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H. CONANT.

ISOCHRONAL CLOCK.

No. 368,814. Patented Aug. 23, 1887.

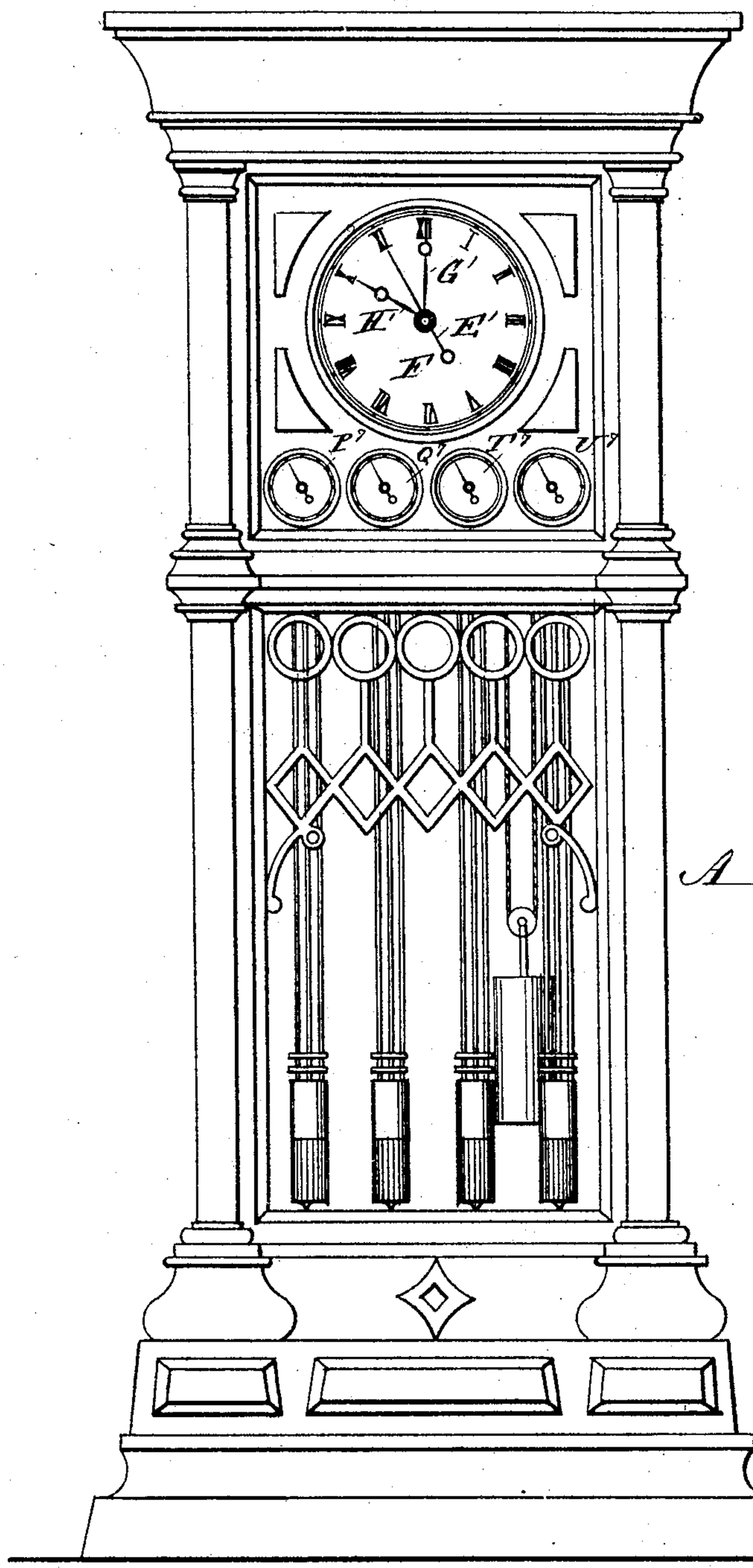

