

No. 685,269.

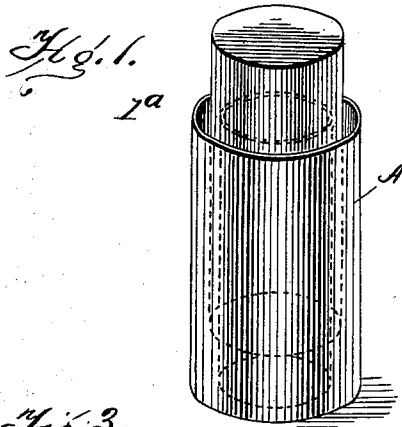
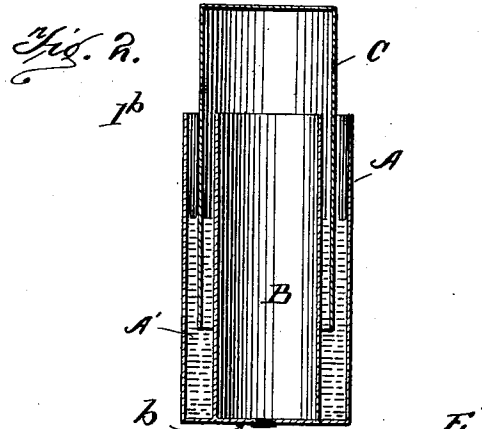
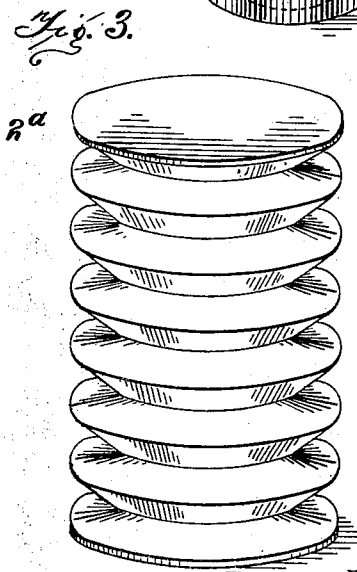
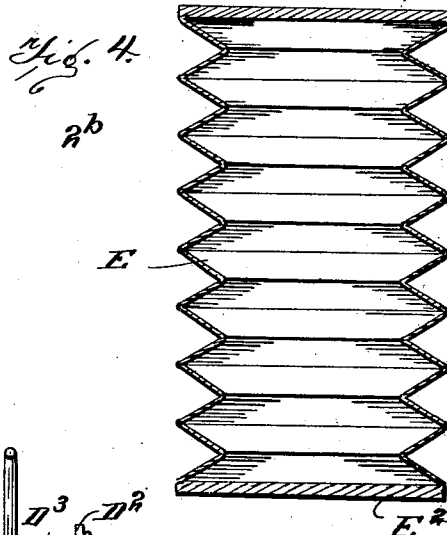
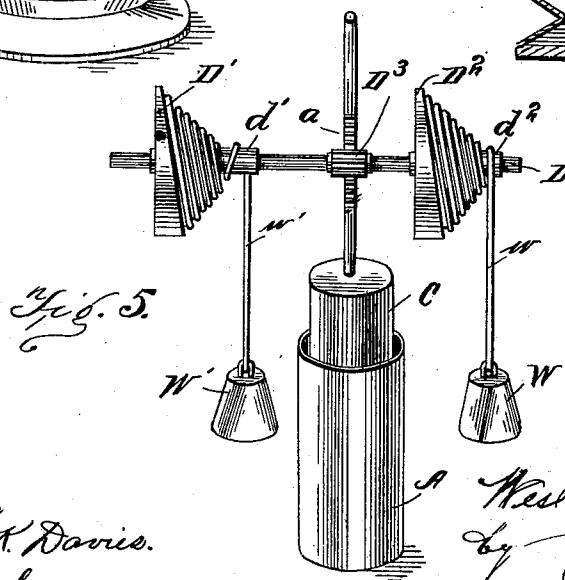
Patented Oct. 29, 1901.

W. M. FULTON.
MOTOR.

(Application filed Jan. 3, 1900. Renewed Feb. 19, 1901.)

(No Model.)

