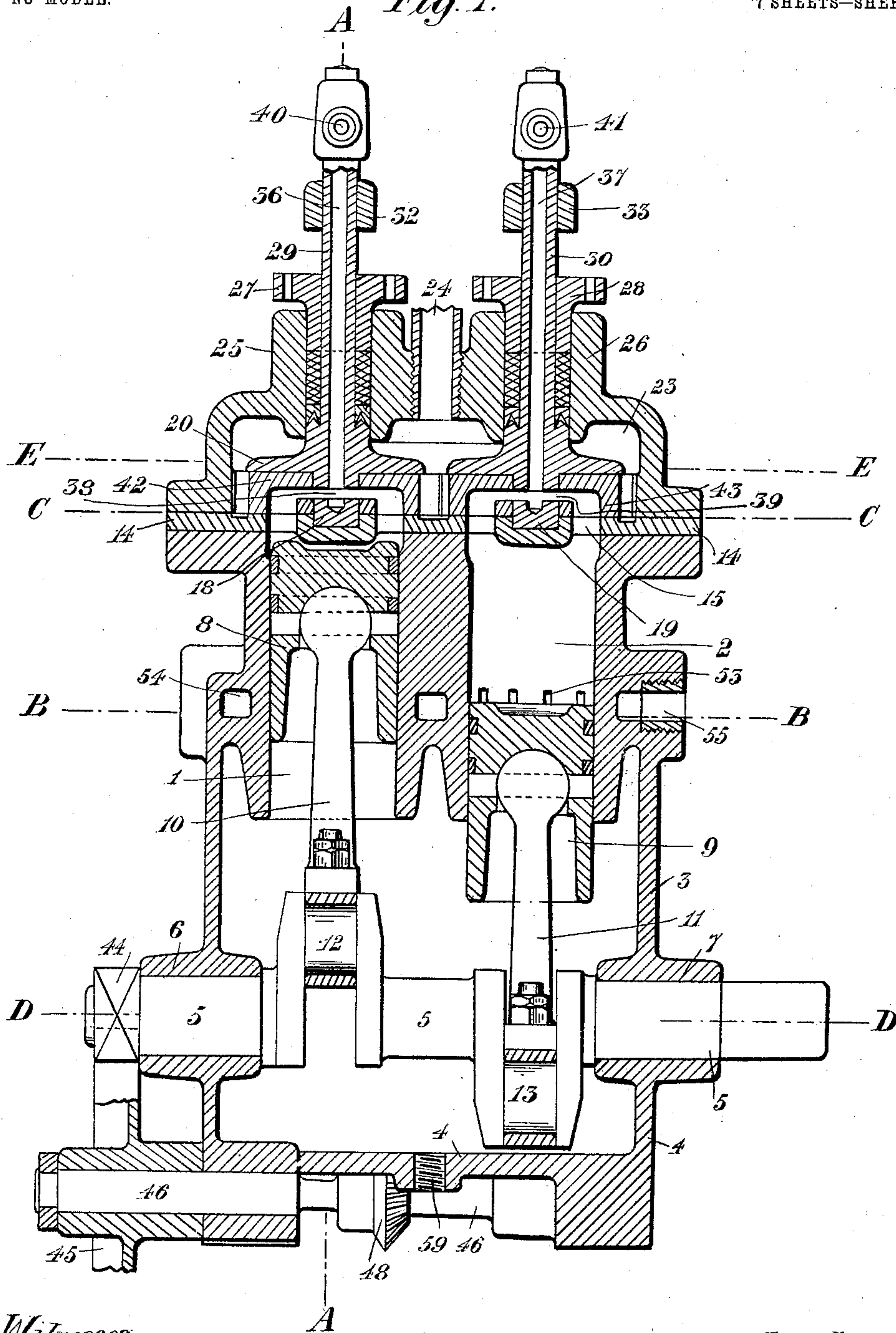
P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

NO MODEL.

*Fig. 1.*

7 SHEETS—SHEET 1.



Witnesses  
T. M. Kuchner  
John A. Percival

Inventor  
Peter Thornley  
By *Ruband*  
ATTORNEYS

No. 765,689.

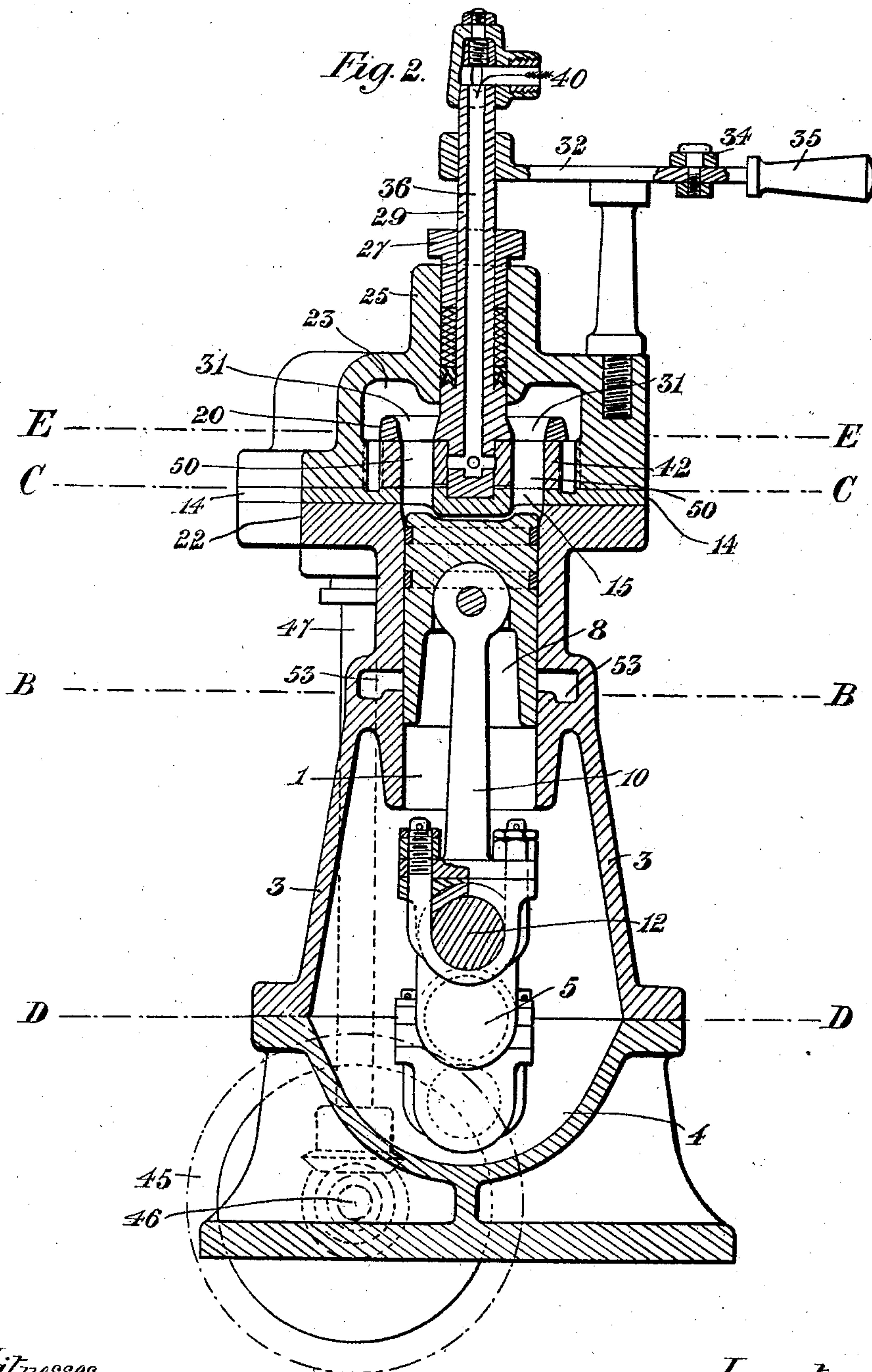
PATENTED JULY 26, 1904.

P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

NO MODEL.

7 SHEETS—SHEET 2.



Witnesses  
Wm. Kuehne  
John A. Percival

Inventor  
Peter Thornley  
BY *Richard H. [Signature]*  
ATTORNEYS

No. 765,689.

