J. K. BRODERICK.

COMBINED INTERNAL COMBUSTION AND COMPRESSED AIR ENGINE.

APPLICATION FILED OCT. 15, 1909.

1,013,528.

Patented Jan. 2, 1912.

3 SHEETS—SHEET 1.

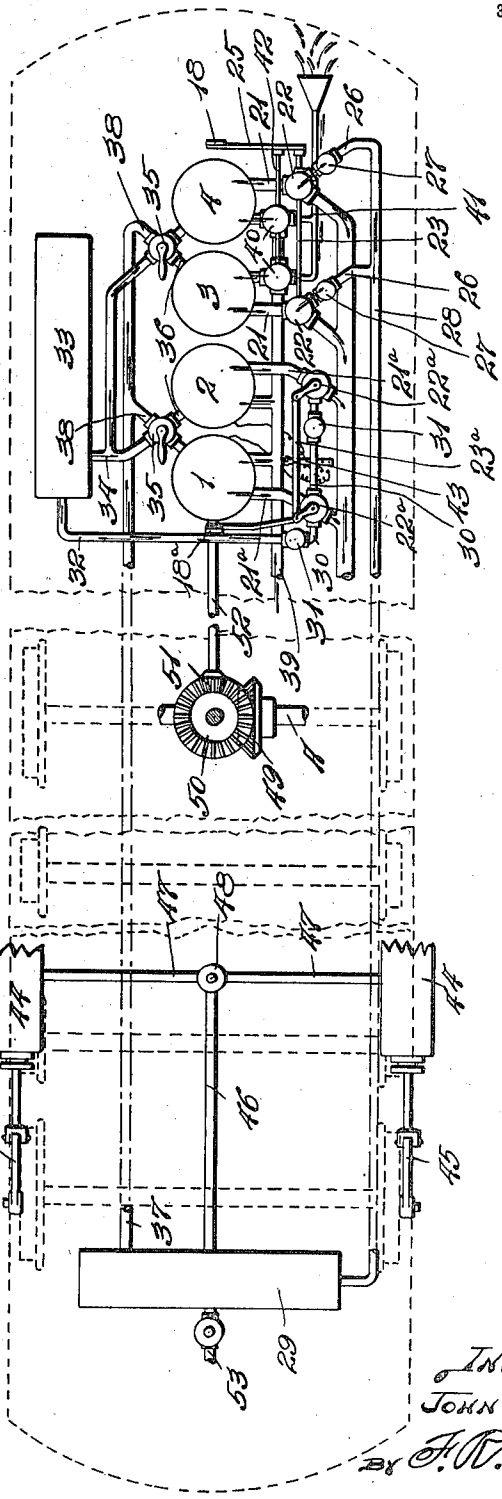

Fig. 1.

