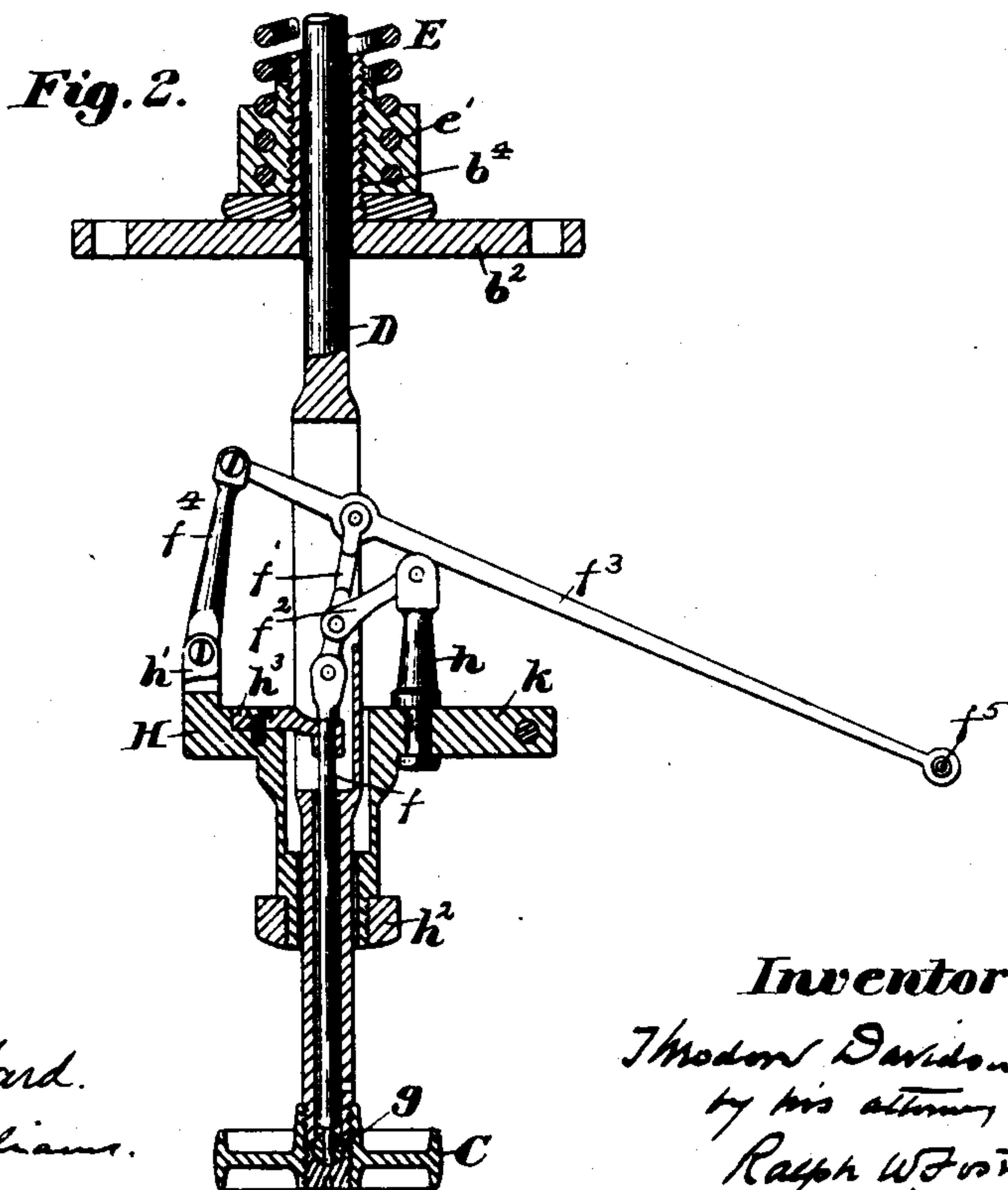
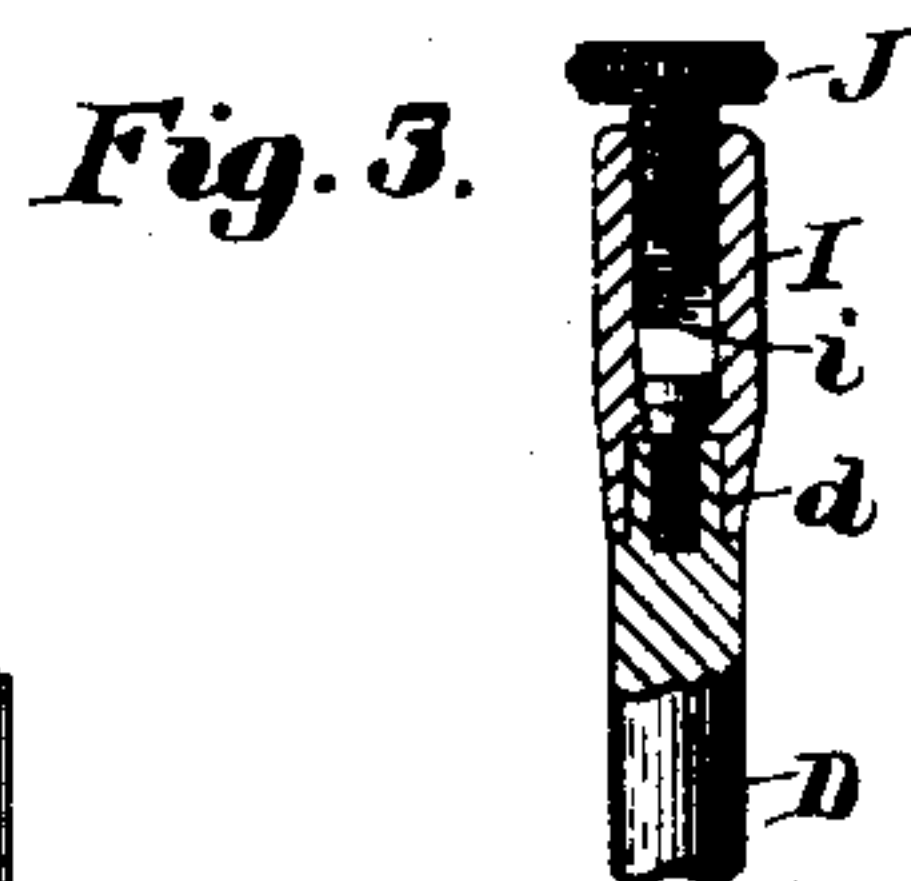