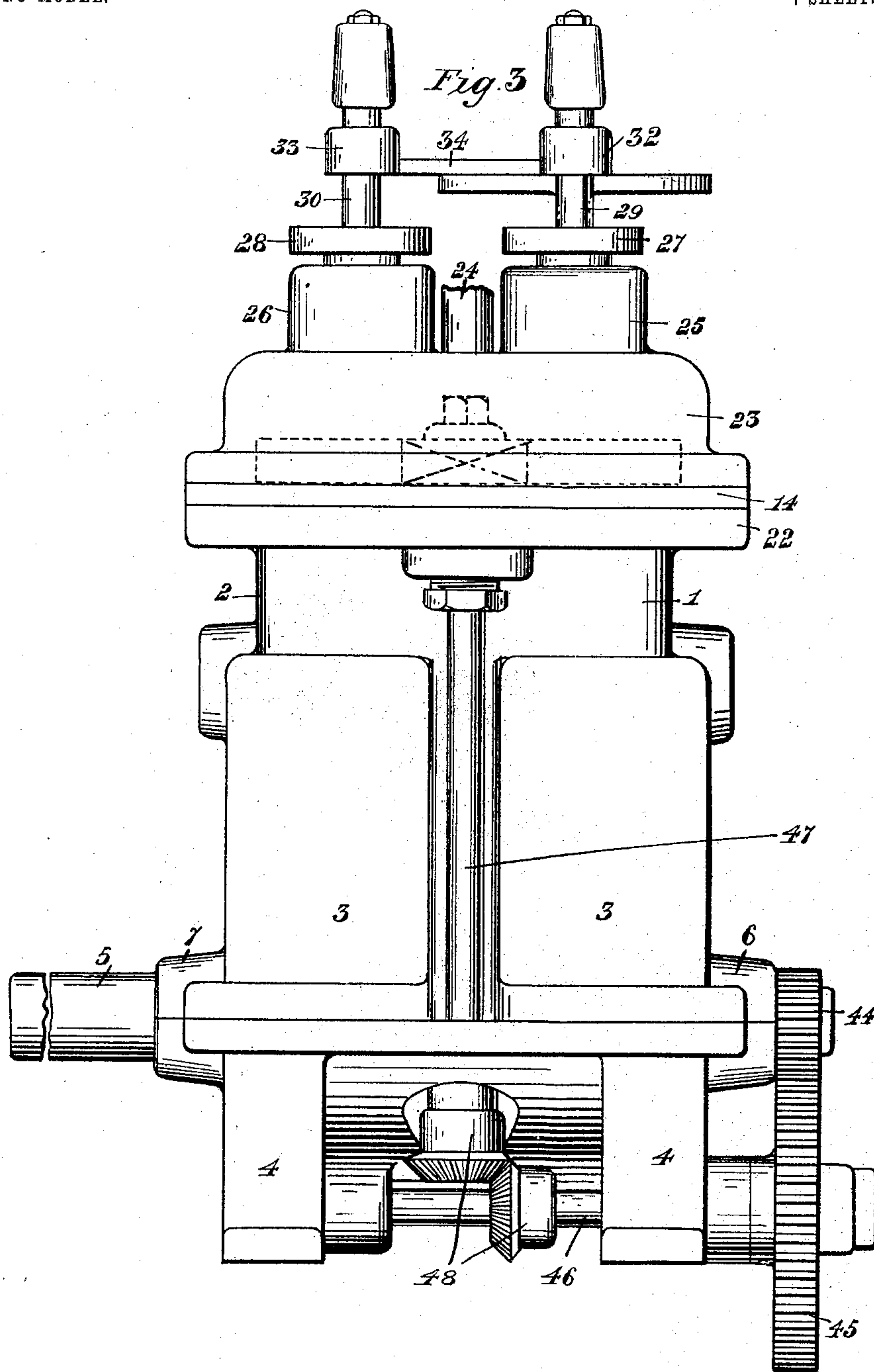
PATENTED JULY 26, 1904.

P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

NO MODEL.

7 SHEETS—SHEET 3.



*Witnesses*  
*Wm Kuehne*  
*John A. Percival*

*Inventor*  
*Peter Thornley*  
*BY* *Richard R.*  
ATTORNEYS



No. 765,689.

