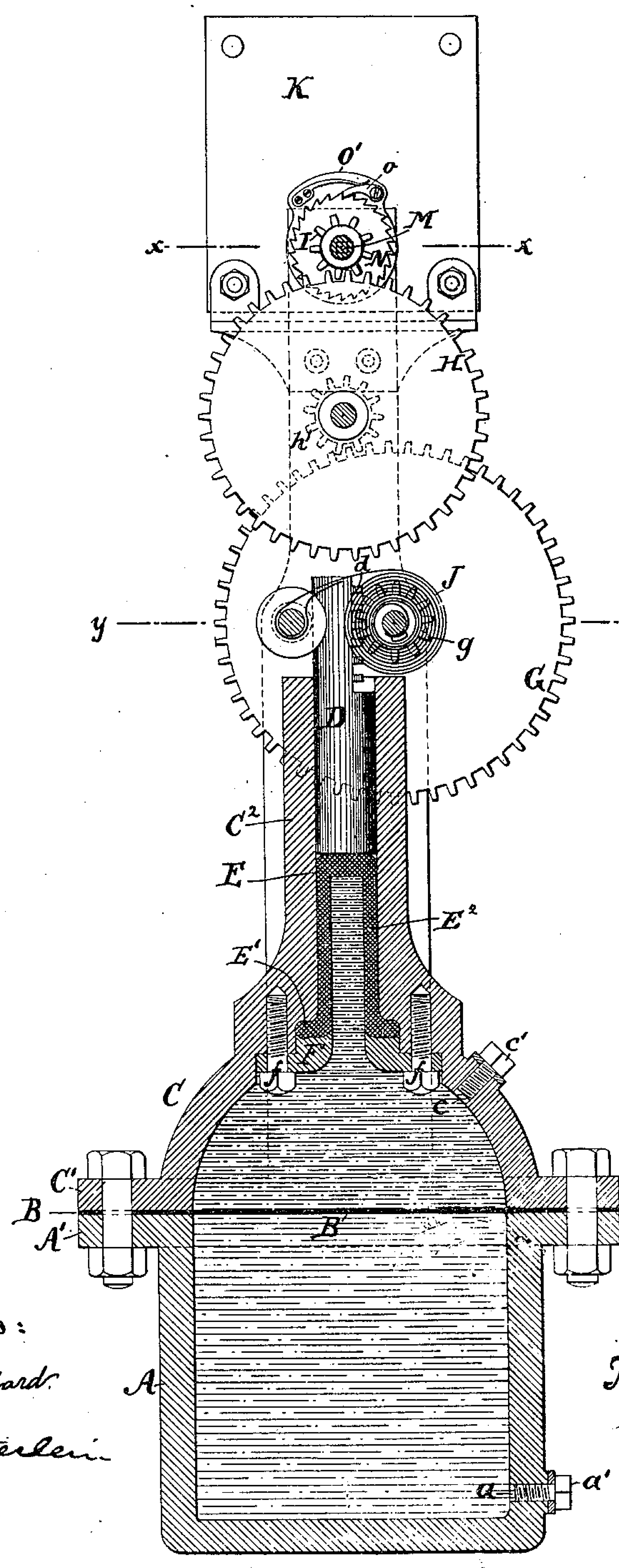
(No Model.) 3 Sheets—Sheet 1.

I. L. ROBERTS.

DEVICE FOR WINDING CLOCKS BY THE VARIATIONS OF TEMPERATURE.

No. 386,557. Patented July 24, 1888.

Fig: 1.



Witnesses:

M. E. Stoddard.

B. T. Vetterlein

Inventor:

I. L. Roberts.

by his att'y

A. H. Gentner

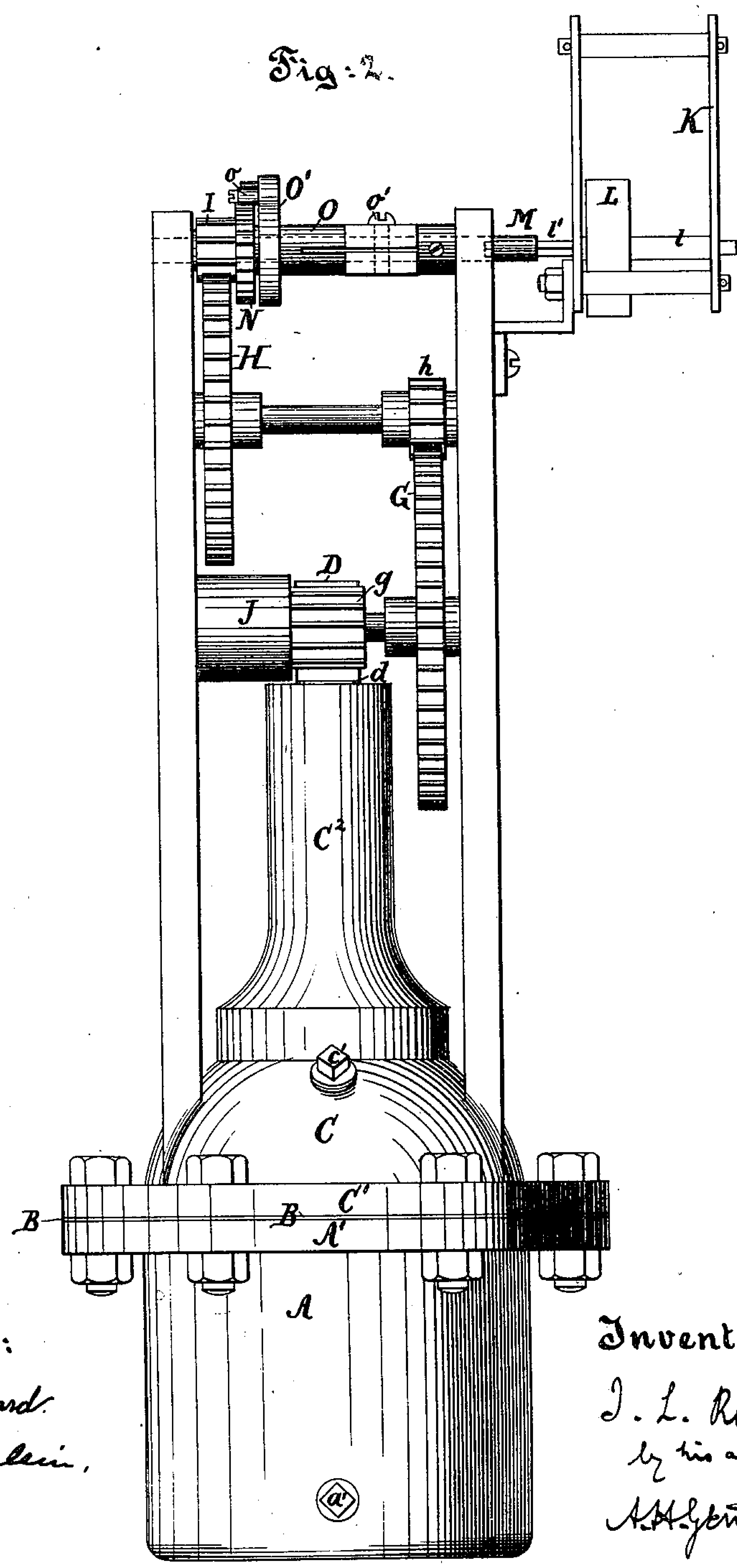
(No Model.) 3 Sheets—Sheet 2.

I. L. ROBERTS.

DEVICE FOR WINDING CLOCKS BY THE VARIATIONS OF TEMPERATURE.

No. 386,557. Patented July 24, 1888.

Fig: 2.



Witnesses:

M. E. Stoddard.

B. T. Vatterlein.

Inventor:

I. L. Roberts,

by his atty

A. H. Gentner, Jr

(No Model.)

3 Sheets—Sheet 3.

I. L. ROBERTS.

DEVICE FOR WINDING CLOCKS BY THE VARIATIONS OF TEMPERATURE.

No. 386,557. Patented July 24, 1888.

Fig: 3.