Fig. 1

A

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Fig. 2

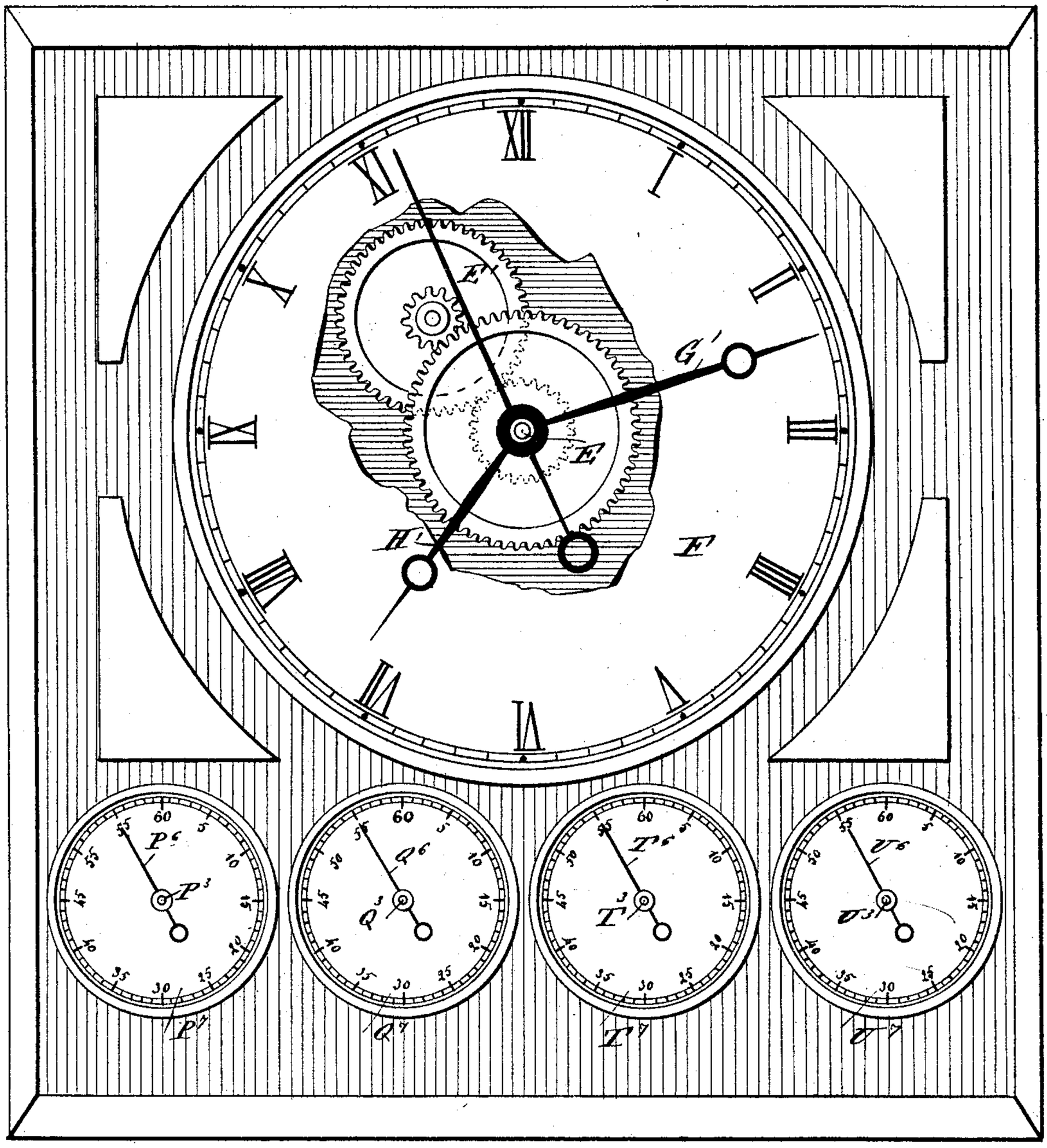