2 Sheets—Sheet 1.



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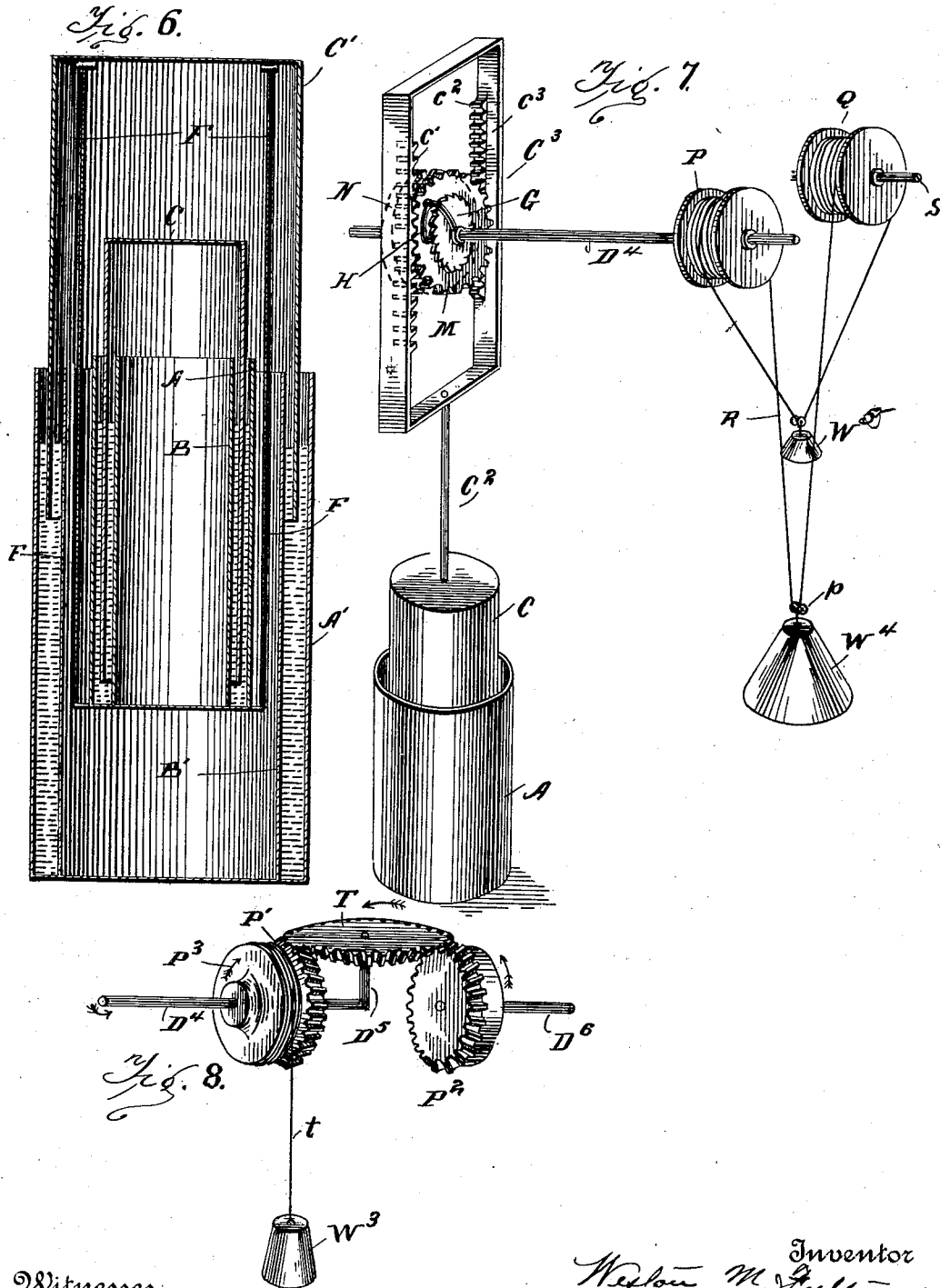
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2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

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MOTOR.

SPECIFICATION forming part of Letters Patent No. 685,269, dated October 29, 1901.

Application filed January 3, 1900; Renewed February 19, 1901; Serial No. 48,003. (No model.)

To all whom it may concern:

Be it known that I, WESTON M. FULTON, a resident of Knoxville, Tennessee, have invented a new and useful Improvement in Motors, which invention is fully set forth in the following specification.

My invention relates to motors, and more especially to a motor designed to utilize the periodic and non-periodic changes of atmospheric pressure and temperature as a motive power.