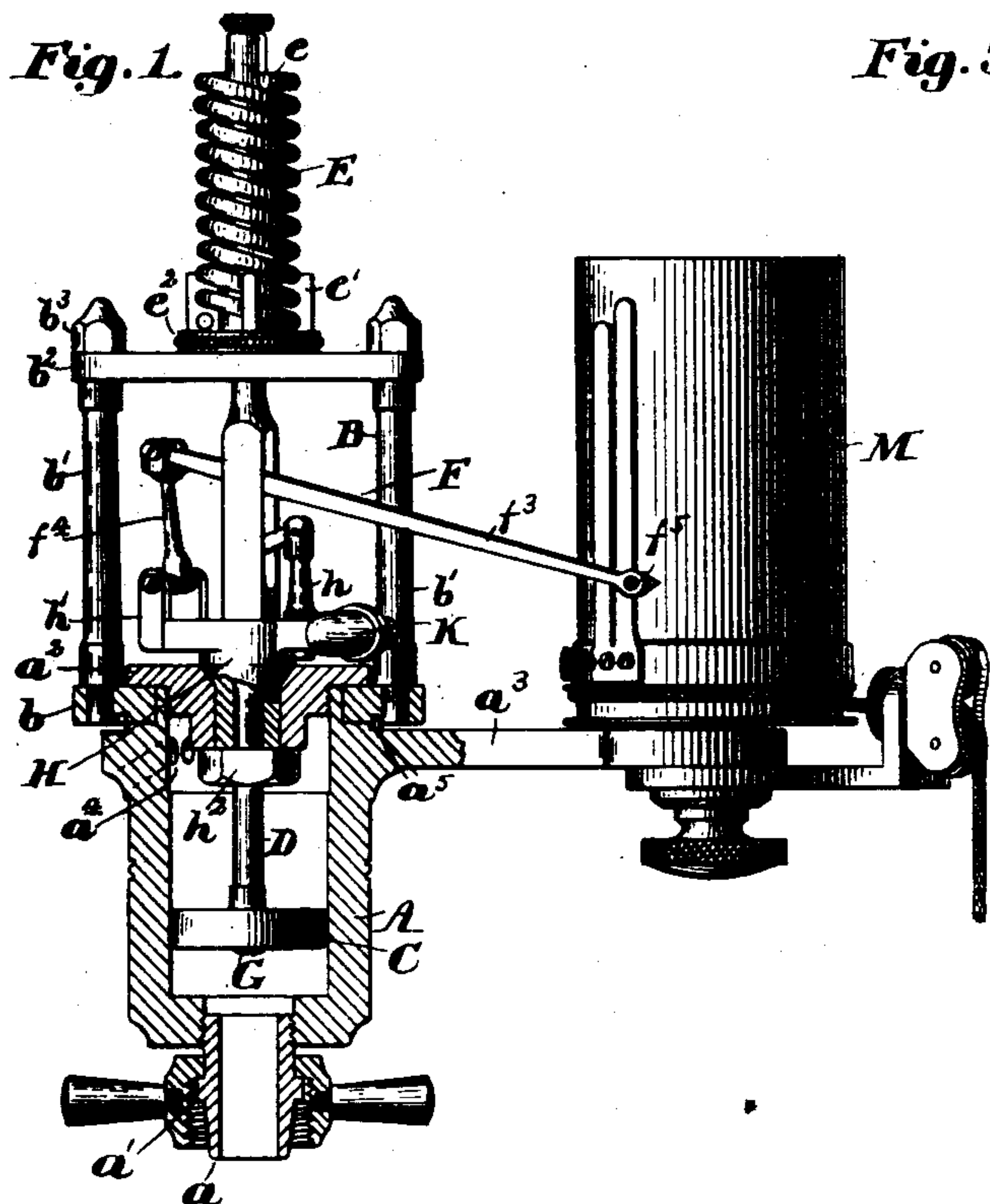