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Fig. 3

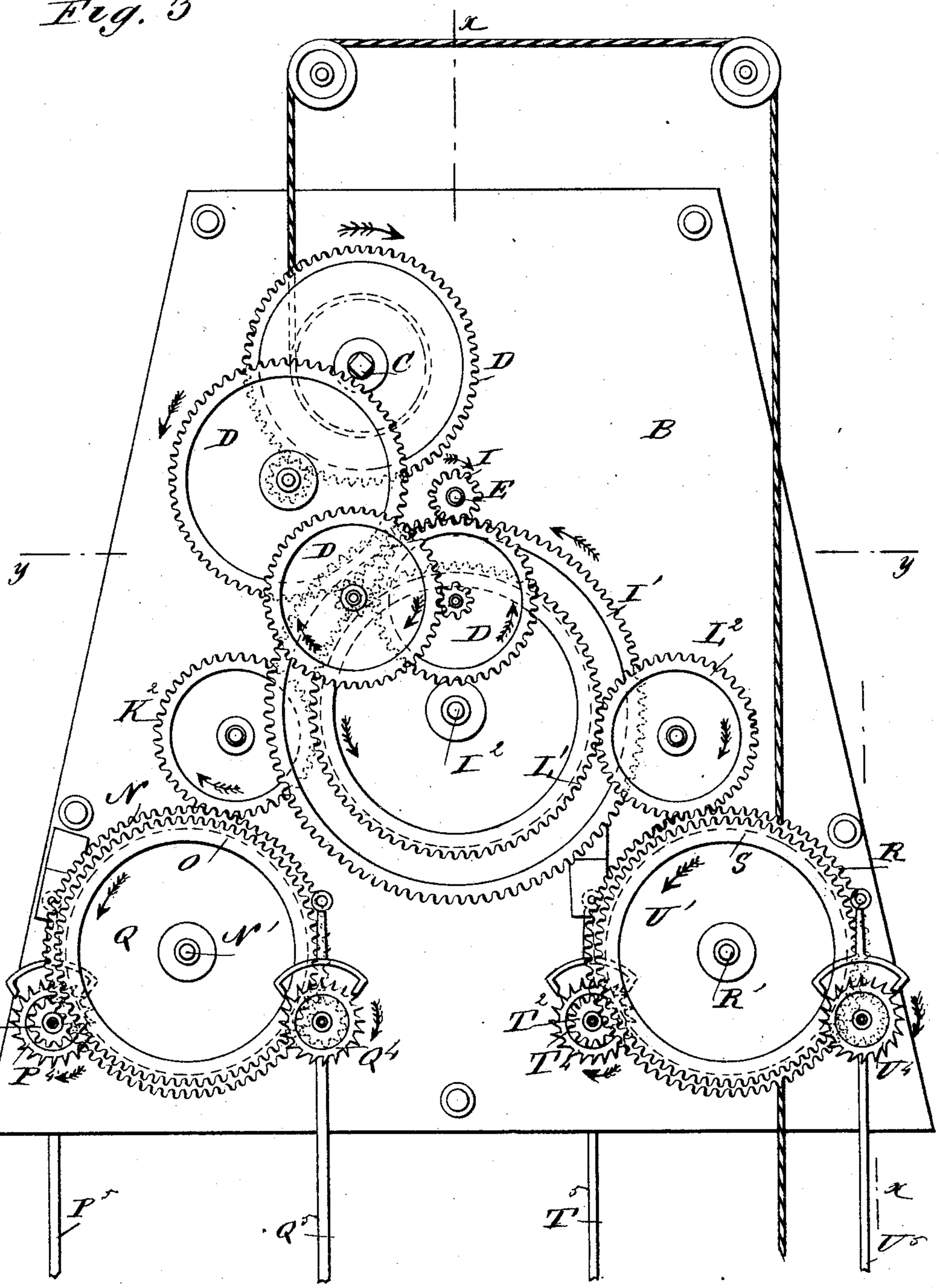

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Fig. 4