With this object in view the invention consists in means whereby changes in atmospheric pressure alone or changes in atmospheric pressure combined with changes in atmospheric temperature may be caused to impart movements to a body, which movements are utilized for the purpose of doing work of a given character—as, for example, in driving light machinery, such as clocks and the like; but while my device is designed more especially for use in connection with light forms of machinery, such as clocks, it is nevertheless only limited in power by the magnitude of certain of its parts. The inventive idea may be embodied in a great variety of mechanical forms, and for the purpose of illustration I have shown some of these forms in the accompanying drawings; but it is to be understood that such drawings are designed for purposes of illustration only and not as defining the limits of the invention.

In the drawings, Figure 1 is a perspective view of the apparatus designed to respond to changes in atmospheric pressure or temperature. Fig. 2 is a central vertical section thereof. Fig. 3 is a view of another form of apparatus designed for a like purpose. Fig. 4 is a central vertical section of the form shown in Fig. 3; and Fig. 5 is a perspective view of mechanical device, showing the means whereby such apparatus is made to respond more readily to changes in atmospheric pressure and temperature, so that these changes may be allowed to impart as large movements to a body as may be desired. Fig. 6 is a sectional view of a modified form of the apparatus shown in Fig. 1. Fig. 7 is a perspective view of an apparatus, showing the operation of my invention in connection with the winding-shaft of a clock or other similar motor;

and Fig. 8 is a modified detail of the apparatus of Fig. 7.

Referring to Figs. 1 and 2, A and B are right cylinders placed one within the other, as shown, each closed at the bottom and preferably having a common base *b*, as shown. C is also a right cylinder of a diameter less than that of A, but exceeding that of B, closed at its upper end and placed in the annular space formed between the cylinders A and B, which space is filled with any suitable liquid for forming a gas-tight closure or joint, mercury being preferred for this purpose. The vessels A, B, and C may be made of any suitable material, such as iron or glass. It will be apparent that the interior volume of the vessels B and C may be decreased by immersing the vessel C within the vessel A or increased by withdrawing the vessel C to a greater or less degree out of the vessel A.

Since by the laws of physics work is equal to force multiplied by the distance through which it acts, it is evident that if it is proposed to utilize any particular force in the performance of work the greater the distance through which that force is made to act the greater will be the amount of work done. Hence in order that the apparatus shown in Figs. 1 and 2 may be most effectual it is necessary that the forces due to fluctuations of atmospheric pressure or of atmospheric pressure combined with fluctuations of temperature be made to act through the greatest distance practicable. For example, let it be supposed that the interior of vessels B and C is filled with dry air whose tension is just equal to the external pressure of the atmosphere. So long as there is neither change of internal temperature nor external pressure equilibrium will be maintained and the volume of the vessel will not be changed; but if the internal temperature remains constant while the external pressure of the atmosphere increases, then the air in the vessel will be compressed and the volume of vessels B and C will be decreased. The same result would follow if the pressure remained constant while the internal temperature decreased or if both pressure and temperature acted conjointly; but the greatest observed fluctuations in atmospheric pressure at the earth's surface repre-

sent only a small fraction of the total atmospheric pressure, and the fluctuations in temperature are within comparatively narrow limits. Hence since the volume of a gas varies with the pressure imposed upon it it is evident in the above supposed case that the fluctuations of pressure and temperature which actually occur in the earth's atmosphere would produce only slight changes in the volume of a vessel filled with dry air whose tension is equal to normal atmospheric pressure and that therefore these forces would act through very short distances. It is desirable, therefore, to produce conditions which will cause greater changes in the volume of the vessel as the result of the slight changes in external pressure or internal tension, and the maximum efficiency of the machine may be reached when the gas in the interior of the vessels is made to so vary in volume that when the atmospheric pressure is at its maximum limit and the temperature at its minimum limit the vessel is compressed to its minimum volume, and, conversely, when the atmospheric pressure is at its minimum limit and the temperature at its maximum the vessel will expand to its maximum limit. These ideal conditions will be most nearly attained by the employment of "saturated vapors," either alone or combined with a gas, in the gas-chamber of vessels B and C, and preferably those vapors are employed whose "critical temperatures" are above the maximum temperature of the locality where the motor is to be used and whose critical pressures are not greatly above normal atmospheric pressure. Preferably one or more of these vapors is combined with a gas which will not be liquefied under the most extreme atmospheric conditions. Some of the vapors which I have found suitable for this purpose are alcohol, ether, carbon disulfid, and chloroform, while some of the gases I have employed in connection with these vapors are ammonia, cyanogen, carbon dioxide, marsh-gas, oxygen, and hydrogen. By combining one or more of the above-named saturated vapors with one of the gases slight fluctuations in atmospheric pressure and temperature will produce large fluctuations in the volume of the vessel. For example, suppose the gas-chamber of the vessel, Figs. 1 and 2, to be filled with vapor of alcohol in the presence of its liquid at a temperature of 65° centigrade. Its tension will then be nearly equal to that of normal atmospheric pressure. Add a sufficient amount of air to make the combined tension of air and alcohol-vapor just equal to the external atmospheric pressure. Now since the alcohol-vapor is in the presence of its liquid it is a saturated vapor, and hence if the temperature remains unchanged, but the external pressure increases, the alcohol-vapor will proceed to condense without increase of tension. This will leave the air which is combined with the vapor, the task of sustaining the entire force of the increase of pressure,