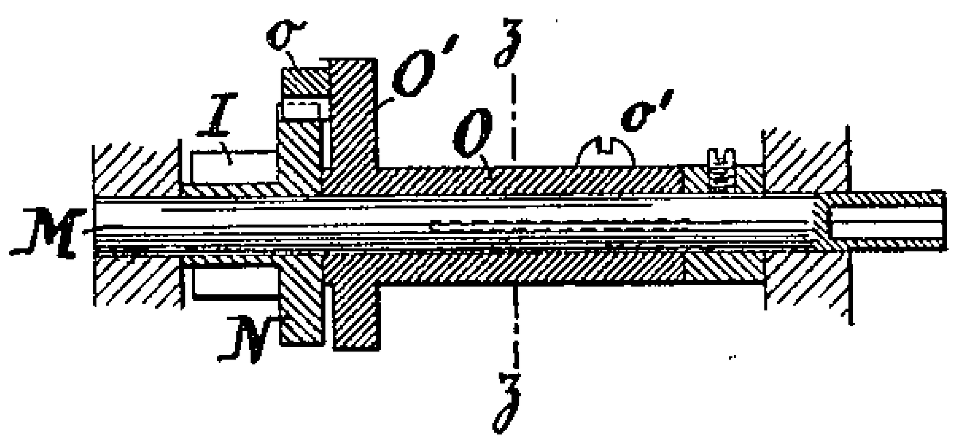


Fig: 3a.

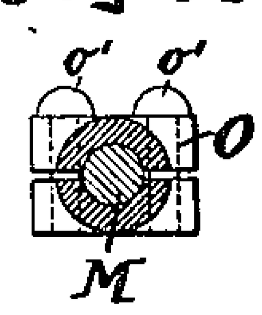


Fig: 4.