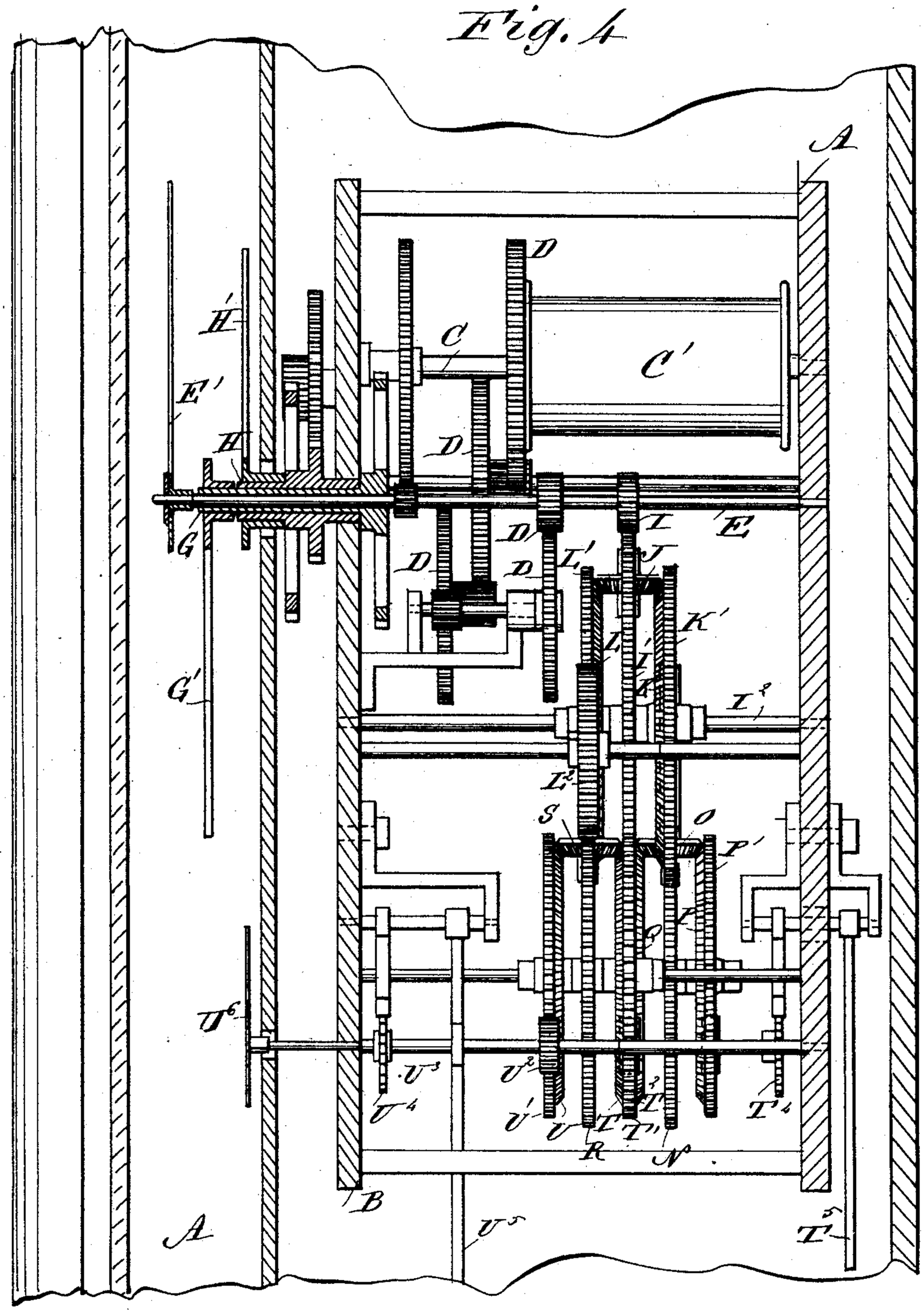

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Fig. 5

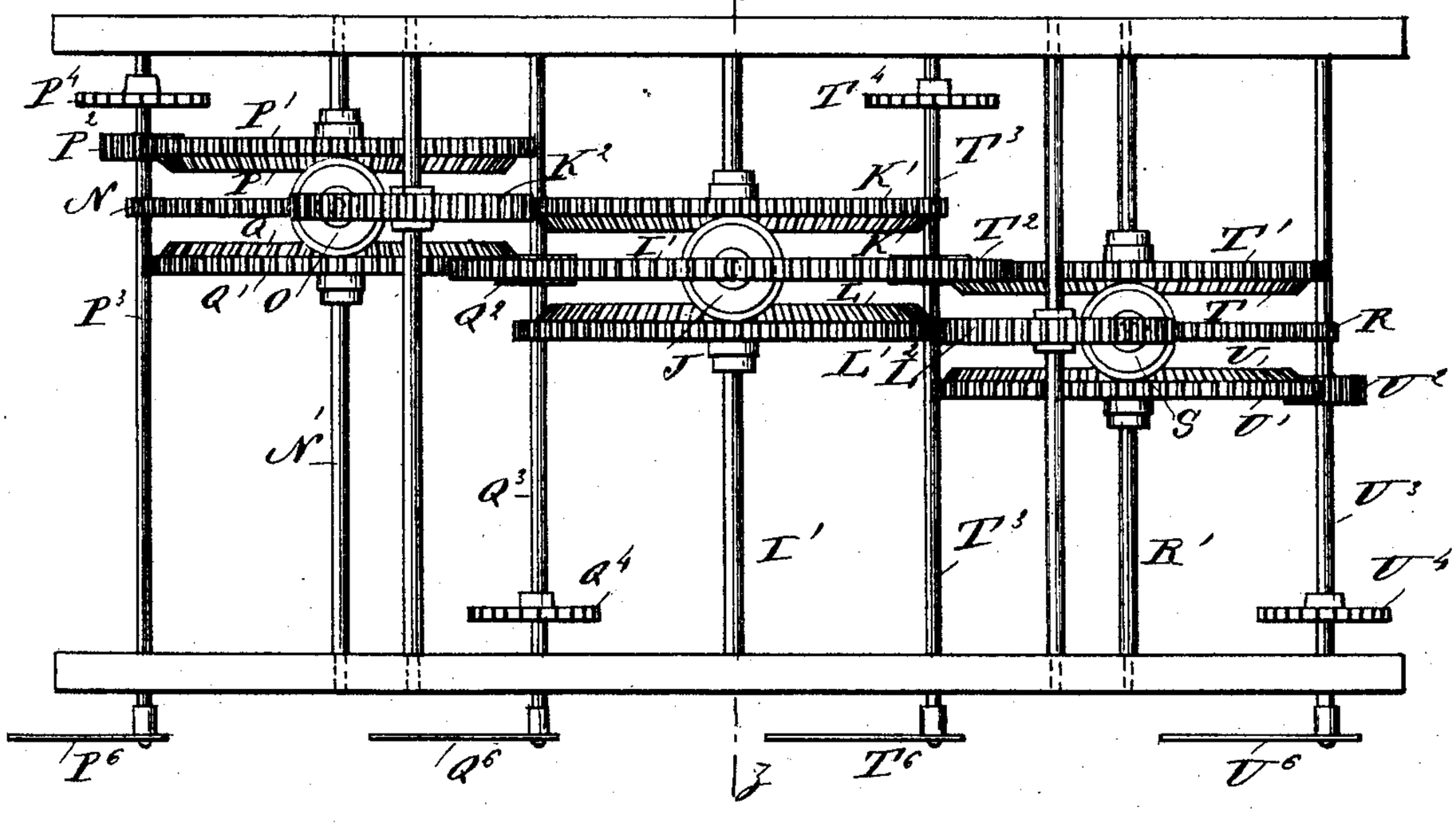