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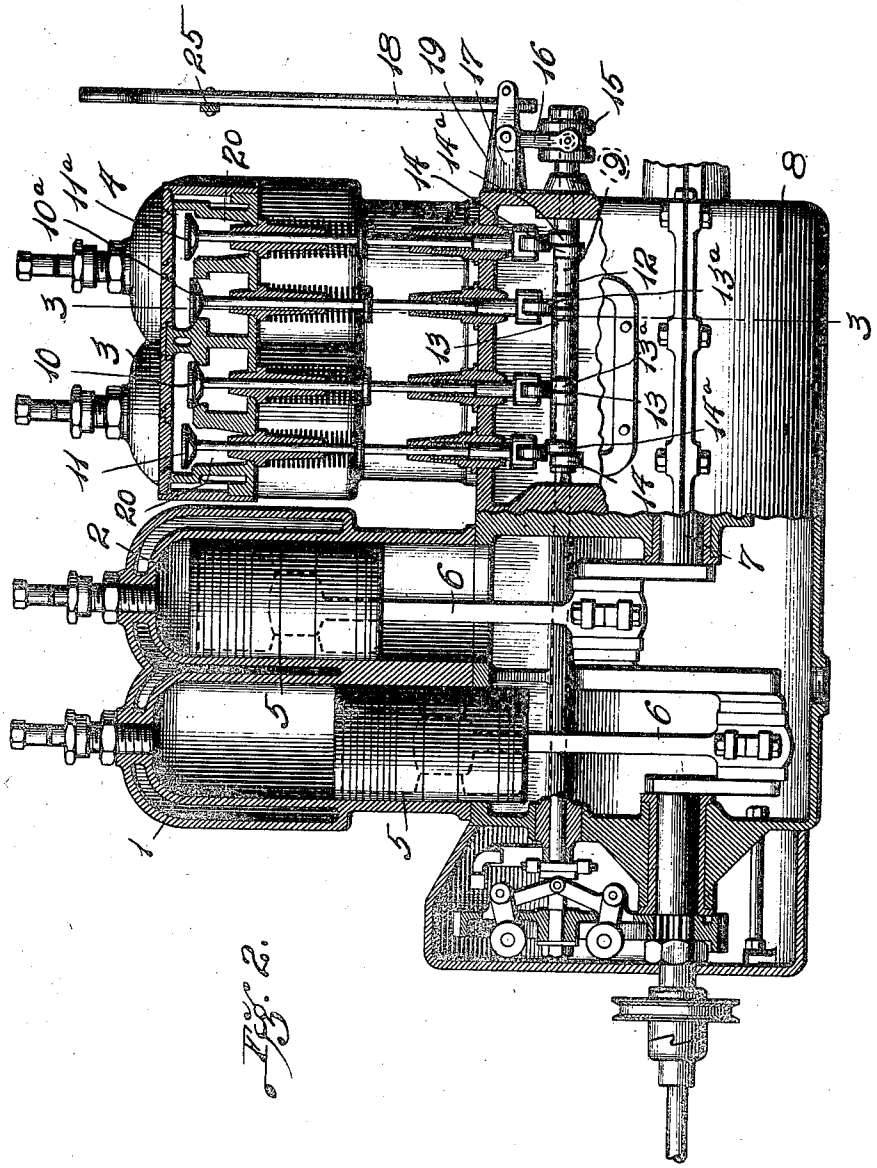

Fig. 2.

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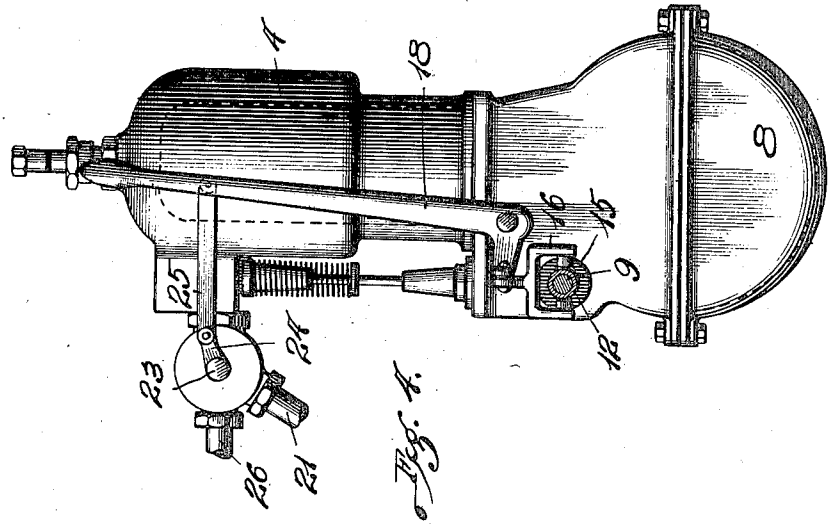

Fig. 4.

