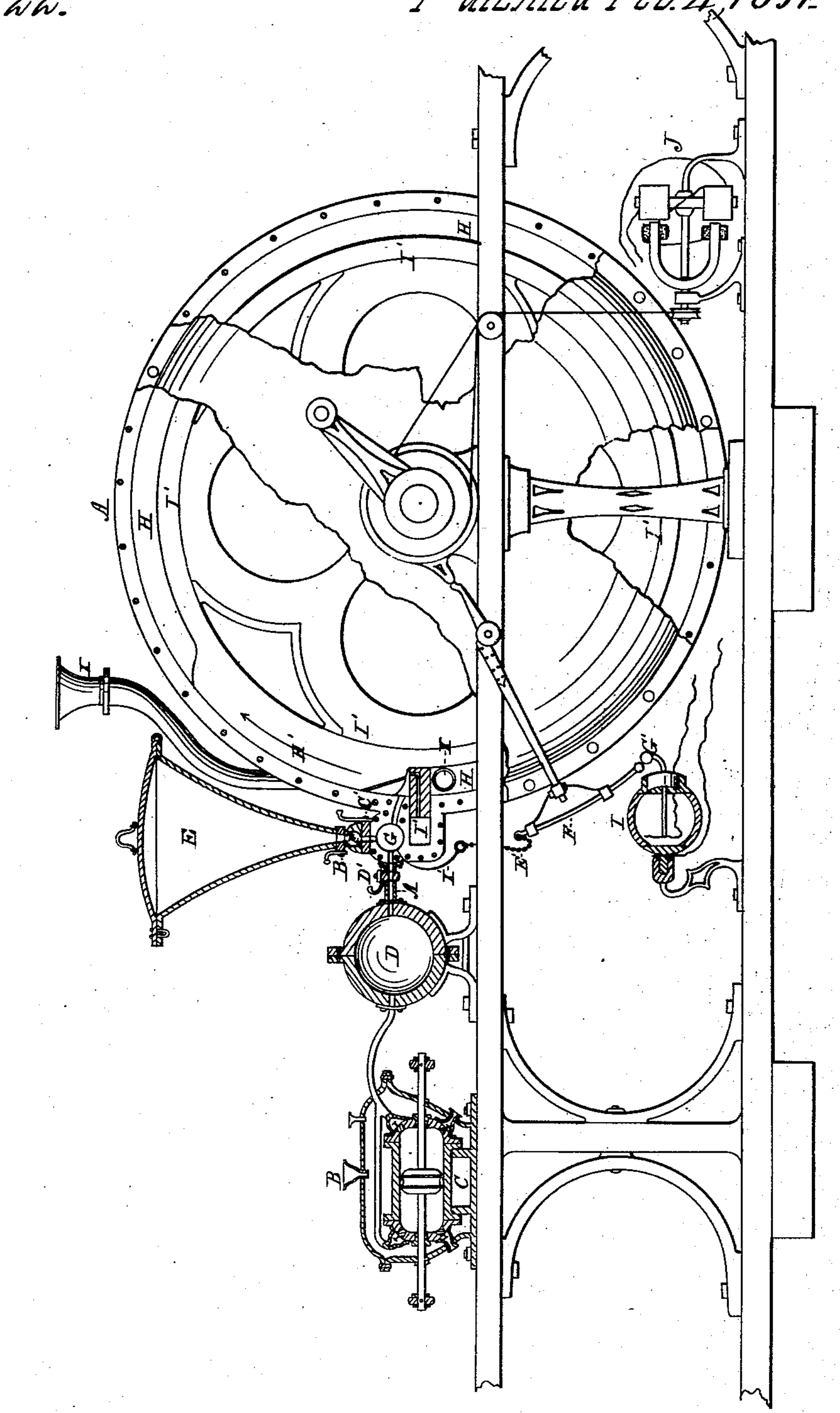
W. Mt. Storm,

Compressing Air.

No. 7,922. Patented Feb. 4, 1851.



Inventor:

Wm. M. Storm

UNITED STATES PATENT OFFICE.

WILLIAM M. STORM, OF TROY, NEW YORK.

IMPROVED METHOD OF OBTAINING MOTIVE POWER.

Specification forming part of Letters Patent No. **7,922**, dated February 4, 1851.

To all whom it may concern:

Be it known that I, WILLIAM M. STORM, of New York, (now residing at Troy, New York,) have invented an Improved Mode of Obtaining Motive Power, which I have termed the "Aerogen Insto-Motive;" and I hereby declare the following to be a full and exact description thereof.