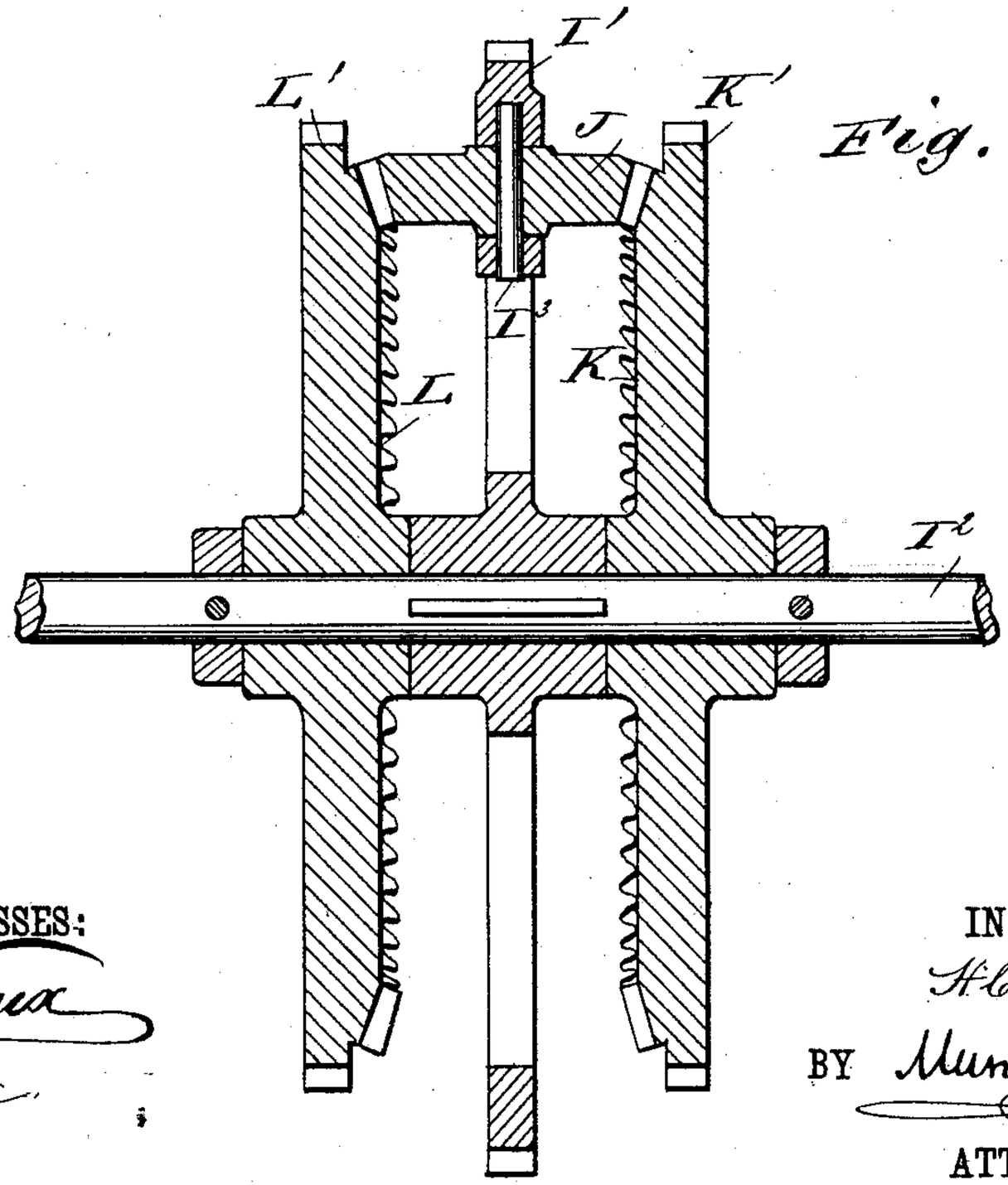


Fig. 6



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UNITED STATES PATENT OFFICE.