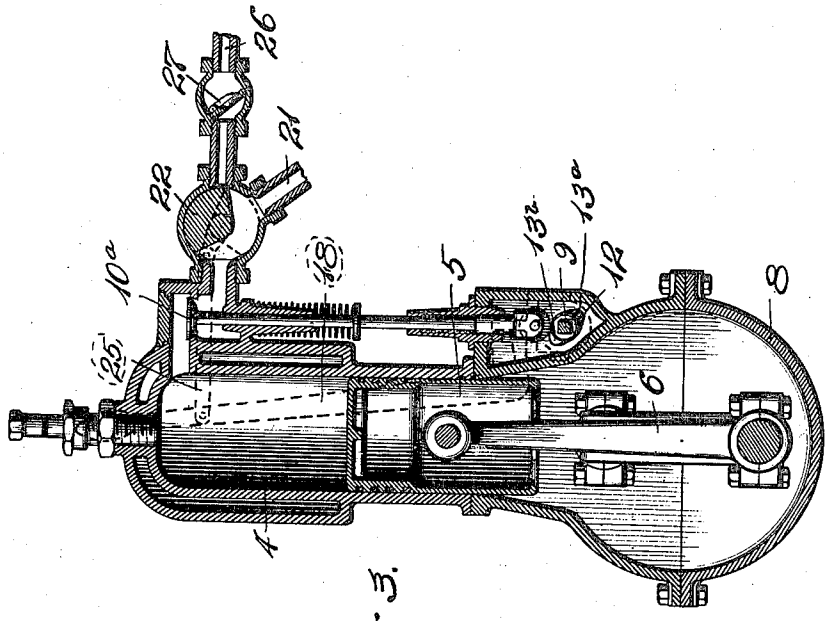

Fig. 3.

WITNESSES:—

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UNITED STATES PATENT OFFICE.

JOHN K. BRODERICK, OF ST. LOUIS, MISSOURI.

COMBINED INTERNAL-COMBUSTION AND COMPRESSED-AIR ENGINE.

1,013,528. Specification of Letters Patent. Patented Jan. 2, 1912.

Application filed October 15, 1909. Serial No. 522,797.

To all whom it may concern:

Be it known that I, JOHN K. BRODERICK, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in Combined Internal-Combustion and Compressed-Air Engines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a diagrammatic view of my improved combination internal and combustion and compressed air engine, and in which view, the outline of a car body in plan view is shown in dotted lines. Fig. 2 is a side elevation partly in vertical section of my improved engine; Fig. 3 is a vertical section taken on the line 3—3 of Fig. 2; Fig. 4 is and end elevation on my improved engine.

My invention relates to a combined internal combustion and compressed air engine, the principal object of my invention being to utilize compressed air in conjunction with an engine used for propelling a vehicle such as a car, thus assisting said engine in starting when under heavy load, or when going up grade.

A further object of my invention is to provide means whereby certain of the cylinders of an internal combustion engine, can be utilized for compressing air while the vehicle is at rest, or going down an incline, and which compressed air can be used as desired for assisting the main engine in starting very heavy loads, or for actuating the brakes of the car.

A further object of my invention is to provide means whereby gas may be generated and forced into a tank, from whence it may be drawn, as desired, for the purpose of illuminating the car on which the engine is located, or for starting said engine.

To the above purposes, my invention consists in certain novel features of construction and arrangement of parts hereinafter more fully described and claimed.

Referring by numerals to the accompanying drawings, 1, 2, 3 and 4 designate the various cylinders of an ordinary internal combustion engine, commonly known as the four cylinder type, and operating in said cylinders are the usual pistons 5, connected in the usual manner by piston rods 6 to the crank shaft 7, which latter operates in a housing 8. Driven from the crank shaft 7 by the usual two to one gearing is the shaft 9, which is instrumental in actuating the inlet valves 10 and 10^a, and the exhaust valves 11 and 11^a of the engine.