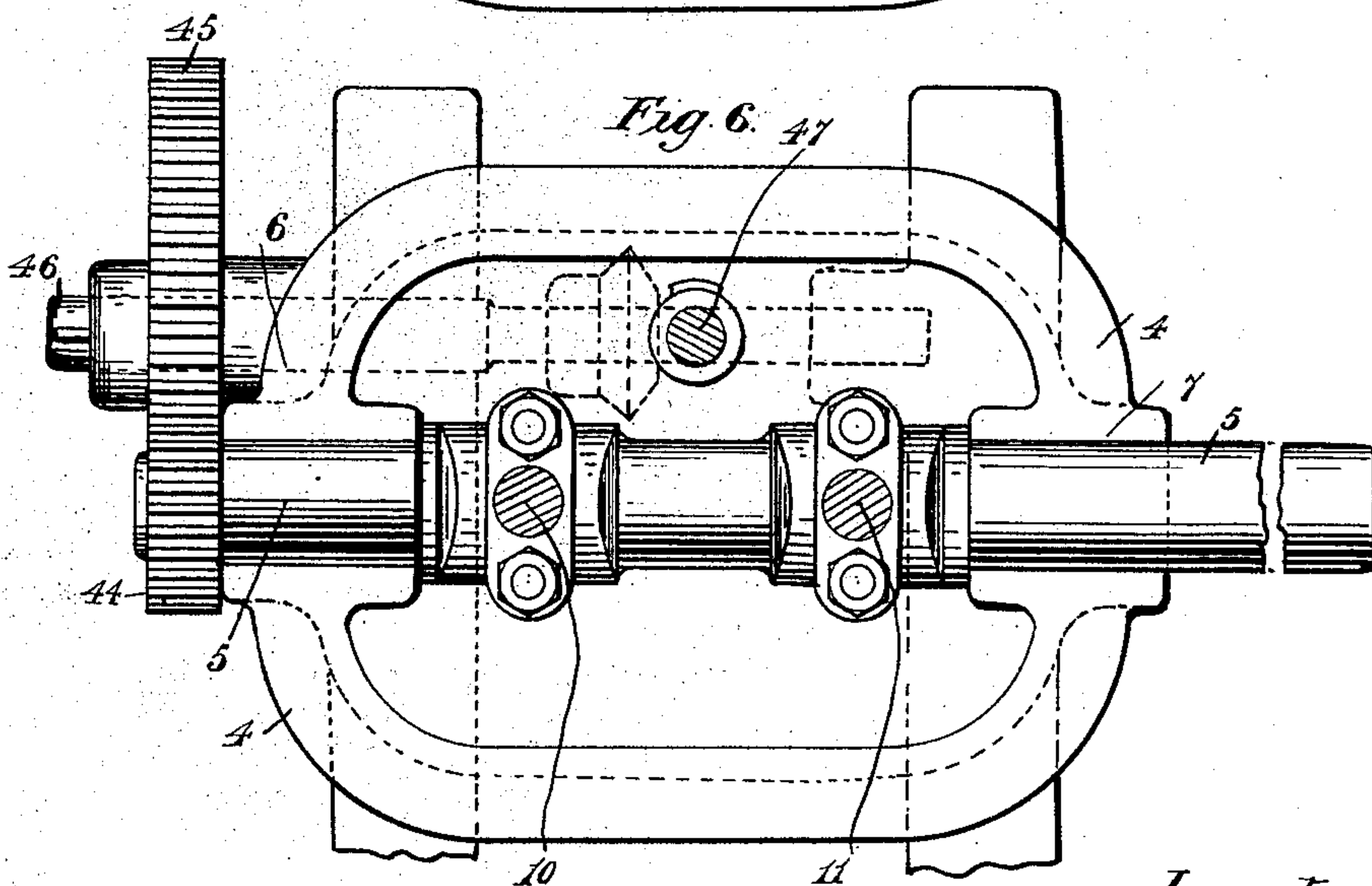
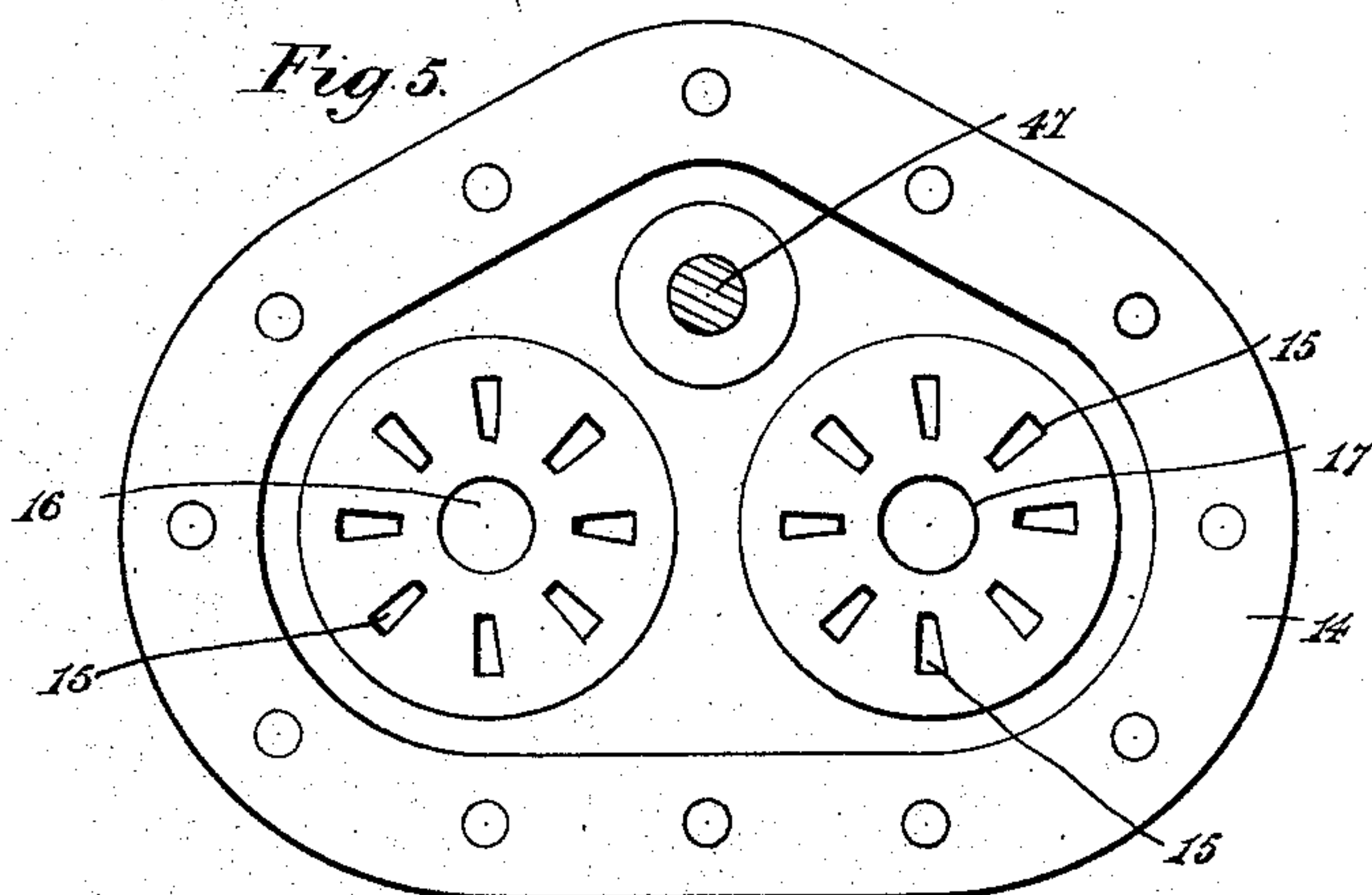
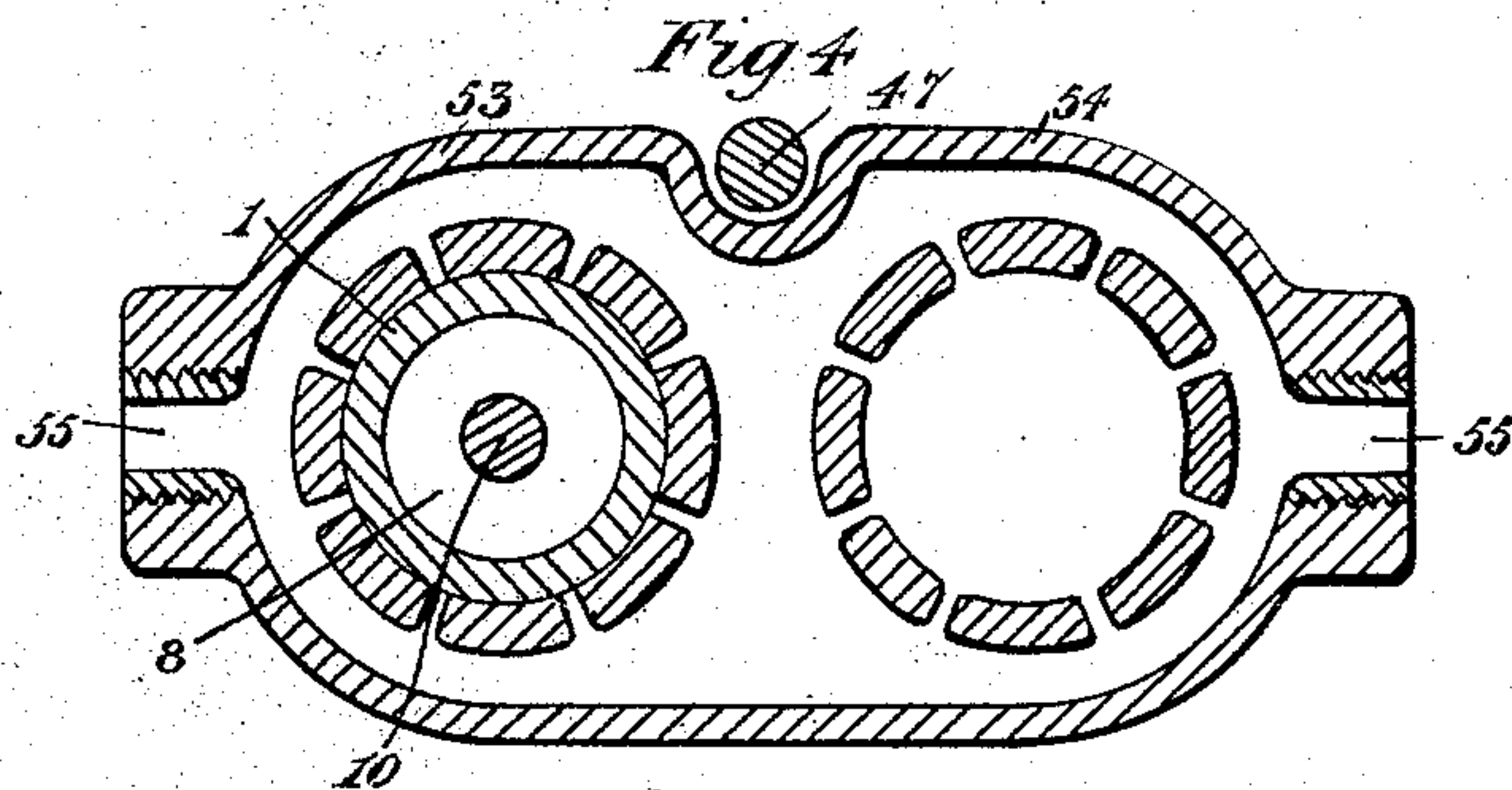
PATENTED JULY 26, 1904.

P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

NO MODEL.

7 SHEETS—SHEET 4.



Witnesses

Wm. Kuchue

John A. Percival

Inventor

Peter Thornley

By *Richard J. Richards*

ATTORNEY'S

No. 765,689.

PATENTED JULY 26, 1904.