HEZEKIAH CONANT, OF PAWTUCKET, RHODE ISLAND.

ISOCHRONAL CLOCK.

SPECIFICATION forming part of Letters Patent No. 368,814, dated August 23, 1887.

Application filed March 9, 1887. Serial No. 230,240. (No model.)

To all whom it may concern:

Be it known that I, HEZEKIAH CONANT, of Pawtucket, in the county of Providence and State of Rhode Island, have invented a new and Improved Isochronal Clock, of which the following is a full, clear, and exact description.

The object of my invention is to provide a new and improved time-measuring instrument which is perfectly isochronal.

The invention consists of two or more independent escapements connected with a single clock-train in such a manner as to indicate or show on a main dial the average time of the several associated escapements.

The invention also consists in the construction and arrangement of various parts and details and combinations of the same, as will be fully described hereinafter, and then pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a front elevation of my improvement. Fig. 2 is an enlarged front elevation of the dial-plate, parts being broken out. Fig. 3 is a front elevation of the clock-movement with the dial-plate removed. Fig. 4 is a vertical cross-section of my improvement on the line *x x* of Fig. 3. Fig. 5 is a sectional plan view of the same on the line *y y* of Fig. 3, and Fig. 6 is a central section of part of my improvement on the lines *z z* of Fig. 5.

It is a well-known fact that two or more independent escapements, however well regulated, differ in indicating the time. The object of my invention is to make use of this difference between two or more independent escapements and to transmit this difference, by the mechanism presently to be described, to a main shaft indicating an average time of several associated escapements, thus reducing the incorrectness of the several escapements to a minimum. It is also well known that the best-made regulators will vary more or less from true time.

My improvement is based on the idea that the average of four nicely-adjusted movements would show a variation of only one-sixteenth of what any one of them would show in the same time, as some of the errors would offset other errors, so that if one is a trifle too slow and another too fast the average will be correct time. The escapements are so combined and impelled that they are substantially independent of each other, and one will run whether the others are idle or not.

In carrying out my invention in practice I can employ escapements of any approved construction, either pendulum, balance-wheel, or other escapements.

In the drawings and the following description I show and refer to pendulum-escapements; but it is understood that any escapement may be used.

My improvement is mounted in the casing A, which supports the clock-frame B, in which is journaled the driving-shaft C, carrying the usual drum, C′, which may be rotated in any suitable manner, either by springs or weights.

The driving-shaft C is connected, by a train of gear-wheels, D, with the second shaft, E, carrying on its outer end the seconds-hand E′, indicating seconds on the dial F, which is divided into twelve hours and subdivisions. The shaft E is also connected in the usual manner by a train of gear-wheels with the sleeve G, carrying the minute-hand G′, indicating the minutes on the dial F, and the said shaft is in a similar manner connected with the sleeve H, carrying the hour-hand H′, indicating the hours on the said dial F. The several connections, as outlined above, are common to almost all clocks, and a detailed description is deemed superfluous.

On the shaft E is secured the gear-wheel I, which meshes into the gear-wheel I′, secured to the shaft I^2, mounted in suitable bearings in the clock-frame B. In the web of this gear-wheel I′ is mounted a shaft, I^3, standing in radial line with the axis of the shaft I^2, and carrying the beveled planetary gear-wheel J, meshing on one side into the beveled gear-wheel K′, mounted loosely on the shaft I^2, and the beveled gear-wheel J meshes on its other side into a beveled gear-wheel, L′, also mounted loosely on the said shaft I^2. (See Fig. 6.)

On the beveled gear-wheels K and L are formed the spur-wheels K′ and L′, respectively, and the spur-wheel K′ meshes at its left side into an intermediate gear-wheel, K^2, which meshes into the gear-wheel N, secured to the shaft N′, mounted in suitable bearings in the clock-frame B. On the gear-wheel N is mounted, on

a radial shaft, a beveled planetary gear-wheel, O, which meshes on one side into the beveled gear-wheel P, turning loosely on the said shaft N′, and the other side of the planetary gear-wheel O meshes into the beveled gear-wheel Q, also loosely mounted on the shaft N′.