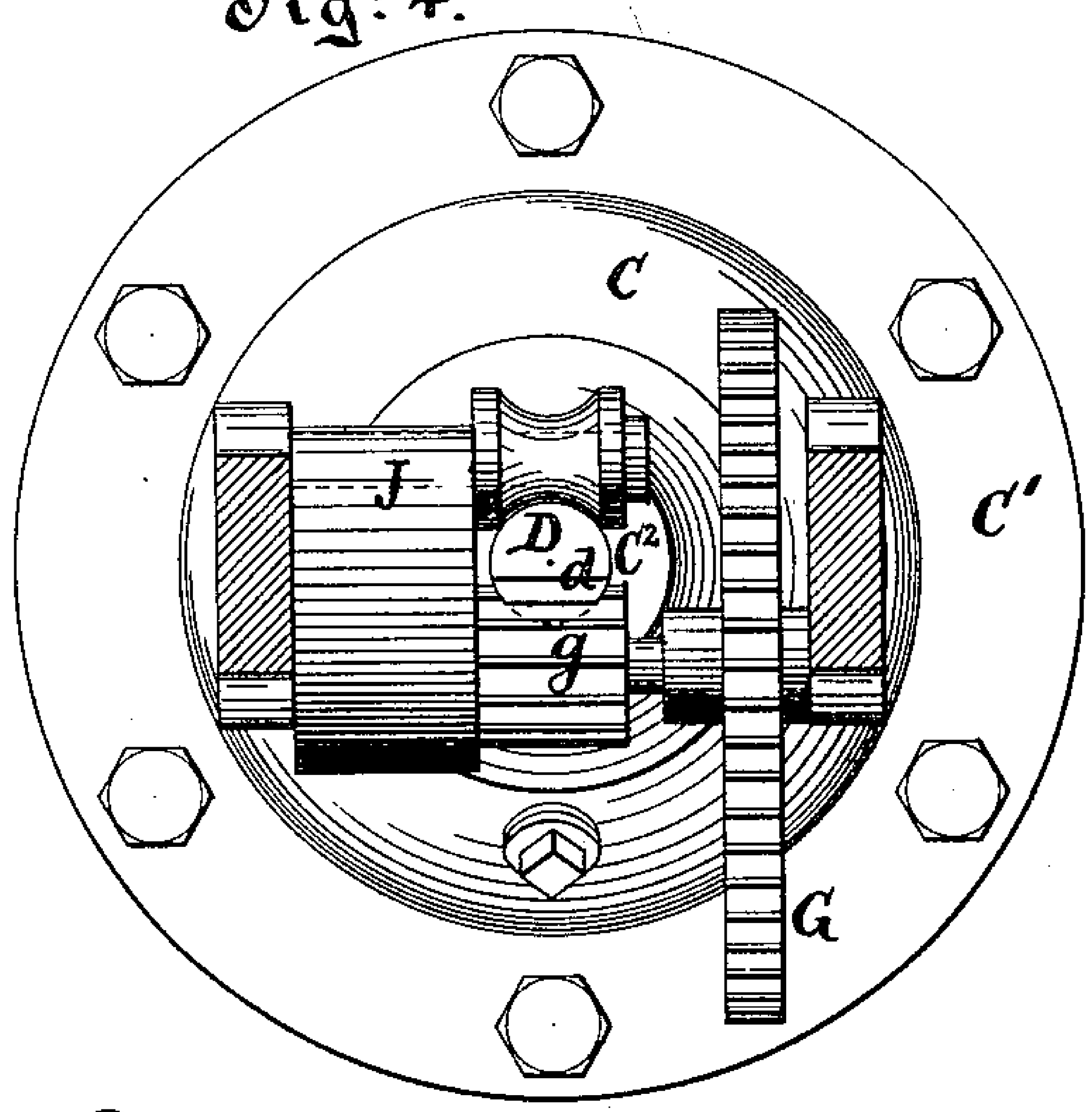
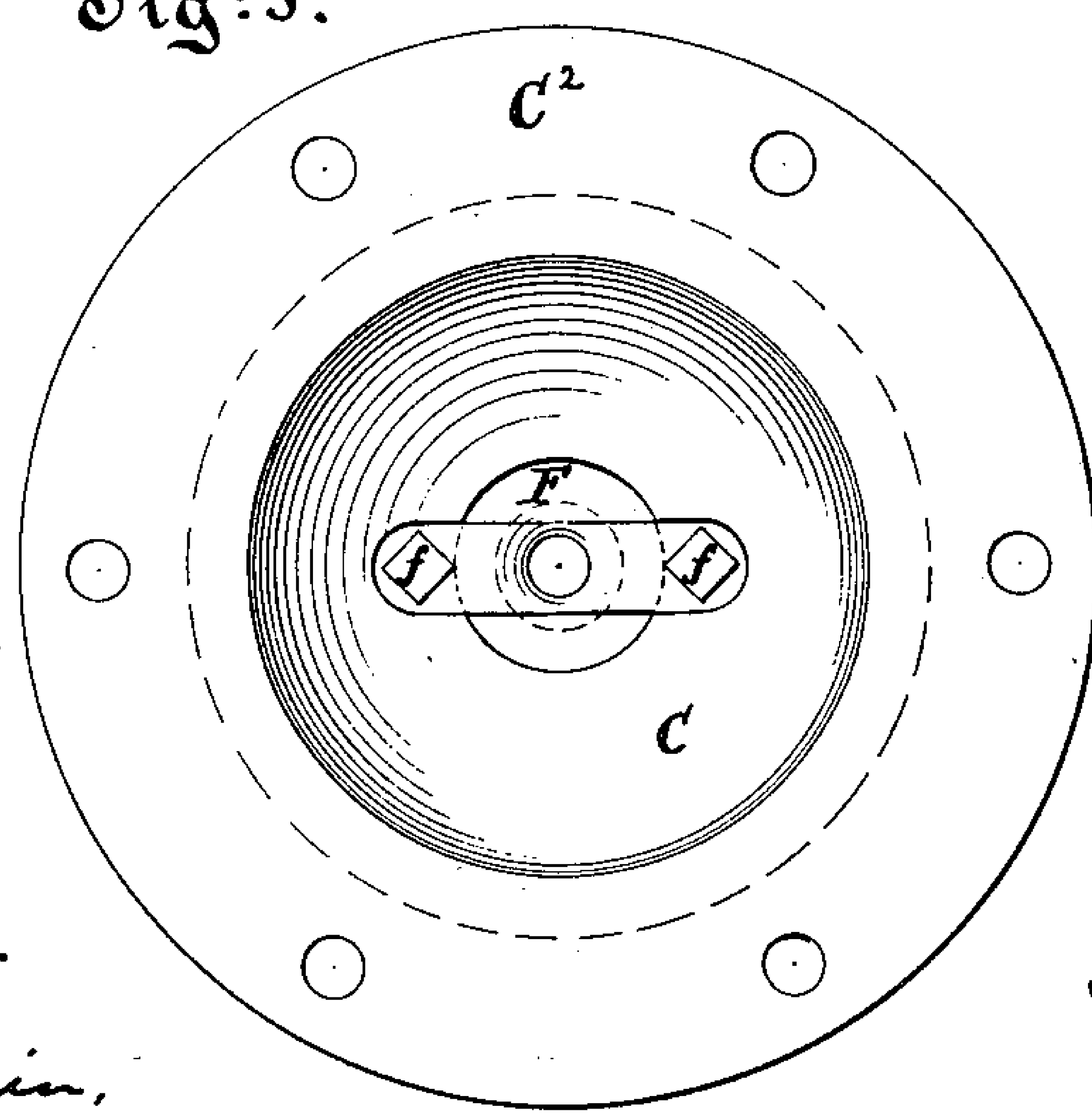