Mounted to rotate with and to slide lengthwise on the shaft 9 in front of the engines 3 and 4 is a sleeve 12, which carries the eccentrics which actuate the inlet and exhaust valves of said engines 3 and 4, and a corresponding sleeve, in every way similar to said sleeve 12, is arranged upon the rod 9 in front of the cylinders 1 and 2 and carries eccentrics for operating the valves of said cylinders 1 and 2.

13 designates the eccentrics which actuate the inlet valve rods of the engines 3 and 4, and located immediately adjacent said eccentrics 13 and arranged directly opposite or at an angle of 180 degrees relative to said eccentrics 13 are eccentrics 13^a.

14 designates the eccentrics which actuate the exhaust valve rods of the cylinders 3 and 4, and located on the sleeve 12 immediately adjacent these eccentrics and arranged opposite thereto, are corresponding eccentrics 14^a.

Under normal conditions, or when the engine is operating in the usual manner, the anti-friction rollers carried by the lower ends of all of the valve rods of the engines 3 and 4 travel upon the eccentrics 13 and 14, and thus the inlet and exhaust valves are actuated in the usual manner. When the sleeve 12 is shifted lengthwise upon the shaft 9, as hereinafter described, the rollers on the ends of the valve rods will be engaged by the various pairs of eccentrics 13 and 13^a, and 14 and 14^a, and therefore said valve rods and the valves connected thereto will be actuated twice with each rotation of the shaft 9 and sleeve 12. This arrangement provides for the operation of the movable parts of two of the cylinders in the usual manner while the movable parts of the opposite two cylinders are being utilized for pumping and compressing air or gas.

As hereinbefore stated, a sleeve carrying eccentrics in every way similar to the sleeve 12 and independent thereof, is arranged on the shaft 9 in front of the cylinders 1 and 2.

Fixed on the outer end of the sleeve 12 is a grooved collar 15, and engaging in the groove therein is the bifurcated end of a bell crank 16, fulcrumed on an ear 17 projecting from the housing 8. Pivotally connected to the outer end of the horizontal arm of the bell crank 16 is the laterally projecting end of a hand lever 18, which is fulcrumed adjacent its lower end to a lug 19 projecting from the housing 8. This hand lever 18 is for the purpose of shifting the sleeve 12 upon the shaft 9, and the corresponding sleeve in front of the cylinders 1 and 2 is similarly shifted by means of a hand lever 18ª pivotally mounted on the engine 1.

Leading from the exhaust chambers 20 of the engines 3 and 4 are exhaust pipes 21, in which are located exhaust valves 22, and which are connected to operate simultaneously by a rock shaft 23, and located on the end thereof is a crank 24, which is connected by a rod 25 with the hand lever 18. The corresponding pair of exhaust pipes 21ª lead from the exhaust chambers of engines 1 and 2, and located in said exhaust pipes 21ª are exhaust control valves 22ª, the same being connected for simultaneous operation by a rod 23ª, which latter is actuated by means of the hand lever 18ª.

Leading from the housings of the exhaust valves 22 are pipes 26, in which are located check valves 27, and which pipes 26 unite with a pipe 28, which leads to a compressed air storage tank 29 located at any convenient point on the car.

Leading from the housings of the exhaust valves 22ª are pipes 30, in which are located check valves 31, and said pipes 30 unite with a pipe 32, which leads to a gas tank 33 conveniently located upon the car. Leading from this gas tank 33 is a pipe 34, which branches, and located in each branch is a three-way valve 35, and leading therefrom, in the upper ends of the four cylinders of the engine, are pipes 36, thus providing means for conveying gas to the cylinders of the engine to be used for initially starting the same.

Leading from the compressed air tank 29 is a pipe 37, and leading therefrom to the housings of the three-way valves 35 are branch pipes 38, thus providing means for delivering compressed air to the engines for the purpose of driving same, or assisting same when starting, or when under a heavy load.