On the beveled gear-wheels P and Q are formed the spur-wheels P′ and Q′, respectively, of which the spur-wheel P′ meshes into the pinion P^2, secured to the escape-wheel shaft P^3, carrying the escape-wheel P^4, actuating the one-second pendulum P^5, of any approved construction. The outer end of the escape-wheel shaft P^3 carries the seconds-hand P^6, indicating on the seconds-dial P^7, located below the dial F to the extreme left. The other spur-wheel, Q′, meshes into the pinion Q^2, secured to the escape-wheel shaft Q^3, carrying the escape-wheel Q^4, actuating the one-second pendulum Q^5, of any approved construction. The outer end of the shaft Q^3 carries the seconds-hand Q^6, indicating on the seconds-dial Q^7, located to the right of the dial P^7 below the dial F.

The arrangement on the right-hand side of the gear-wheel I′ is the exact counterpart of the mechanism above described on the left-hand side of the gear-wheel I′, inasmuch as the gear-wheel L′ meshes into the intermediate gear-wheel, L^2, which meshes into the gear-wheel R, carrying a planetary beveled gear-wheel, S, meshing into the beveled gear-wheels T and U, respectively, and on which are formed the spur-wheels T′ and U′, respectively. The spur-wheels T′ and U′ mesh, respectively, into the pinions T^2 and U^2, secured to the respective escape-wheel shafts T^3 and U^3, carrying the escape-wheel T^4 and U^4, actuating the one-second pendulums T^5 and U^5, respectively.

The escape-wheel shaft T^3 carries on its outer end the seconds-hand T^6, indicating on the seconds-dial T^7, located to the right of the dial Q^7. On the other shaft, U^3, is also secured a seconds-hand, U^6, indicating on the dial U^7, placed to the right of the dial T^7.

The operation is as follows: The rotary motion of the shaft E is regulated by the average speed of the four escapement-wheel shafts P^3, Q^3, T^3, and U^3, each of which makes a revolution once in every minute, and indicates each beat of the pendulum in seconds by its respective hand on the respective dial P^7 Q^7 T^7 U^7. The difference in motion between the four escapement-wheel shafts is very slight; but the difference, whatever it may be, is diminished to one-sixteenth on the shaft D, which, when all the escapements are going, travels at the rate of one minute for every revolution; but when one of the pendulums and its escape-wheel shaft is stopped then the result on the shaft E is only three-fourths of a revolution in a minute, and if two pendulums are stopped the main shaft E and its hand E′ will go at half-rate, and if only one pendulum is allowed to run this hand E′ on the main shaft E will record one minute in four minutes' time, thus showing that the variation of any pendulum affects the main movement only one-quarter of such error. Each escapement has a seconds-hand of its own to show its own rate, and thus can be properly regulated, so that if one loses more time than it ought then it is regulated to keep to its proper speed. The main shaft E imparts, by means of the gear-wheel I, motion to the gear-wheel I′, which carries with it in its rotation the planetary beveled gear-wheel J. The latter, by being carried by the rotating gear-wheel I′, imparts rotary motion at the same time to both double gear-wheels K K′ and L L′. Each of the gear-wheels K K′ and L L′ impart, by means of the respective intermediate gear-wheels, K^2 and L^2, a rotary motion to the gear-wheels N and R, respectively. As each of the latter carry a beveled planetary wheel, which acts on two double-beveled gear-wheels in the same manner as above described in reference to the beveled planetary gear J, it will be seen that a rotary motion is imparted to the respective escape-wheel shafts with which the said beveled gear-wheels are directly connected. Now, as the motion of each escape-wheel shaft is regulated by its respective escapement, and each motion differs, however slightly, from the other, it follows that this difference in speed is transmitted to the respective two sets of double gear-wheels, P P′ Q Q′ and T T′ U U′. The average speed between the two beveled gear-wheels of each set is imparted to the beveled planetary gear-wheels O and S, respectively, which turn on their respective axes, and, on account of being held in the gear-wheels N and R, impart their average motion derived from the respective sets of beveled gear-wheels to the said gear-wheels N and R. Thus it will be seen that the gear-wheels N and R travel at the average speed of their respective sets of double gear-wheels. The gear-wheels N and R, being connected by the intermediate gear-wheels, K^2 and L^2, respectively, with the set of double gear-wheels K K′ and L L′, impart to the latter their respective average motion. The difference of speed, however small it may be, between these two sets of double gear-wheels is imparted to the beveled planetary gear-wheel J, which imparts its average motion derived from the said set of double gear-wheels K K′ and L L′ to the gear-wheel I′, with which it turns. As the latter gears directly into the gear-wheel I, it will be seen that the shaft E, carrying the latter gear-wheel, I, travels at the rate of one-second motion, subject to the average speeds of the four escape-wheel shafts P^3, Q^3, T^3, and U^3, the independent motion of each of the latter being indicated on the dials P^7, Q^7, T^7, and U^7, while the average motion of the four is indicated on the dial F in seconds, minutes, and hours.