and since only a small amount of air was added its action will be just as though it was in the vessel alone and in a highly-rarefied state—viz., it will be very sensitive to changes in pressure—and slight variations in the external pressure of the atmosphere will produce decided changes in the volume of the air in the vessel and a corresponding increase in the distance through which any member attached to the vessel C would move. A similar result would evidently follow if the the pressure remains constant while the temperature changes or if both pressure and temperature act conjointly. The proportions in which the gases and vapors are to be mixed will depend upon local peculiarities of climate and upon the character of the work which the motor is to perform. Vapors will often be used alone without gases.

I have shown in Fig. 5 a mechanical device by means of which slight changes in atmospheric pressure and temperature may be made to produce decided changes in the volume of the vessels, Figs. 1 and 3, without the use of vapor, as just described. This method is desirable in some cases. A rack *a* is secured to the movable cylinder C, the cylinder A being held against movement, and D is a shaft supported in any suitable bearings and having secured thereto the fusees D' and D², with their extensions *d'* and *d*², respectively, which extensions are of regular diameter. W W' are weights attached, by means of the cords *w w'*, to the fusees, as shown, said cords being wound in reversed directions on the fusees and their extensions *d' d*². The operation of this device is as follows: Whenever the changes of temperature or atmospheric pressure cause the vessel C to descend, the rack *a* engages the pinion D³ on the shaft D and revolves said shaft in a direction to wind up the cord *w*, bearing the weight W, and to unwind the cord *w'*, bearing the weight W'. On the other hand, any changes in atmospheric pressure which caused the vessel C to ascend would wind up the weight W', while unwinding weight W.

Fig. 7 shows a means whereby the movements of the cylinder C may be utilized to perform work. C² is a standard attached to the top of the cylinder C and supporting upon its upper end a frame C³, having the racks *c' c*² formed on the inner faces of its opposite sides, but lying in different vertical planes. D⁴ is a shaft which may be supported in any suitable bearings and having two pinions M (shown in full lines) and N (shown in dotted lines) loose thereon. Secured on the face of each pinion is a ratchet-wheel G, and rigidly attached to the shaft D⁴ is a pawl H in operative engagement with the ratchet-wheel G. The pinion M engages the rack *c'*, and the pinion N engages the rack *c*². P is a pulley mounted to turn with the shaft D⁴ and has wound around it a number of times an endless cord R, which is in turn wound around a second pulley Q on the shaft S, which may

be supported in any suitable bearings. W^4 W^5 represent weights supported by the cord R between the pulleys P and Q, small pulleys p being attached to the weights W^4 W^5 to permit the cord to move freely therethrough. W^4 is a large weight, while W^5 is a small weight whose office is simply to maintain a sufficient tension on the cord R to prevent slipping on the pulleys P and Q.

10 The operation of the construction shown in Fig. 7 is as follows: The rack-frame C^3 responds to the movements up or down of the cylinder C due to the changes of atmospheric pressure or temperature, and in its downward movement the rack c' engages the pinion M and revolves the same, carrying with it the ratchet-wheel G, which, by reason of its engagement with the pawl H, imparts revolution to the shaft D^4 . On the upward movement, however, while the rack c' revolves the pinion M revolution is not imparted to the shaft, because the teeth of the ratchet-wheel G slip under the pawl without engaging therewith; but on said upward movement the rack c^2 engages with the pinion N, which, by reason of a ratchet-and-pawl connection (not shown) similar to that of the ratchet-wheel G and pawl H on the pinion M, imparts motion to the shaft D^4 in the same direction as was given said shaft by the pinion M on the downward movement of the racks. It will thus be seen that any increase or decrease of the volume of the vessels A C will result in the revolution of the shaft D^4 in one direction only and that such revolution of the shaft D^4 will wind the cord R upon the pulley P without interfering with the action of the weight W^4 on the pulley Q, through which it acts to continuously drive the shaft S, which may serve as the power-shaft for driving machinery.