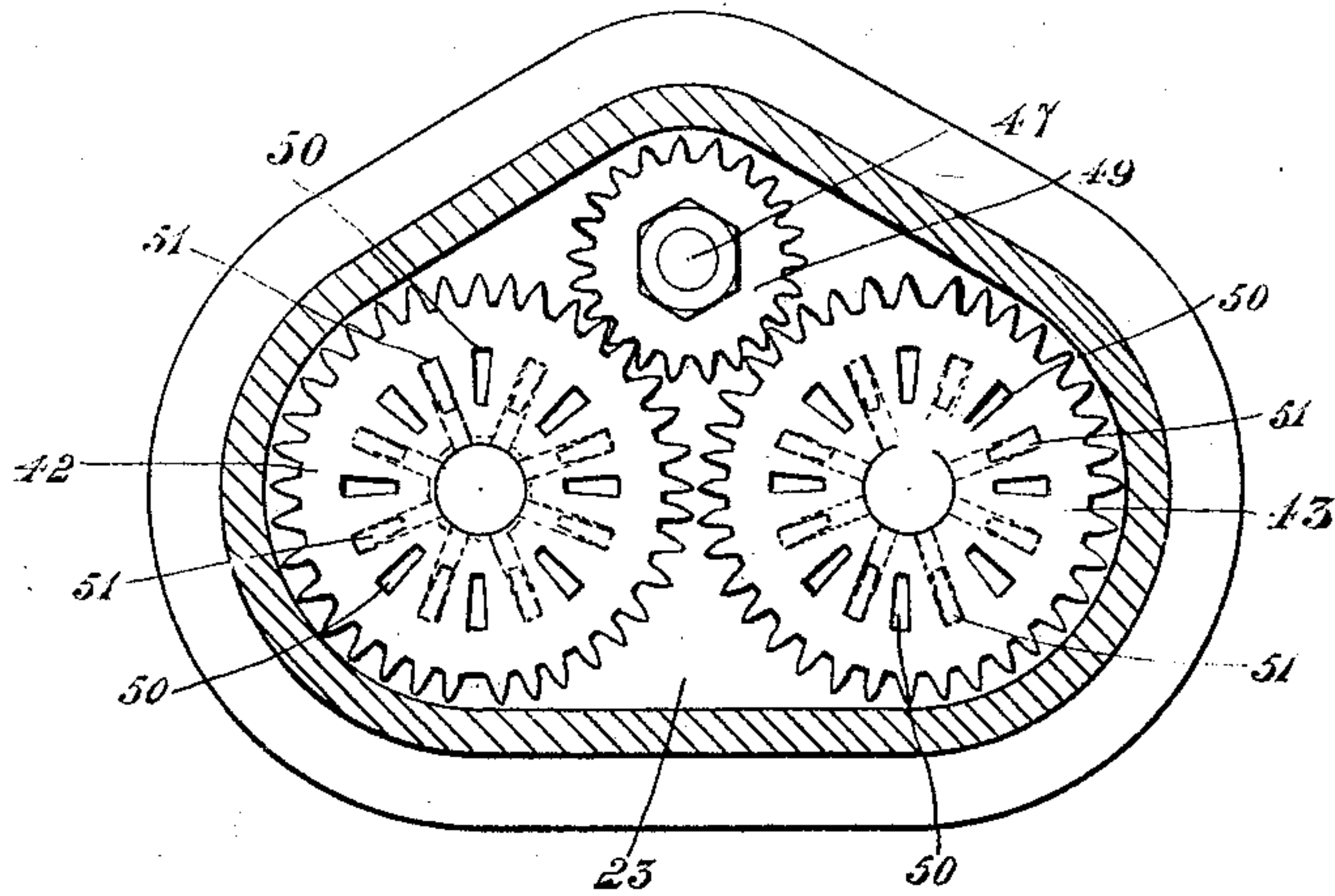
P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

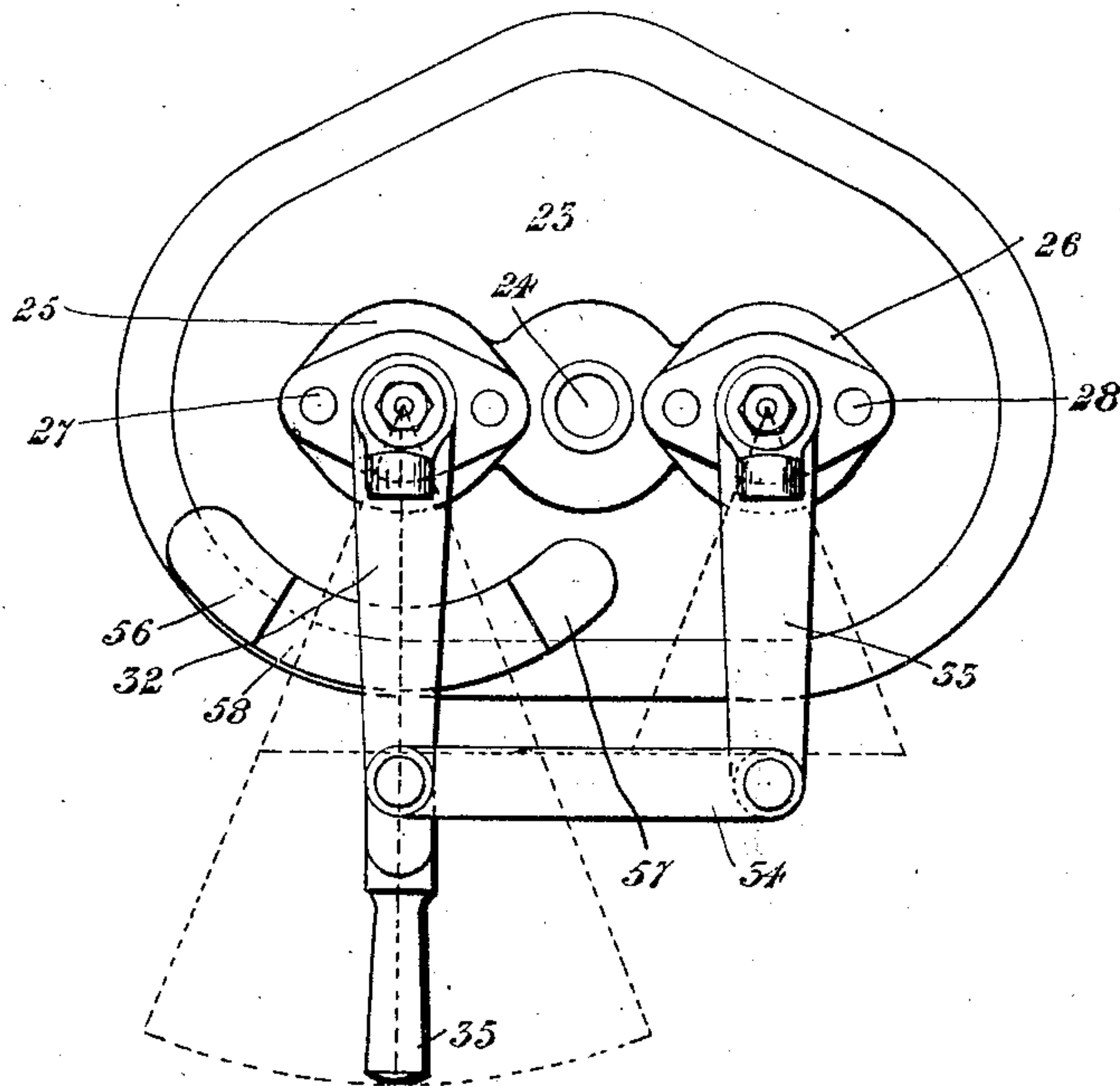
NO MODEL.

7 SHEETS—SHEET 5.

Fig. 7.




*Fig. 8.*



*Witnesses.*

Wm. Kuchner  
John A. Percival

*Inventor.*

Peter Thornley  
BY   
ATTORNEYS

ATTORNEYS

No. 765,689.

PATENTED JULY 26, 1904.