It will be seen that if the two wheels L L′ and K K′ receive an impulse from the wheel I′ through the medium of the planetary wheel J, (see Fig. 6,) then the wheel I′, carrying the said planetary wheel J, must in the first instance be supplied by a power equal to the power required to propel the two escapements

connected with the beveled gear-wheels L L′ and K K′, and at the same time the wheel I′ will move forward at an average speed of the two beveled gear-wheels L L′ and K K′, connected with the escape-wheel shafts. It is evident from this that the power applied to the main shaft E must be sufficient to propel the four escapements, and consequently will be acted upon with a force having fourfold power of the ordinary one, and is hence less liable to be affected by imperfection in the mechanism operating on the said main shaft E. Thus this extra power given to the main shaft E overcomes any slight frictional obstructions, whereby the resultant of the arrangement is a strong motion without danger of increasing the abrasion at points of the escapement.

To illustrate the action of this instrument more clearly, it is supposed that the pendulums are at rest and the seconds-hands P^6, Q^6, T^6, and U^6 of the escapements and the seconds-hand E′ on the main shaft E all point exactly alike at zero on their respective dials. Now if one pendulum is started alone the seconds-hand on its escapement-shaft will mark seconds on its dial, while the seconds-hand on the main dial, although responsive to the same and moving synchronally with it, will move only one-fourth of a second at each beat and will make one revolution while the former has made four. Now let a second pendulum be started, and the effect will be that the respective escapement gear-wheel will move the seconds-hand on the main dial at each beat one-fourth of a second, so that as the other going pendulum moves the seconds-hand on the main dial also one-fourth of a second at each beat, the effect will be that the speed of the seconds-hand on the main dial will be doubled—that is, one-half of a second at each beat of the two pendulums. Three pendulums moving will triple it, and when the four pendulums are in action the main train is at full speed, and the speed of the main seconds-hand is exactly the average of the combined speed of the four escapements. Thus it will be seen that the variation of speed or error in time of one escapement affects the movement of the main frame only one-fourth of such error, and as it is not likely that the same errors would occur in different escapements simultaneously, and be of the same character as well, it is safe to say that this association of the escapements with a single clock-train will reduce the errors to a fraction indicated by the square of the number of pendulums and escapements employed. Thus, if two pendulums or escapements were employed, it would reduce liability of error to one-fourth, or four to one-sixteenth, and eight to one sixty-fourth, and so on, by reason of the chances of one error offsetting another, and also by the increased power of the main train, rendered necessary by the multiplicity of the escapements.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. In an isochronal clock, the combination, with two or more escapements, of a main shaft and a clock-train connecting the said escapements with the said main shaft in such a manner that the main shaft indicates the average time of the said escapements, substantially as shown and described.

2. In an isochronal clock, the combination, with a main shaft, of independent escapements and a differential mechanism, substantially as described, for transmitting the average motion of the said escapements to the said main shaft, as set forth.

3. In an isochronal clock, the combination, with a main shaft actuated by suitable clock-work, of independent escapements actuated from the said main shaft and a differential mechanism, substantially as described, for transmitting the average motion of the said escapements to the said main shaft, substantially as shown and described.

4. In an isochronal clock, a main shaft actuated by suitable clock-work, a hand held on the said shaft, and a dial, in combination with independent escapements actuated from the said main shaft, a hand operated by each escapement, dials for said escapement-hands, and an intermediate differential mechanism, substantially as described, for transmitting the average motion of the several escapements to the said main shaft, as and for the purpose set forth.

5. In an isochronal clock, a shaft, a gear-wheel secured on the said shaft, and a beveled planetary gear-wheel held on the said gear-wheel, in combination with two beveled gear-wheels held loosely on the said shaft and meshing into the said beveled planetary gear-wheel, and escapements connected by suitable means with the said beveled gear-wheels, substantially as shown and described.

6. In an isochronal clock, a main shaft actuated by suitable clock-work, a pinion secured on the said shaft, a gear-wheel meshing into the said pinion, a shaft on which the said gear-wheel is secured, and a beveled planetary gear-wheel held on the said gear-wheel, in combination with two beveled gear-wheels meshing into the said beveled planetary gear-wheel and being held loosely on the said shaft, and independent escapements connected by suitable means with the said beveled gear-wheels, substantially as described.

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Witnesses:
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C. SEDGWICK.