In Fig. 8 I have shown a modification of the means whereby the revolutions of the shaft D^4 may be utilized to store energy and transmit that energy to do work. In said Fig. 8, P^1 is a bevel-gear loosely mounted on the shaft D^4 and having on one side thereof a drum P^3 , on which is wound a cord t , supporting a weight W^3 . D^5 is a crank-arm rigid with the shaft D^4 and having loosely mounted on the end thereof a bevel-pinion T, meshing with the bevel-gear P^1 on the shaft D^4 , and with the bevel-gear P^2 , rigid on the shaft D^6 , which latter shaft forms the driving-shaft of the mechanism to be operated—as, for example, the driving-shaft connected to the operating mechanism of a clock. The revolution of the shaft D^4 , caused by the movements of the rack C^3 , operates to wind up the cord t , bearing the weight W^3 , and it will be apparent that the weight W^3 will furnish the power for the continuous driving of the shaft D^6 . Furthermore, the continuous movement of the shaft D^6 will not be interrupted by the action of the rack C^3 , which serves to wind up the weight W^3 , as the bevel-gears P^1 and

P^2 will then be revolved together and in the same direction by the action of the pinion T, connecting them.

In Figs. 3 and 4 I have shown a modification of the vessel, whose variations in volume serve to impart movement to the motor-shaft. In these figures, E is a vessel of bellows-like shape composed of suitable elastic material—as, for example, thin sheet-steel—and having top and bottom plates E' E^2 of sufficient thickness or rigidity to support the vessel and the portions of the mechanisms that may be connected thereto for conveying its motions to a shaft—as, for example, the rod C^2 . (Shown in Fig. 7.) The principle of operation of this modification is identical with that of the vessel shown in Figs. 1 and 2, with the single exception that the elasticity of the material of which the vessel is composed serves to assist in the motions imparted in one direction.

In Fig. 6 I have shown still a different modification of the construction shown in Figs. 1 and 2, which consists in placing the vessel composed of cylinders A, B, and C within a second vessel of like construction composed of cylinders A' , B' , and C' , the only difference between the two vessels being that of size. For the purpose of supporting the vessel A, B, and C within the vessel A' , B' , and C' a suitable brace or braces F are employed. All the gas is exhausted from the smaller vessel, so as to produce a vacuum therein, and the gas in the larger vessel may then be considerably rarefied. This will enable slight fluctuations in pressure and temperature to produce more decided changes in volume.

While I have herein shown and described certain forms and constructions of vessels whereby the variations in atmospheric pressure and temperature may be utilized and while I have shown certain means of imparting motion from said vessels to suitable shafting designed to perform certain work, it will be understood that my invention is not limited either to any specific form of vessel or to any specific means of conveying motion therefrom to the operating-shaft of the machinery to be driven, as numerous forms of vessels and of connecting mechanism may readily be devised for carrying out the inventive idea which finds expression in the mechanism shown in the drawings.

Having thus described my invention, I claim—

1. The combination of a collapsible vessel containing a saturated vapor combined with a suitable gas, the volume of said vessel varying with variations in atmospheric pressure, and means operatively connected to said vessel whereby the movements of the vessel due to its variations in volume may be utilized to perform work.

2. The combination of a collapsible vessel containing saturated vapors combined with a suitable gas, a shaft, and means operatively

connecting said vessel and shaft whereby either the increase or decrease in volume of the vessel will impart rotary movement to the shaft in one direction only.

5 3. The combination of a collapsible vessel containing a saturated vapor and a gas, a shaft having a pinion mounted thereon, and a rack connected to said vessel and in operative engagement with the pinion on the shaft,
10 whereby the variations in volume of the vessel will impart movement to the pinion and shaft.

4. The combination of a collapsible vessel containing a saturated vapor and a gas, a
15 shaft having two pinions thereon capable of loosely turning on the shaft, and two racks, one engaging each pinion and means connecting the racks to the said collapsible vessel whereby the changes in volume of the vessel

will impart rotary movement to the shaft in 20 one direction only.

5. The combination of a collapsible vessel having a saturated vapor and a suitable gas therein, a shaft, means whereby the variations in volume of the vessel impart move- 25 ment to the shaft in one direction only, a drum or pulley on said shaft and having a weighted cord wound thereon, a power-shaft and means operatively connecting the said drum or pulley with said power-shaft. 30

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WESTON M. FULTON.

Witnesses:

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SAMUEL B. O'DELL.