The fundamental principle of my invention consists in producing and applying as a motive force the sudden expansion or increased tension produced by the intensely-rapid combustion or the explosion of a solid combustible in a compressed gaseous supporter of combustion. For manifold reasons the most advantageous combustible is carbon in the form of a charcoal, and air the best supporter that can be employed. The air should be compressed to a density several times exceeding that of the atmosphere, and the charcoal should be granulated. Both combustible and supporter should be fed and consumed in charges. The conditions essential to the proper application or rather the combined operation of these principles may be best elucidated by a sketch.

Annexed is one of a mechanism which, although not intended as appropriate to use, serves to illustrate the conditions above named and that in practice should be carried out, although it be in a different form.

Let A represent a rotary engine, and B a double-acting compressing air-pump, surrounded by its cooler C for absorbing in part the caloric expelled by compression from the air, and which if left free would cause unnecessary and serious reaction. Let D represent a compressed-air receiver and reservoir, and E a carbon feeder and reservoir with its charger F. Let G represent a discharge-chamber communicating with the cylinder H of the engine, and from about one-fiftieth to one-hundredth of the capacity thereof, (these proportions being subject, however, to great variation,) and communicating also, by means of the pipe A′, with the receiver D, and also, as seen by the sketch, with the charger F. Let I represent an insulated Leyden jar, and J a rotary magnetic electro-generator. X is the eduction of the engine. Now place granulated or pulverized charcoal in the feeder E and let the air-pump B compress air into the receiver D to such a density as will enable it when in contact with said combustible in a state of ignition to support combustion so powerfully as to produce explosion or a combustion so vivid as to be closely allied thereto. Then, suppose the supply of air to the reservoir D to be kept up by the continuous operation of the pump B, moved by mechanical connection to the engine proper, all the movements described herein being effected by similar means and the temperature of the engine being by some proper means kept under control, the further operations of charging and discharging may be described as follows: The cut-off B′ being opened, a charge of the combustible will descend from the feeder E into the charger F. B′ then closes. C′ then opens and the charge of combustible descends or passes into the discharge-chamber G. C′ then closes. The cut-off or cock D′ between the reservoir D and the chamber G in the pipe A′ then opens, and a charge of compressed air passes from D through A′ to G. D′ then closes, shutting off all communication from the discharge-chamber, and the combustible and supporter are now closely confined together in proportions proper for combination with each other by combustion, (the surplus, if of either, should be of the supporter,) although as yet their combustion has not taken place; but the ignition-wire x' projecting into the discharge-chamber G and connected by the chain E′ or other conductor of electricity to a discharging-rod F′, which is now brought in contact with the prime conductor G′ of the Leyden jar I, which is supposed to be kept charged by the action of the rotating magnetic electro-generator J, the passage of the electric charge through x' will ignite the charge in G, the carbon and the oxygen of the air suddenly combining by combustion and forming, according to their relative proportions, carbonic oxide or carbonic acid, or, as may occur, a portion of each, which, together with the nitrogen which had constituted previous to combustion a part of the atmospheric supporter, will be suddenly expanded, or the gaseous compound will have its elastic tension (considerable in its previous form) greatly increased by the heat evolved in the explosion and strike the reaction cam or projection H′ (at this moment to be in the position represented in the sketch,) with a strong impact, and, reacting between it and the sliding piston J, (pressed from its case by the gases passing through and behind it,) will cause the wheel I′, of which H′ is a part, to rotate in the direction indicated by the arrow, the effect produced being somewhat similar in nature to the explosion of gunpowder, though much less violent. It should be observed that the admission of the charge into G, or at least of the supporter, is supposed to take place while H′ is passing G and closing all communication with the rest of the engine.

The principle of the aerogen power, among other things, might, with a proper adaptation of the operating mechanism, be applied to engines of war—as cannon and other fire-arms—by exploding gunpowder or any other explosive solid compound, as a substitute for carbon, simply, in air compressed and confined with it; but this mode of obtaining power being comparatively much more costly than the method previously described, not to mention many other great disadvantages that would ensue if applied to general purposes, it needs no further description. The same may be remarked as to the substitution of oxygen gas (to be obtained by the distillation of a nitrate or an oxide) for air as the supporter.