Leading from the carbureter (not shown) to the inlet valve housings of the four engines is a gas intake pipe 39, and located in said pipe at the point where the same enters the cylinders 3 and 4 are valves 40, to which leads an air inlet pipe 41, and said valves 40 being controlled by means of a rod 42 actuated by the lever 18.

A switch 43 is arranged in the electrical connection leading to the spark plugs in the cylinders 1 and 2, said switch being connected to and controlled by the rod 23ª.

Located adjacent the rear trucks of the car or vehicle on which my improved engine is located, is a pair of cylinders 44, and connected to the pistons operating therein are driving rods 45, which are connected to a pair of the wheels of the rear trucks.

Leading from the compressed air tank 29 is a pipe 46, which branches, as designated by 47, and leads to the cylinders 44. Located in the pipe 46 adjacent the point where the same branches is a control valve 48.

The front truck of the car or vehicle on which my improved engine is mounted is pivotally connected to the vehicle or car at a point immediately above the center of the front axle A of said truck. Fixed on said front axle is a beveled gear wheel 49 which meshes with a double-faced beveled gear wheel 50, and meshing with the teeth on the upper side of said last mentioned wheel is a pinion 51 which is fixed on the engine shaft 52. By pivoting the front truck to the car body at a point above the center of the front axle, the car is enabled to make short turns without throwing the driving shaft out of alinement.

Leading from the compressed air tank 29 to the cylinders of the air brakes (not shown) is a pipe 53, thus providing means for utilizing the compressed air in the tank 29 for setting the car brakes.

When my improved engine is operating under normal load, the pistons and valves of the four cylinders operate in the usual manner, and the explosive charge which is drawn into the cylinders is ignited, after which the burned gases are forced from all the cylinders through the exhaust pipes 21 and 21ª and the valves 22 and 22ª located therein. When the car upon which the engine is located is going down grade or is at rest for a short period of time, and the operator of the car desires to charge the tank 29 with compressed air, the hand lever 18 is manually engaged and shifted in such a manner as to actuate the bell crank 16 and shift the sleeve 12 lengthwise upon the shaft 9. This shifting movement of the sleeve 12 moves the offset eccentrics 13ª and 14ª, into such positions as where the rollers on the lower ends of the valve rods of the engines 3 and 4 will be engaged by both the eccentrics of each pair, and therefore the valves of said engines 3 and 4 will be actuated twice as often as are the valves of the engines 1 and 2. At the same time the sleeve 12 is shifted, the exhaust valves 22 will be shifted so as to cut off the exhaust through the pipes 21 and establish communication from the exhaust chambers of the engines 3 and 4 to the pipe 26 leading to the compressed air tank. The rod 23 connects the exhaust

valves 22, and the valves 40 in the intake pipe are shifted so as to cut off the intake of gas and to establish communication from the air pipe 41 to the inlet valves 10 and 10ª of the engines 3 and 4. With the valves of the engine so positioned, the pistons and valves of cylinders 1 and 2 will operate in the usual manner, thus driving the pistons in cylinders 3 and 4, and as a result air will be drawn into the cylinders 3 and 4 through the air inlet pipe 41 on each downstroke of the pistons in said cylinders 3 and 4. On the upstroke of the pistons in these cylinders, the air drawn thereinto will be forced out through the exhaust valves 22 into and through the pipes 26, and from thence through the pipe 23 to the compressed air tank 29. Thus it will be seen that two of the cylinders of the engine operate in the usual manner and drive the pistons of the two remaining cylinders to compress air which is stored in the tank 29 to be used as desired. As hereinbefore stated, this compression of air only takes place when the car upon which the engine is located is traveling down grade, or is at rest for a brief period of time, as is the case when a stop is made at a station. The compressed air can be withdrawn from the tank 29 through the pipe 53 to operate the car brakes, or it can be withdrawn through the pipes 46 and 47 to actuate the pistons in the cylinders 44, thus driving the rear trucks of the vehicle and assisting the internal combustion engine of the car when starting, when under heavy load, or when ascending a grade.