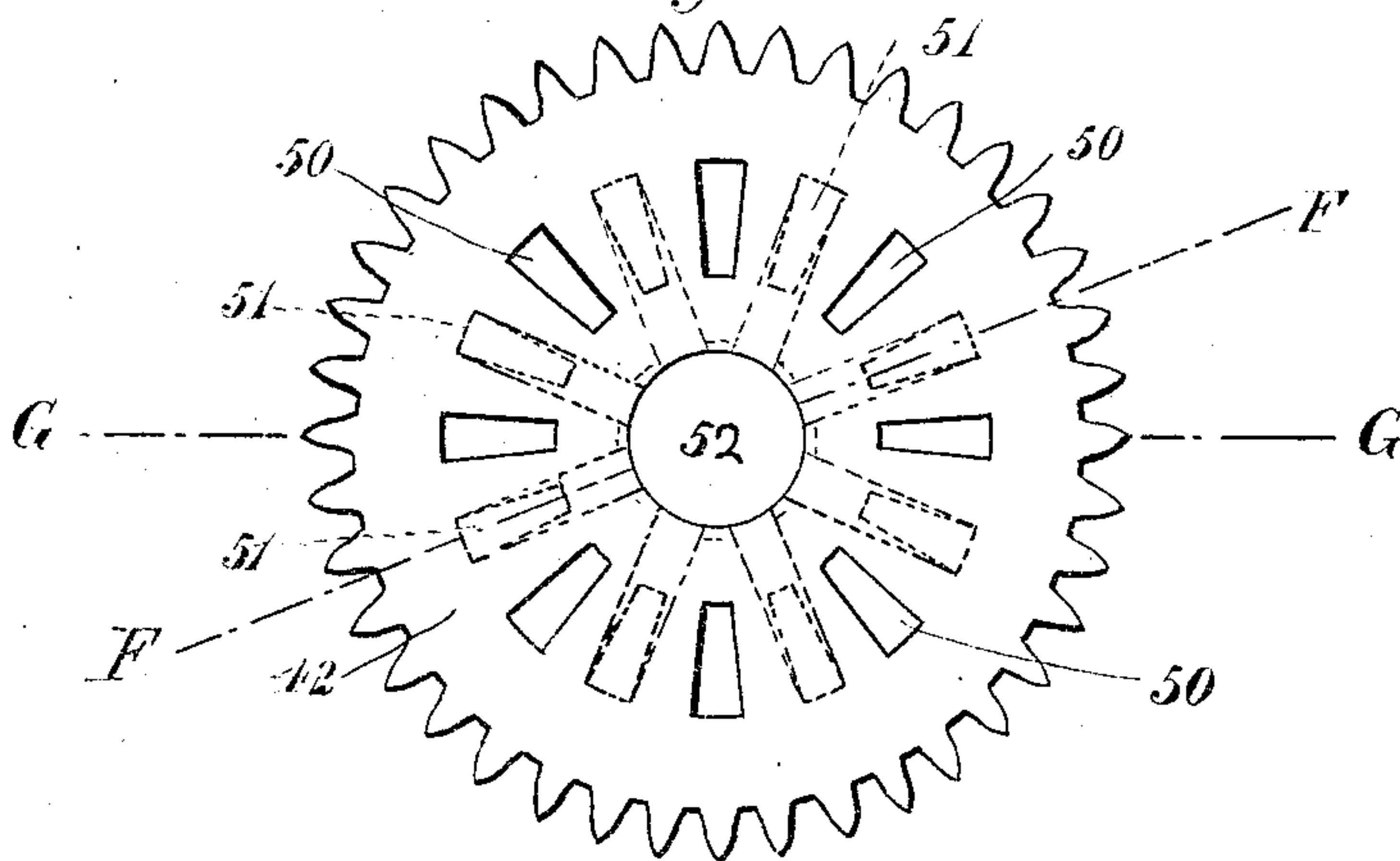
P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

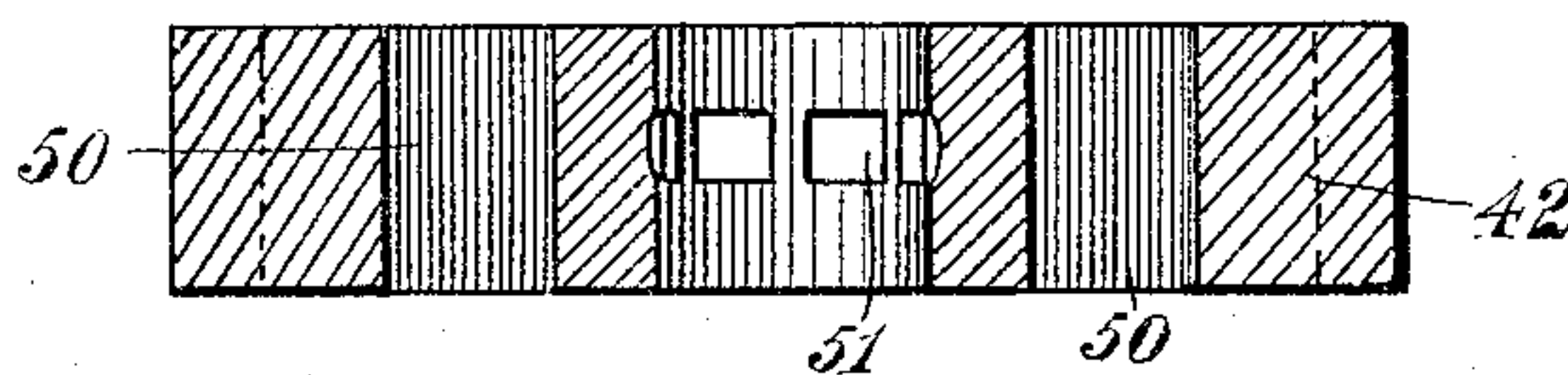
NO MODEL.