In applying the aerogen principle, the more highly compressed the supporter may be the greater will be the initial pressure of the gases at the moment of combustion, the capacity of gases for caloric, as is well known, being nearly inversely as their density, and therefore their increase of elastic tension at the moment of their being heated being directly as their density previous thereto, and this is an important consideration, inasmuch as the said increase, together with some considerable attendant expansion of the gases beyond their original volume previous to compression, constitutes the net motive force gained. Continued practice alone, however, can decide what density of the supporter is generally best and all things considered the most economical. It will probably be perceived that one reason why it is essential to use the carbon in a cracked or pulverized form is that if it were not reduced to some uniform consistency it could scarce be controlled or its quantity regulated in the feeding; but there are other reasons the ignition could not, as is highly necessary, be punctually and so thoroughly effected, and it would be difficult to effect explosion at all were the combustible not previous to use subjected to the process of cracking, or by some means either before or after charring reduced to the granulated or pulverized form.

As I have before mentioned, the mechanism herein described is not exactly adapted for practical purposes, but is introduced the better to elucidate the main points involved and to be observed in the application of the aerogen principle, or rather to show the principle itself. Yet in any case a discharge-chamber, with means of shutting off all connection with the reservoirs, a carbon reservoir or feeder, a charger of some kind, an apparatus for compressing the air, and a means of thoroughly igniting the charge would be indispensable. A reservoir for compressed air might be dispensed with, but not conveniently, by causing the force-pump to compress each charge of the supporter at the proper period directly into the discharge-chamber.

Ordinary combustion, even though conducted in the manner here described—that is, in a discharge-chamber, &c.—would produce but a comparatively trifling effect. It is desirable, therefore, that combustion should be vivid and sudden. To this end the supporter should be dry and dense, the latter that it may by occupying less space be brought more immediately in contact with the combustible and by its increased elasticity more capable of permeating the pores thereof, and so in a situation enabling it to combine more unimpeded and instantly with the combustible and more within the sphere of the electric attraction that ensues between an ignited combustible and supporter. The combustible should be dry and, if convenient, even heated. It should be granulated, which not only adapts it to be fed in charges, but, what is of as great importance, it enables the supporter to mingle more thoroughly through the mass of the charge and exposes an immensely greater surface of the combustible to the supporter and combustion in no case whatever. I assume, even in gases elsewhere than at the surface of contacts between the combustible and supporter and the points upon which the greatest rapidity of combustion depends, assuming the combustible and supporter to be pure and dry as possible, may be summed up thus: first, the presence of all the oxygen necessary to the entire combustion of the combustible; second, the greatest possible surface of contact between the supporter and combustible; and third, the most thorough and simultaneous ignition of the combustible at as many points as possible.

I am aware that combustibles and supporters, both gaseous, as oxygen and hydrogen, have been compressed and exploded in close vessels to produce motive power; but no practically useful result has thus far been attained, as those gases, even were they not too costly, their compression together to any great degree, which is a principal source of economy, destroys their explosive properties by effecting partial recombination, and so aqueous vapor in all probability; and, moreover, these gases, from their very nature, yield only an impracticable kind of power, giving when exploded together, first, a brief expansive impulse, then almost at the same instant combine, forming water and producing vacuum, and again even this vacuum is destroyed almost as soon as formed by the water produced by the explosion being through the caloric thereby set free converted into vapor, which would fill about six-sevenths of the space occupied by the gases before explosion, even at the atmospheric density.

I am aware, also, of the use for a like purpose of carbureted hydrogen or coal-gas and air uncompressed; but nearly the same objections would exist, excepting that under ordinary circumstances no vacuum would be formed, but an initial expansive force or onward pressure of perhaps about three atmospheres, the capacity of the vessel (if a separate one were used) in which the explosion takes place being necessarily about one-third as great as the cylinder or vessel into which the remaining gases, principally carbonic acid and nitrogen, are allowed to expand to make their power available, and the compression of carbureted hydrogen or coal-gas with any supporter could not be carried to an extent that would render the ultimate result substantially different or yield more power with economy sufficient for practice. From these and other facts it would be inferred that carbon in the form of a charcoal is the only combustible advantageously to be used in general practice for the production of motive power immediately by combustion, it being most manageable and is economical and generally procurable, as also is atmospheric air compressed the most advantageous and economical supporter, being omnipresent and absolutely costless.