Fig: 5.



Witnesses:

M. E. Stoddard,
B. T. Vetterlein.

Inventor:

I. L. Roberts.
by his atty
A. H. Gentner

UNITED STATES PATENT OFFICE.

ISAIAH L. ROBERTS, OF BROOKLYN, NEW YORK, ASSIGNOR OF ONE-HALF TO EDMUND TWEEDY, OF DANBURY, CONNECTICUT.

DEVICE FOR WINDING CLOCKS BY THE VARIATIONS OF TEMPERATURE.

SPECIFICATION forming part of Letters Patent No. 386,557, dated July 24, 1888.

Application filed March 30, 1886. Serial No. 197,230. (No model.)

To all whom it may concern:

Be it known that I, ISAIAH L. ROBERTS, a citizen of the United States, residing in the city of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Apparatus for Obtaining Power by the Utilization of Variations of Temperature, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

This invention relates to means adapted to utilize the variations of temperature for obtaining power.

Heretofore the expansive and contractive force of a liquid has been utilized by subjecting the liquid to the influence of varying temperatures in an open-mouthed vessel containing a piston tightly packed that rested upon the liquid and was moved thereby during its expansion. Such a device is impracticable, for the reason that considerable power must be exerted upon the power-transmitter in order to overcome the friction and weight of the parts affected by its movement, and from the necessity of this power great difficulty has been experienced in effectively packing the piston, so that the liquid will exert its full expansive force upon the piston and not escape or pass the piston, and thus have little or no effect thereon.

The present invention consists, briefly, in the employment of a hermetically-sealed vessel inclosing a liquid completely filling said vessel, which is provided with a yielding portion on which the expansive force of the confined liquid acts and by which the expansive and contractive force of said liquid is transmitted to the device or mechanism to be moved.

It also consists in other novel features and combinations of parts too fully hereinafter set forth to need further preliminary description here.

The device best suited for utilizing the expansion and contraction of liquids caused by the variations of temperature must necessarily vary within wide limits, according to the ultimate objects to be attained and the conditions under which it is to operate, the principle, however, remaining the same in all cases. The device also, according to my invention, may be constructed to operate by artificially-produced variations of temperature; or it may be constructed, and is preferably so, to operate by the natural variations of the temperature of the atmosphere. I have therefore in my experiments paid special attention to the construction of a device capable of transmitting power by the natural variations in the temperature of the atmosphere, and will describe what I consider a perfect and elaborate type of apparatus designed for this purpose, indicating hereinafter certain simpler forms and modifications which may be used to good advantage.

The accompanying drawings represent an apparatus constructed according to my invention and adapted to furnish power for winding the mainspring of a clock.

In said drawings, Figure 1 is a rear sectional elevation of the apparatus; Fig. 2, a side elevation thereof; Fig. 3, a horizontal section taken on the line *x x* of Fig. 1, showing the construction of a shaft and its sleeve, hereinafter referred to; Fig. 3ª, a cross-section of the same, taken on the line *z z* of Fig. 3; Fig. 4, a horizontal section taken on the line *y y* of Fig. 1, and Fig. 5 is a view looking at the under side of the auxiliary receptacle.