7 SHEETS—SHEET 6.

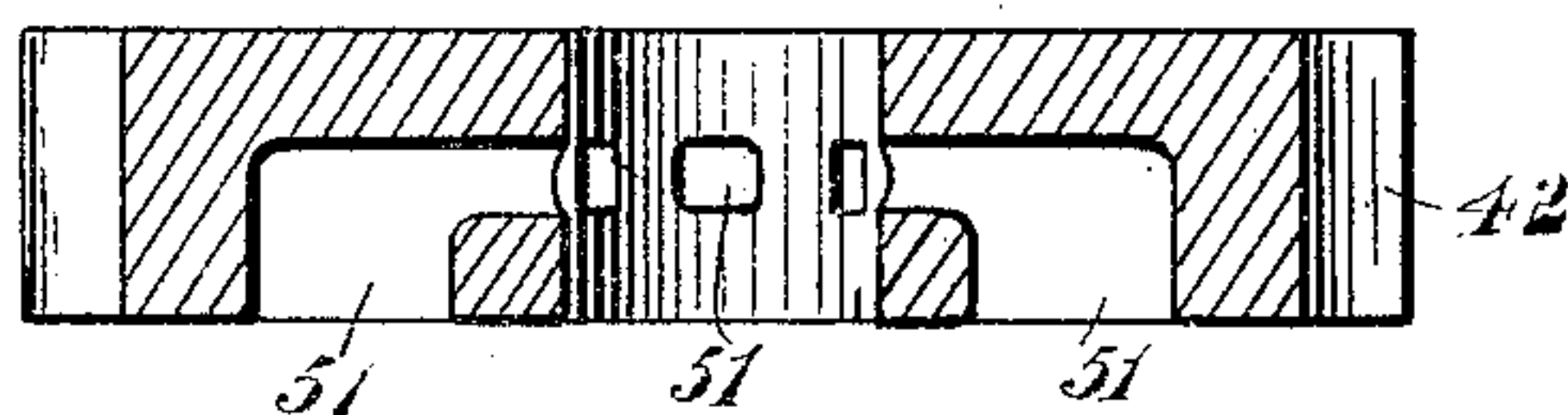
*Fig. 9*



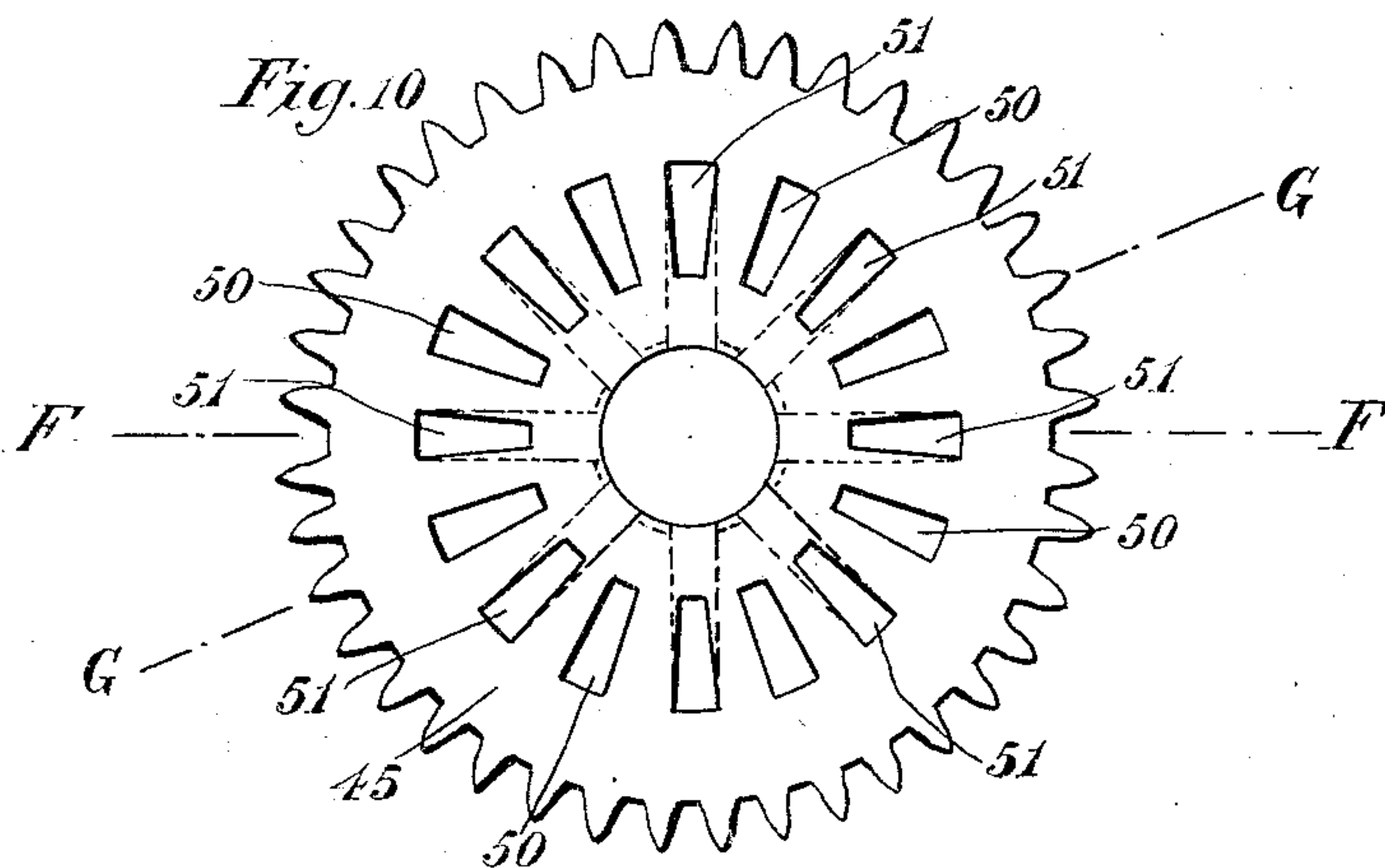
*Fig. 12.*



*Fig. 11.*



*Fig. 10*



Witnesses.

*Wm. Kuchel*  
*John A. Percival*

Inventor

*Peter Thornley*  
BY *Ruband*  
ATTORNEYS



No. 765,689.

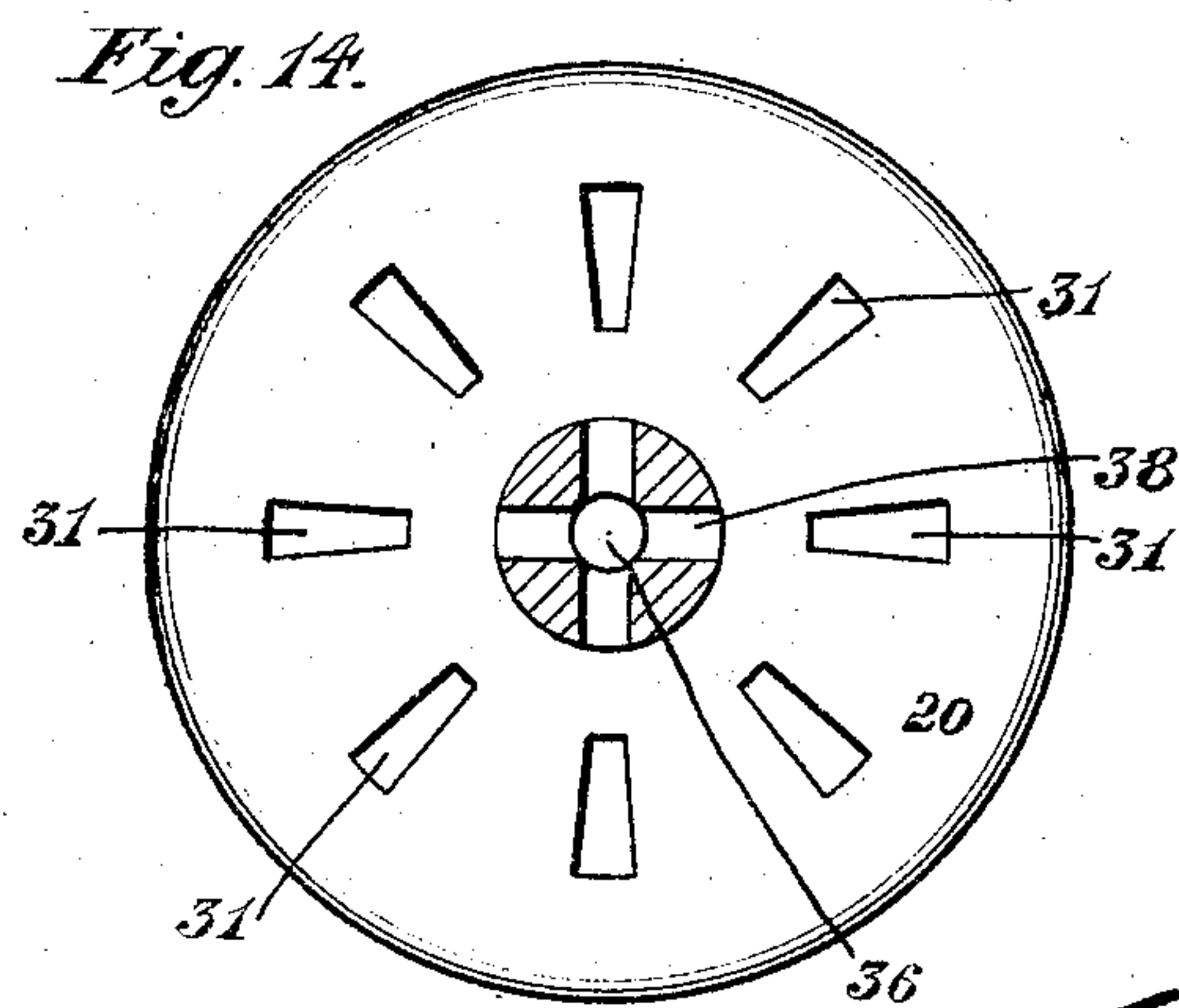
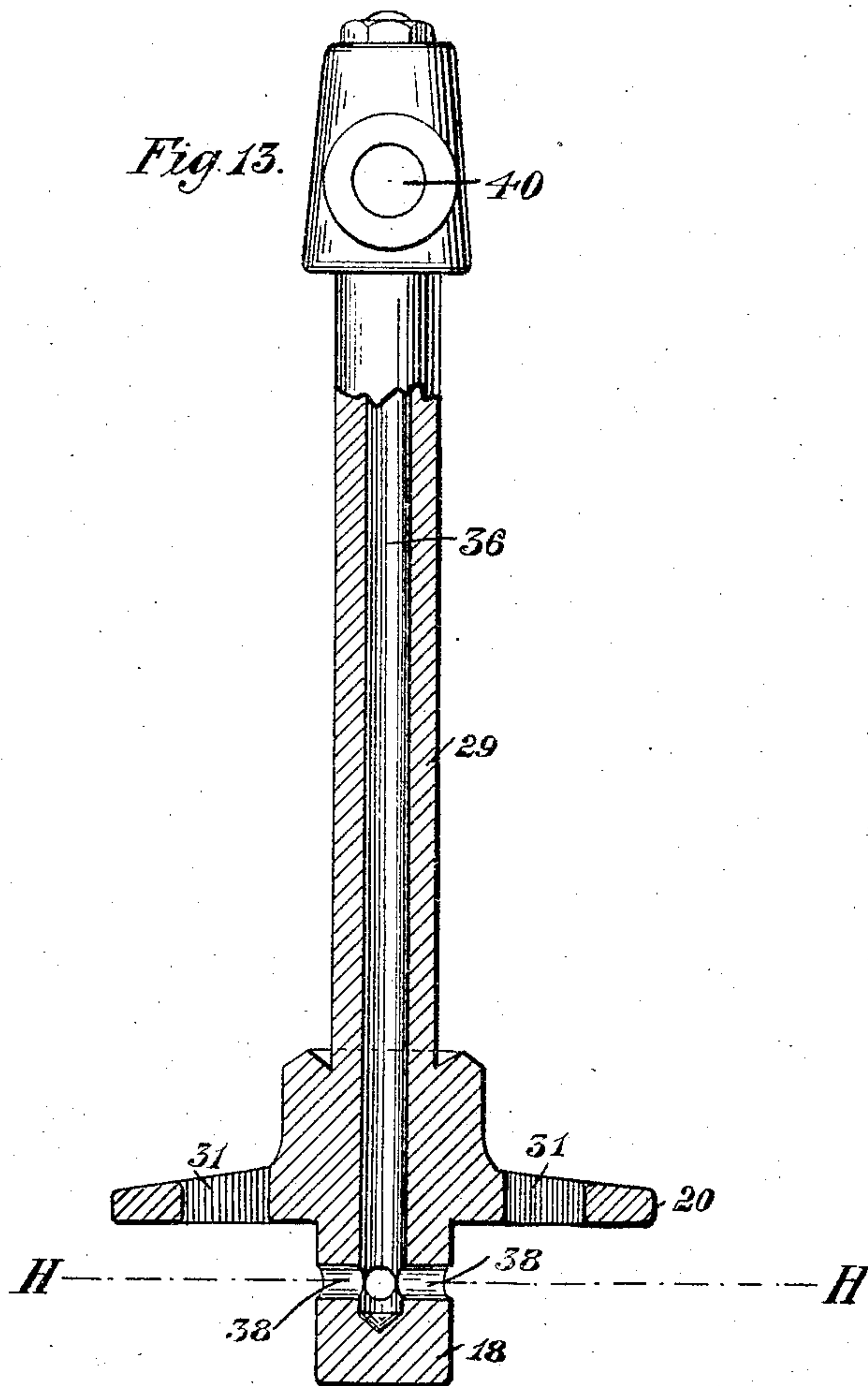
PATENTED JULY 26, 1904.