I am also aware that air compressed to some extent and again expanded by the combustion in it of coal, charred and uncharred, has been tried as a means of motive power; but not that such compression was ever carried to near such an extent as to produce anything bordering on explosion, and whereby a vastly different result would have been attained both as regards power and economy, or that such attempts were so managed that the whole effect of combustion might act unimpeded and as directly as possible upon the piston, and the initial expansive force thereby not be dissipated in unnecessary space, or that the combustible and supporter were consumed in regular charges, or that the conveyance of the combustible and supporter, and particularly the last, into the furnace used in such cases did not take place against the pressure of the gases therein evolved and expanded and against its own reaction caused by the continuous combustion therein, and this difficulty, beside many others incident to this mode, unless strictly obviated, would, owing to the reaction upon and resistance to the compressing force which must be derived from the expansive force, in all cases too nearly equalize or greatly waste the latter for any amount of power to be thus realized that would for practical purposes be worthy of notice.

A theoretical estimate of the power to be obtained on the aerogen principle may be derived from the following data: Dalton (see "New System of Chemical Philosophy," Part First) asserts the specific caloric of air as compared to that of water to be for equal weights as 1.79 to 1.00. Again, one pound of charcoal (costing, when ready for use on the aerogen principle, say, one-half of one cent) will, according to other well-known authors, raise the temperature of thirteen thousand pounds of water 1° Fahrenheit, and if these relations of quantity to temperature hold good in the main, as is to be presumed, one thousand pounds 13° Fahrenheit, and so on. Carbon will combine with two and two-thirds times its weight of oxygen, two and two-thirds grains of which are found at a mean of the barometer and thermometer in about thirty-five to thirty-eight cubical inches of atmospheric air, which then would be the quantity necessary for the entire combustion of one grain of carbon in a chemical view, and which, according to the above data, would be heated by this combustion to about 640° Fahrenheit, and although this result differs slightly from those derived from the experiments of different authors, it appears to agree closely with practical observations made by experienced engineers on the bulk of the products of combustion in furnaces of a given weight of carbon. Again, according to Dalton and authors in general, gaseous fluids are expanded under a constant pressure of one atmosphere one four hundred and seventy-ninth of their volume at zero for each elevation of their temperature of 1° Fahrenheit. Hence, supposing the augmentation to 640° Fahrenheit in temperature of the above amount of air to take place under a constant pressure of one atmosphere, it would be increased in volume about two and one-third times.

To ascertain the tension, which I will let be represented by p, effected by caloric in air when compressed, and thus of an increased density, I may say, let K equal 15, the pressure per square inch in pounds of the air at the ordinary density and temperature, let d equal the density to which it may have been reduced by compression, let a equal one four hundred and seventy-ninth, the augmentation of volume for each increase of temperature of 1° Fahrenheit, let t equal 640° Fahrenheit, the temperature to which carbon by the foregoing data will raise the amount of air chemically necessary for its combustion under the ordinary pressure and density and "we obtain $p=Kd\ (1+at)$ for the expression of the elastic force of any gas in a function of its density and temperature," (see Pneumatics, Brande's Encyc., page 947;) but, again, as is well known, compressed gases are sensitive to caloric in proportion to such compression, their capacity for caloric being held nearly inversely as their density, and thus the temperature of 640° would be proportionally surpassed at the moment of combustion. In any case, here is shown a great increase of tension, which may represent weight aised, and an important increase of volume which is equivalent to distance raised; therefore, the power invested in compressing the air to be employed on the aerogen principle is returned with a high increase, and some thousands of tons raised some feet may be set down as a perfectly feasible and practicable result for the expenditure of one cent on this principle for fuel, and any degree of density of the air for supporting the combustion that will produce a combustion bordering on explosion or a sudden combustion and impact will yield a power not only more economical by far than steam or any other known artificial power, but the danger from explosion is comparatively annihilated, to which may be added the advantages involved in its application of immensely greater lightness and compactness and its being ever ready at a moment's notice.

Having thus fully described the nature of my invention and pointed out its distinctions from all others, what I claim, and desire to secure by Letters Patent of the United States, is—

1. Actuating an engine such as are now usually driven by steam, or of any convenient form, by means of the combustion allied to an explosion of a measured or detailed quantity of a charcoal (or other solid carbonaceous fuel similar in nature and of like effect) in a measured quantity of highly-compressed air, (or oxygen,) said combustion being effected in a vessel which at that time is not in connection either with the reservoir or main source of compressed air or with that of the charcoal, and the gases resulting from each separate and distinct explosion being allowed to act on the pistons or their equivalents before the other charges are introduced into the exploding or combustion vessel, the whole operation being effected through the agency of apparatus in nature substantially such as are herein specified, or apparatus that shall effect the whole operation in the manner claimed.

2. Actuating an engine as just claimed, using the combustible in a granulated or pulverized form, for the purposes and various reasons made known.

WM. M. STORM.

Witnesses:
P. McMANUS,
MOSES WARREN.