The device for utilizing the expansive force of liquids, as herein shown, consists of a stout receptacle or chamber, A, of cast-iron or other suitable heat-conducting material, that is hermetically sealed and provided with a portion capable of yielding under the pressure of an expanding liquid, such yielding portion being represented by a diaphragm, B, of lead or other suitable material, which may be secured to a flange, A′, of the chamber A, as shown. This chamber, either previous to securing said diaphragm in position or thereafter, through a suitable hole, *a*, (tightly closed by a screw-plug, *a′*,) will be supplied with a liquid, preferably alcohol, it having a relatively high ratio of expansion, so as to completely fill said chamber, being introduced therein at a relatively low temperature. If now this chamber inclosing the liquid be allowed to remain for a short time in an atmosphere of slightly higher temperature than that at which the liquid was introduced, said liquid, by reason of the heat absorbing quality of the metal composing the chamber, will be caused to expand therein, and acting upon that part of the vessel most easily affected by its expansion—namely the diaphragm—will force said diaphragm outward to an extent equal to the degree of the expansion of the liquid, from which it will be seen that if a piston or other transmitting device be allowed to rest or bear upon or be connected to said diaphragm it will be moved to the same extent that the diaphragm is; and thus it is obvious that if the temperature of the atmosphere becomes still higher said liquid will continue to expand and the diaphragm be still further forced outward, causing a corresponding movement of the piston or transmitting device. If, on the other hand, the temperature be lowered, the chamber will become correspondingly cooled, causing the diaphragm by the pressure of the atmosphere aided, it may be, by a weight or pressure against it to yield and return to its normal position with the liquid followed by the piston or transmitting device. Thus, if this piston be suitably connected to a mechanism to which it is desired to transmit motion that each time or whenever the liquid expands, or it may be contracts, sufficient to move the diaphragm, a movement may be simultaneously imparted to such mechanism. In the preferred construction, however, the chamber A will be provided over the diaphragm B with an auxiliary chamber, C, secured thereto by bolts passing through its flange C′. From the top of this chamber extends a hollow cylindrical projection, C^2, adapted to receive from its open end and guide in its vertical reciprocations the end of a piston or transmitting device, D. This auxiliary chamber, between the diaphragm B and the piston, will preferably be filled with water to the exclusion of the slightest air-bubble through a hole, *c*, tightly closed by a screw-plug, *c′*. The water is of low expansive ratio and simply serves as a means of transmitting the expansive force of the liquid in the chamber A from the diaphragm to the piston, suitable packing being provided at the juncture of the hollow projection with the auxiliary chamber to prevent leakage of the liquid. In order, however, to practically prevent any leakage of this water, I prefer to employ the structure shown, consisting of a rubber diaphragm, E, of thimble shape, interposed between the water and the bottom of the piston D, the closed end E^2 of which diaphragm projects into the hollow projection C^2, abutting against the under side of the piston, and its flanged end tightly clamped to the top of the auxiliary chamber by means of an annulus, F, secured in place by bolts *f*, from which it will be apparent that as the liquid in the auxiliary chamber is displaced by the movement of the diaphragm B, the elastic diaphragm E will expand and act directly upon the piston to move it.

It should here be observed that the operation would be the same if the alcohol were made to act directly upon the piston D or elastic diaphragm E without the intervention of the diaphragm B and the water above; but alcohol when brought in contact with rubber gradually disintegrates the latter and renders it useless. In order, therefore, to secure in one apparatus the advantages of the positively tight elastic diaphragm E and of the relatively high expansive ratio of alcohol, I prefer to employ the auxiliary reservoir C and diaphragm B.

The upward or effective stroke of the piston D is transmitted through teeth *d*, formed in its upper portion, and through the accelerating train of gearing *g* G *h* H to the pinion I, from which it is further transmitted, in the manner hereinafter described.

The return movement of the parts when contraction of the alcohol takes place, as herein shown, is effected by the force exerted by the spring J, one end of which is connected to the shaft of the wheels *g* G and the other to an independent hub mounted on the frame-work.

The mechanism to which the power of the expansive force of the liquid confined in the chamber A is transmitted is represented herein by a clock, the mainspring of which is to be wound, as seen in Figs. 1 and 2, in which K indicates the frame thereof, L its mainspring, and *t* the arbor of said mainspring, the squared extending end *t′* of which arbor enters a square hole in the end of a shaft, M, upon which latter the said pinion I turns loosely. (See Figs. 2 and 3.) The pinion I has secured to it a ratchet-wheel, N, also loose on said shaft, the teeth of which ratchet are engaged by a spring-pressed pawl, *o*, pivoted upon an arm, O′, that projects from and forms a part of a sleeve, O, surrounding the shaft M. This sleeve is partly split, as represented, and is held with a certain amount of friction to the shaft by being clamped more or less tight thereon by the screws *o′*. (See Fig. 3ª.) The direction of the teeth of the ratchet-wheel N is such that they engage the pawl *o* and turn the sleeve O when the pinion I and wheel N are moved by the ascending piston, thus, by reason of its friction upon the shaft M, winding the clock-spring L, while the teeth of the ratchet-wheel will pass idly under said pawl when turning in the opposite direction—for instance, when the piston descends on the contraction of the liquid. The amount of friction between the shaft M and sleeve O should be so adjusted that when the piston ascends the shaft M will be turned and wind the clock-spring until the latter is sufficiently wound, when, should the piston continue to ascend, the increased resistance of the said spring will overcome such friction and prevent any overwinding of the same.