T. DAVIDSON.
STEAM ENGINE INDICATOR.

(Application filed May 10, 1901.)

(No Model.)



Witnesses:
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UNITED STATES PATENT OFFICE.

THEODORE DAVIDSON, OF SALEM, MASSACHUSETTS, ASSIGNOR TO CROSBY STEAM GAGE & VALVE COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

STEAM-ENGINE INDICATOR.

SPECIFICATION forming part of Letters Patent No. 713,611, dated November 18, 1902.

Application filed May 10, 1901. Serial No. 59,668. (No model.)

To all whom it may concern:

Be it known that I, THEODORE DAVIDSON, a citizen of the United States, and a resident of Salem, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Engine Indicators, of which the following is a specification.

My invention relates to steam-engine indicators in which a spherical piston, in conjunction with a steam-cylinder and a spring-operated piston-rod, is employed to operate a pencil mechanism; and its objects are, first, to provide a piston which shall operate with the least possible friction and adapt itself readily to any inequalities in the pressure or to other disturbing features; second, to provide an independent rod for actuating the pencil mechanism and means for securing its vertical movement; third, to provide means for adjusting the height of the pencil on the drum, and thus enable one to fix conveniently the atmospheric line on the diagram carried by the drum as desired.

My invention is illustrated by the accompanying drawings, in which—

Figure 1 is an elevation, partly in section, of the entire mechanism. Fig. 2 is an elevation, partly in section, of the pencil mechanism, piston, piston-rod, and lower portion of the spring. Fig. 3 is an elevation, partly in section, of the upper end of the piston-rod and swivel attachment.

Similar letters refer to similar parts throughout.

A is a steam-cylinder furnished with the bushing a , to which is attached the coupling a' , furnished also with the removable cap a^2 , the arm a^3 for supporting the paper drum M, the exhaust-ports a^4 , and the pin a^5 for holding the annular base b in place.

B is a frame consisting of the annular base b , adapted to encircle the cylinder A, the posts b' , fixed to said base, and the yoke b^2 , attached to said posts and held in position by the nuts b^3 and furnished with the threaded projection b^4 .

C is the piston, threaded for engagement with the piston-rod D, which I prefer to call the "spring-operated rod," and with the cap-

screw G, which is hollowed out to receive the ball g , forming therewith a universal joint.

The piston-rod or spring-operated rod D is slotted and bored to receive the pencil mechanism, threaded at its upper end for engagement with the swivel-pin d , Fig. 3, threaded at its lower end for engagement with the piston, and hollowed out to receive the ball g .

E is the spring, made of a single piece of wire wound from its middle point e into a double coil, the spiral ends of which are screwed into a brass head e' , having four radial wings, with spirally-drilled holes to receive and hold them securely in place. This brass head e' is threaded for longitudinal adjustment on and engagement with the projection b^4 and is held in adjustment thereon by the check-nut e^2 .

The pencil mechanism F consists of the rod f , attached at its lower end to the ball g , the link f' , the link f^2 , attached to the post h , the pencil-lever f^3 , and the link f^4 , attached to the posts h' . These posts h h' are supported by the sleeve H, which has a rotary motion, limited by the posts b' , but whose vertical motion is prevented by the nut h^2 . Fixed to this sleeve H is the bracket h^3 , adapted to guide the rod f and limit its motion to a vertical.

I is a swivel having a slot i for receiving the spring E and threaded to receive the cap-screw J.

K is a handle with a threaded shank which engages the threaded arm k of the sleeve H and by contact with the post b' adjusts the contact of the pencil f^5 with the paper drum M.

The annular base b is rotatable about the cylinder A and is locked in place by the peg a^5 .