When it is desired to generate gas and force the same into the tank 33, the hand lever 18ª is manipulated to shift the valves 22ª to the exhaust pipe 21, and at the same time communication is established from the pipes 21ª to pipes 30 and 32 leading to the gas tank 33. When the valves 22ª are shifted, the connecting rod 23ª shifts the switch 43, thus cutting out the electrical connections to the spark plugs of the cylinders 1 and 2. With the parts so positioned, the operating parts of the cylinders 3 and 4 drive the operating parts of the cylinders 1 and 2, and the gas drawn into said cylinders 1 and 2, in the usual manner, is forced through the pipes 21ª, 30 and 32 into the tank 33, from whence it can be drawn as desired, to illuminate the car, or it can be delivered to the cylinders of the engine through the pipes 34 and 36 for the purpose of providing an explosive charge for initially starting the engine.

Thus it will be seen how I have provided means whereby an internal combustion engine or the like may be used for compressing air, which latter is used for assisting the internal combustion engine in propelling the car upon which it is mounted, or for operating the brakes of the car, and which internal combustion engine is also used for pumping up a supply of compressed gas to be used as desired.

My improved engine is comparatively simple, inexpensive, and can be advantageously employed on cars used in cities and interurban service. The compressed air is primarily intended to be used for assisting the main engine in its work, although of course, if the main engine becomes inoperative for any reason, the compressed air alone can be used for driving the car.

I claim:

1. The combination with an engine utilized for driving the trucks of a vehicle, of a compressed air tank on the vehicle, means whereby certain of the engine cylinders in which the combustion of gas takes place are utilized as air compressors to force compressed air into the tank, while the remaining engine cylinders operate in the usual manner by the ignition of combustible gases, and means whereby the energy of the compressed air is applied direct to one of the trucks for driving the vehicle.

2. The combination with an engine utilized for driving the trucks of a vehicle, of a compressed air tank on the vehicle, means whereby certain of the engine cylinders in which the combustion of gas takes place are utilized as air compressors to force compressed air into the tank, and means whereby the energy of the compressed air is applied directly to one of the trucks for assisting the engine in driving the vehicle.

3. The combination with a vehicle mounted upon trucks, of an engine mounted thereon and adapted to drive said vehicle, a tank located on the vehicle and adapted to contain compressed air, and means whereby the power of the compressed air from the tank is applied direct to one of the trucks of the vehicle and utilized for assisting the engine in driving the vehicle.

4. The combination with a vehicle mounted upon trucks, of an engine mounted upon and adapted to drive said vehicle, a storage tank on the vehicle, means whereby air is compressed by the engine and delivered to the storage tank, and means whereby the power of the compressed air from the storage tank is applied direct to one of the trucks of the vehicle and utilized for assisting the engine in driving the vehicle.

5. The combination with a vehicle, having two sets of trucks of an engine mounted on the vehicle, and having a driving connection with one of the trucks, a compressed air tank on the vehicle, and means whereby the compressed air from the tank is utilized for driving the opposite one of the trucks.

6. The combination with a vehicle, having two sets of trucks of an engine mounted upon the vehicle, and having a driving connection with one of the trucks, a compressed air storage tank on the vehicle, means where-

by air is compressed by the engine and delivered to the storage tank, and means whereby the compressed air from the tank is utilized for driving the opposite one of the trucks.

7. The combination with a vehicle, having a pair of trucks one of which trucks is pivotally connected to the body of the vehicle at a point above the center of the front axle of said truck, an engine mounted on the vehicle, and there being a driving connection between said engine and the central portion of the front axle of the truck, a compressed air tank on the vehicle, and means operated by the compressed air in said tank for driving the other truck.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this 4th day of October, 1909.

JOHN K. BRODERICK.

Witnesses:
M. P. SMITH,
L. A. CORRAO.