The multiplying-gearing should be so calculated that the minimum daily variation of the temperature of the atmosphere is sufficient to wind the spring L enough to cause the clock to run for one day or more, any excess of motion obtained by greater variations of temperature being rendered harmless by the connections just described.

Many variations and modifications may be made in the construction and arrangement of the apparatus according to the uses to which it may be put and the power which it is desired to obtain, &c. The variations of temperature may be produced by artificial heating and cooling, in which case the apparatus may be caused to work at any desired period of the day or night. The means for transmitting the power from the piston may be as widely varied as are or may be the uses of the apparatus. Various devices other than the clock spring shown may be used for storing the power and for dispensing it in an even and regular manner.

It is evident that any other liquid than alcohol may be employed in the chamber A; but care should be taken to employ such liquids as will not freeze at the lowest temperature to which the apparatus is likely to be exposed. Such liquids are, for instance, naphtha and sulphur-trioride. If an apparatus with an auxiliary receptacle, as shown in the figures, be exposed to a temperature lower than the freezing-point of water, said receptacle should of course be filled with some liquid having a lower freezing-point than water, or, and in any case, the liquid in the auxiliary receptacle may be entirely dispensed with, and a solid piece of soft rubber filling the entire interior of the auxiliary receptacle in a manner exactly similar to the water may be substituted.

What I claim is—

1. The combination of a hermetically-sealed vessel having a portion of its body formed of a yielding material and inclosing a liquid that completely fills such vessel, and a power-transmitter adapted to transmit the movement of said yielding material, whereby the variations of temperature to which the inclosed liquid is subjected will act thereon through said yielding material, substantially as described.

2. The combination of a hermetically-sealed vessel having a portion of its body formed of a yielding material and inclosing a liquid that completely fills such vessel, a power-transmitter adapted to transmit the movement of said yielding material, and an auxiliary receptacle filled with a liquid interposed between said yielding material and the power-transmitter, substantially as described.

3. The combination of a hermetically-sealed receptacle, a piston and cylinder connected therewith, a liquid completely filling said receptacle and adapted to act upon said piston, and two power-storing devices, both arranged to receive power from the piston, and serving the one to return the piston when the liquid contracts and the other to receive and transmit a portion of the power exerted by the piston, substantially as herein specified.

4. The combination of a hermetically-sealed receptacle, a piston and cylinder connected therewith, a liquid filling said receptacle and adapted to act upon said piston, a power-storing device serving to return the piston after it has been acted upon, a second power-storing device, suitable power-transmitting connections between the latter and the piston, and a mechanism or apparatus adapted to receive motion from said second power-storing device, substantially as described.

5. The combination of a receptacle, a cylinder, a piston, a liquid completely filling said receptacle, and an elastic impermeable thimble separating the space of the receptacle from the space of the cylinder, substantially as specified.

6. The combination of a main receptacle, a liquid filling said receptacle, a diaphragm, an auxiliary receptacle, a yielding but non-compressible substance filling said auxiliary receptacle, a cylinder connected with the auxiliary receptacle, and a piston moving in said cylinder, substantially as described.

7. The combination of a main receptacle, a diaphragm, an auxiliary receptacle, liquids filling both receptacles, a cylinder, a piston, and an elastic impermeable thimble separating the space of the auxiliary receptacle from the space of the cylinder, substantially as specified.

In witness whereof I have hereunto set my hand this 27th day of March, 1886, in the presence of two subscribing witnesses.

ISAIAH L. ROBERTS.

Witnesses:
A. H. GENTNER,
B. T. VETTERLEIN.