The principal feature of my invention is the piston C, which is the central zone of a sphere, whose diameter is just enough less than the diameter of the steam-cylinder to permit its use as a piston. The zone may be of any width desired, or the piston may be a sphere. The contact between the cylinder and piston will be approximately a line, and it is obvious that the piston may deviate from its horizontal position in the cylinder without increasing the area of contact and that this

area of contact will always be approximately a line constituting a circumference of the sphere, of which the piston constitutes a zone. The object of this spherical piston is to reduce the friction to a minimum and to avoid the injurious effects of friction arising from any cause.

Another feature of my invention is the rod *f*, adapted to actuate the pencil mechanism. This rod *f* is limited to a vertical movement by the bracket-guide *h*³ and the ball *g* and is undisturbed by any deviation of the piston-rod or spring-operated rod *D* from its vertical.

That the piston, piston-rod, and rod or spring-operated rod *f* may normally have the same vertical axis I have bored and slotted the piston-rod or spring-operated rod for the reception of rod *f* and the pencil mechanism.

This swivel I enables one to screw the spring-head *e'* upon the frame *B* to any desired extent, thus providing for the adjustment to any height desired of the pencil on the paper drum. The check-nut *e*² provides for maintaining this adjustment. The cap-screw *J* holds the spring in the slotted swivel *I*. To explain more fully this function of the spring, I will say that the spring *E* (being thus longitudinally bodily adjustable upon the frame *B* by means of the threaded engagement of the head *e'* with the projection *b*⁴ and operating the pencil-mechanism rod *f* by means of the spring-operated rod *D* and piston *C*) enables the operator by raising or lowering the spring to raise or lower the pencil *f*⁵ on the drum *M*, and thus to fix conveniently the atmospheric line on the diagram carried by the drum *M* as he may desire. The spring being thus fixed to the frame *B* and to the swivel-head of the piston-rod acts in extension and not by compression.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, and a pencil mechanism operated by said rod; substantially as described.

2. In a steam-engine indicator the combination with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, and a pencil mechanism operated by said rod; substantially as described.

3. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism operated by said rod, and a paper drum whereon the pencil records its movements; substantially as described.

4. In a steam-engine indicator the combination, with a steam-cylinder and a piston con-

sisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism operated by said rod, and a paper drum whereon the pencil records its movements; substantially as described.

5. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical; substantially as described.

6. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical; substantially as described.

7. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical, and a paper drum whereon the pencil records its movements; substantially as described.

8. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical, and a paper drum whereon the pencil records its movements; substantially as described.

9. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, and a pencil mechanism operated by said rod; substantially as described.

10. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, and a pencil

mechanism operated by said rod; substantially as described.

11. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism operated by said rod, and a paper drum whereon the pencil records its movements; substantially as described.

12. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism operated by said rod, and a paper drum whereon the pencil records its movements; substantially as described.

13. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical; substantially as described.

14. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical; substantially as described.

15. In a steam-engine indicator the combination, with a steam-cylinder and a spherical piston, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical, and a paper drum whereon the pen-

cil records its movements; substantially as described.

16. In a steam-engine indicator the combination, with a steam-cylinder and a piston consisting of a central zone of a sphere, of a spring-operated rod in engagement with said piston, a longitudinally-adjustable spring adapted to operate said rod, a pencil mechanism and in engagement therewith an independent pencil-mechanism rod joined at its lower end to the piston by a ball-and-socket joint, together with means for limiting the motion of said independent rod to a vertical, and a paper drum whereon the pencil records its movements; substantially as described.

17. In a steam-engine indicator the combination, with a steam-cylinder, a spherical piston, and a spring-operated rod in engagement with said piston, of a longitudinally bodily adjustable spring adapted to operate said rod, with means for making the adjustment; substantially as described.

18. In a steam-engine indicator the combination, with a steam-cylinder, a piston consisting of a central zone of a sphere, and a spring-operated rod in engagement with said piston, of a longitudinally bodily adjustable spring adapted to operate said rod, with means for making the adjustment; substantially as described.

19. In a steam-engine indicator the combination, with a steam-cylinder, a spherical piston, and a spring-operated rod in engagement with said piston, of a longitudinally bodily adjustable spring adapted to operate said rod, means for making the adjustment, and means for maintaining the adjustment; substantially as described.

20. In a steam-engine indicator the combination, with a steam-cylinder, a piston consisting of a central zone of a sphere, and a spring-operated rod in engagement with said piston, of a longitudinally bodily adjustable spring adapted to operate said rod, means for making the adjustment, and means for maintaining the adjustment; substantially as described.

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

THEODORE DAVIDSON.

Witnesses:

WATERMAN L. WILLIAMS,
RALPH W. FOSTER.