P. THORNLEY.  
STEAM ENGINE.

APPLICATION FILED DEC. 1, 1903.

NO MODEL.

7 SHEETS—SHEET 7.



Witnesses  
*Wm. Kuehne*  
*John A. Fercival*

Inventor  
*Peter Thornley*  
BY *Richard H. [Signature]*  
ATTORNEYS

# UNITED STATES PATENT OFFICE.

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

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 765,689, dated July 26, 1904.

Application filed December 1, 1903. Serial No. 183,394. (No model.)

*To all whom it may concern:*

Be it known that I, PETER THORNLEY, engineer, a subject of His Majesty the King of Great Britain and Ireland and of the British  
5 Dominions beyond the seas, Emperor of India, residing at 59 Shobnall street, Burton-upon-Trent, in the county of Stafford, England, have invented certain new and useful Improvements in Steam and other Fluid-Pressure Engines,  
10 of which the following is a specification.

This invention consists of the herein-described improvements in steam and other fluid-pressure engines—such, for instance, as compressed-air engines and water-pressure en-  
15 gines. An engine constructed according to this invention has very few working parts, and therefore the wear and tear are reduced to a minimum, and moreover the arrangement is such that there is practically no waste of  
20 fluid-pressure in the ports and passages, and when working with an expansive fluid, such as steam or compressed air, the steam or compressed air can be cut off at various parts of the stroke or the engine reversed by one lever,  
25 which also serves for stopping and starting.

This invention is illustrated by the accompanying drawings, on which—

Figure 1 is a sectional side elevation of a double-cylinder steam-engine constructed in  
30 accordance with this invention. Fig. 2 is a cross-sectional elevation of the same on line A A of Fig. 1. Fig. 3 is a back elevation of the said engine. Fig. 4 is a sectional plan of the cylinders through the line B B in Figs. 1  
35 and 2. Fig. 5 is a plan on line C C of Figs. 1 and 2, so as to show the steam-inlet passages to the cylinders. Fig. 6 is a plan of the lower part of the engine on line D D of Figs. 1 and 2, but with the crank-shaft shown in elevation.  
40 Fig. 7 is a sectional plan through the steam-chest on line E E of Figs. 1 and 2, showing the steam-inlet valve and the means for operating it. Fig. 8 is a plan of the upper part of the engine. Fig. 9 is a plan of one of  
45 the steam-inlet valves. Fig. 10 is an inverted plan of the same. Fig. 11 is an elevation of the same valve on line F F of Figs. 9 and 10. Fig. 12 is a cross-sectional elevation of the same on line G G of Figs. 9 and 10. Fig. 13  
50 is an elevation, partly in section, of one of the

combined cut-off and stopping and starting and reversing valves of the said engine drawn on the same scale as Figs. 9, 10, 11, and 12; and Fig. 14 is an inverted sectional plan of the said valve on line H H of Fig. 13.

The same reference-numerals indicate the same parts in all the figures.

I will describe my invention constructed as a double-cylinder steam-engine; but it is to be understood that the same engine will  
60 work equally well with other fluid, such as compressed air or water under pressure, and that it can be made with only one or more than two cylinders, and when made with more than one cylinder the cylinders are arranged  
65 side by side, as in Fig. 1, with the connecting-rods of their pistons all coupled to the same crank-shaft.

The engine has two steam-cylinders 1 2, forming part of the casing 3 of the engine, 70 which is bolted onto the base part 4, so as to make an inclosure for the lubricating-oil, the joint of the casing 3 to the base 4 being, as in some other engines, about on the center line of the crank-shaft 5, which revolves in bear- 75 ings 6 7 in the casing 3 and base 4. Working, respectively, in the cylinders 1 2 are ordinary trunk-like pistons 8 9, connected by connecting-rods 10 11 onto the crank-pins 12 13 of the crank-shaft 5, so that each cylinder 80 is single-acting, and for this reason the crank-pins 12 13 are arranged on opposite centers, as shown. So far this construction of engine is common. Fixed on the top of each of the cylinders 1 2 is a plate 14, (shown separately 85 by Fig. 5,) through which are steam-ports 15, arranged radially through the center of each cylinder, and for each cylinder I have shown eight of these steam-ports, because in the particular engine on my drawings the steam-in- 90 let valves, hereinafter described, revolve once for eight revolutions of the crank-shaft; but it is to be understood that I do not limit myself to any particular number of the steam-ports 15. These steam-ports 15 are, as shown, 95 narrow radial ports arranged in a circle which is somewhere about the same diameter as the cylinder, and in the center of each circle over the cylinder there is a circular recess, (marked, respectively, 16 17,) which form bearings for 100



the lower parts 18 19 of the stems of the cut-off valves 20 21, hereinafter described. Fixed on the top of this plate 14 and to the top flange 22 of the cylinder is a steam-chest 23, provided with a steam-inlet 24 and made with stuffing-box bearings 25 26, fitted with glands 27 28 for the stems 29 30 of the cut-off valves 20 21, one of which is shown separately in Figs. 13 14 and by which it will be seen that each cut-off valve 20 21 has a disk-like part of somewhat larger diameter than the cylinder and made with eight cross-ports 31 passing through it and corresponding with the eight steam-ports 15 in the plate 14. Fixed, respectively, on the stems 29 30 of these two valves 20 21 are two levers (marked, respectively, 32 33) jointed together by a cross-line 34 (see Fig. 8) and the lever 32 being continued as a handle 35 for stopping or starting or reversing or altering the cut-off of the engine. Each of the stems 29 30 is made tubular by having an internal passage, which passages are respectively marked 36 37, leading from cross-passages 38 39 in the lower parts 18 19 of the valve and up to outlets 40 41 for the escape of part of the exhaust-steam from the cylinders in the working of the engine, as hereinafter described. Between the under face of the valves 20 21 and the top of the plate 14 there is provided for each cylinder a disk-like valve, which valves are marked, respectively, 42 43, and one of them—namely, that marked 42—is shown separately on an enlarged scale in Figs. 9, 10, 11, and 12. Each of these valves 42 43 is made like a wheel with spur-teeth on its periphery, so as to revolve round the stems 18 19 of the valves 20 21, the rotary motion being obtained from the crank-shaft 5 by means of suitable gearing—such, for instance, as shown on my drawings, where it will be seen that on the end of the crank-shaft 5 there is a spur-pinion 44, which gears with a spur-wheel 45, fixed on the counter-shaft 46, which revolves in suitable bearings in the base part 4 of the engine. Rotary motion is communicated from the shaft 46 to the vertical shaft 47 through miter-wheels 48 and from this shaft 47 to the valves 42 43 by the spur-pinion 49, which is fixed on the shaft 47 in the steam-chest 23 and gears with both the valves 42 43. In this particular engine the gearing is so proportioned that the valves 42 43 revolve at one-eighth the speed of the crank-shaft 5; but this reduction of speed is merely to save the wear on the valves 42 43 and the surfaces on which they work, and, if desired, this proportion of gearing may be varied, as will readily be understood. Each of the valves 42 43 has eight steam-ports 50 passing right through the valve from the top to the bottom and corresponding with the ports 15 in the plate 14 and also with the ports 31 in the valves 20 21. In each of the valves 42 43 there are also eight exhaust-ports 51, arranged at intermediate distances between the steam-ports 50 and also

matching the steam-ports 15 in the plate 14; but these exhaust-ports 51 do not pass right through the valves 42 43, but extend upward from the under side of the same, as shown in Fig. 11, and then turn toward the center and open out into the opening 52 at the center of the valve, where they communicate with the passages 38 39 in the stems of the cut-off valves 20 and 21 and to the passages 36 37, leading up the center of the same to the exhaust-outlets 40 41. In the walls of each cylinder 1 2 and at the lower part of the same, so as to be uncovered by the pistons just before they arrive at the end of their travels, there are exhaust-passages 53, communicating with an exhaust-chamber 54 and with an exhaust-outlet 55, these passages 53 taking the main portion of the exhaust; but such steam as cannot escape before these ports are again covered by the piston escapes through the other exhaust-ports 51 and up through the valves 20 21 and out through the exhaust-pipes 40 41, as hereinbefore described.

The engine above described operates as follows: When the lever-handle 35 is in its central position, (shown in Fig. 8,) the valves 20 21 are in such positions that the steam cannot enter the cylinders, as the ports 31 in the valves 20 21 are intermediate between the ports 15 in the plate 14, and the ports 31 are closed by the blank spaces of the valves 42 43 before the ports 15 are open. In order to start the engine, the hand-lever 35 has to be moved to the right hand to run the engine in one direction or to the left hand to run the engine in the other direction, this movement of the hand-lever turning the combined starting and stopping and reversing and cut-off valves 20 21 so far that there is for a short period a passage for the steam through the ports 31, 50, and 15 to the cylinder just at the proper time for the downstroke of the piston, and the proportion of the stroke during which these ports remain open depends upon the angle through which the hand-lever 35 is turned, as if the hand-lever 35 is turned through but a short distance from its central position, (shown in Fig. 8,) the steam-ports will be open for a very short time, and the steam will be cut off early in the stroke, and thereby work expansively, and the farther the hand-lever 35 is moved the more nearly the ports 31 of the cut-off valves come opposite to the ports 15 in the plate 14, the engine taking full steam when the hand-lever 35 is moved to its full distance (indicated by the dotted lines in Fig. 8) and limited by the stop 56 or 57 on the quadrant 58. When it is desired to run the engine in the opposite direction, the lever 35 has to be moved from its central position in the opposite direction, and when it is desired to stop the engine the hand-lever is moved to its central position. (Shown in Fig. 8.) It will be seen that when the engine is at work the valves 42 43 revolve with



the engine and admit and cut off the steam at the proper times to the cylinders, and when the main portion of the steam has been exhausted through the ports 53 what further steam remains passes out through the ports 15 and exhaust-passages 51 and up the passages 36 37 in the valve-stems 29 30 and out through the outlets 40 41 in the upper part of the said valve-stems.

10 It is to be understood that the working faces of the valves 42 43 and of the plate 14 and valves 20 21 are very accurately fitted, so as to be steam-tight, and the engine is effectually lubricated by the oil being admitted with the steam through the steam-inlet 24, from whence it works down through the cylinders and into the inclosed casing 3 4, and thus lubricates the bearings of the connecting-rods 10 11 and of the crank-shaft 5.

20 59 is an outlet for the superfluous oil, a suitable drain-pipe and cock (not shown on the drawings) being provided.

The accompanying drawings illustrate what I consider to be the best way of carrying my invention into practice; but it is to be understood that my invention is not limited to the precise details shown, as, for instance, the driving of the valves 42 43 may be varied without departing from the nature of my invention.

30 What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a steam or other fluid-pressure engine of the cylinder and reciprocating-piston type, a cylinder, a series of inlet-ports arranged in a circle in the cylinder end, a revolving disk-like valve adapted to revolve on the cylinder end and having inlet-ports corresponding with said inlet-ports of the cylinder and also having intermediate exhaust-ports on the side adjacent to the cylinder communicating with its hollow central portion, means for rotating said valve from the engine crank-shaft, a disk-like combined cut-off, stopping, starting and reversing valve fitting on the face of said revolving valve and made with ports corresponding with the ports therein and having a hollow stem communicating with the exhaust-passages in the said revolving valve, means for turning the cut-off valve from the outside, said cylinder having exhaust-ports which are uncovered by the piston when nearly at the end of its forward stroke, said valves being so

arranged that as the revolving valve revolves the steam or other fluid-pressure is thereby admitted to and cut off from the cylinder at the proper times, the point of cut-off being determined by the angle through which the cut-off valve is turned which when in its central position shuts off the supply of steam or other fluid-pressure to the cylinder and when turned from the right to the left hand or vice versa will reverse the engine, substantially as set forth.

2. A steam or other fluid-pressure engine of the cylinder and reciprocating-piston type, having two or more cylinders and reciprocating pistons with connecting-rods connected to one and the same crank-shaft, each cylinder having a series of inlet-ports arranged in a circle in the cylinder end and also a revolving disk-like valve adapted to revolve on the cylinder end and provided with inlet-ports corresponding with said inlet-ports of the cylinder and also having intermediate ports on the side adjacent to the cylinder communicating with its hollow central portion, means for rotating said valves simultaneously from the engine crank-shaft, each cylinder having a disk-like combined cut-off, stopping, starting, and reversing valve fitting on the face of its revolving valve and made with ports corresponding with the ports therein and having a hollow stem communicating with the exhaust-passages in said revolving valve, means for turning the cut-off valves simultaneously from the outside, each of said cylinders having exhaust-ports which are uncovered by its piston when nearly at the end of its forward stroke, the said valves being so arranged that as the revolving valves revolve the steam or other fluid-pressure is thereby admitted to and cut off from the cylinders at the proper times in consecutive order, the point of cut-off being determined by the angle through which the cut-off valves are turned, which cut-off valves when in their central positions shut off the steam or other fluid-pressure to the cylinder and when turned from the right to the left hand or vice versa will reverse the engine, substantially as set forth.

In witness whereof I have hereunto set my hand in presence of two witnesses.

PETER THORNLEY.

Witnesses:

CHARLES BOSWORTH KELLEY,  
THOMAS JOHN ROWE.