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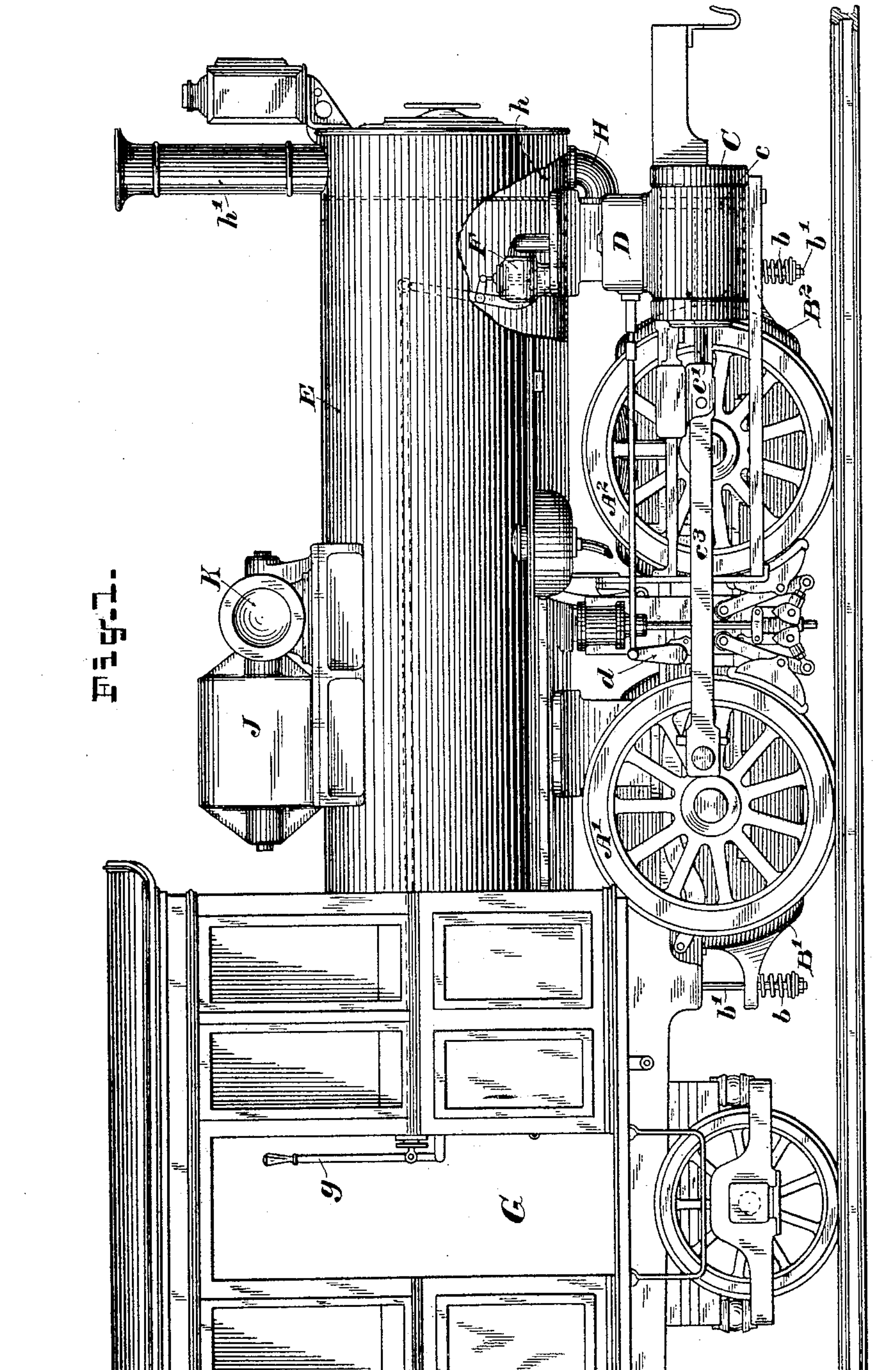
G. WESTINGHOUSE, Jr.
ELECTROPNEUMATIC LOCOMOTIVE.

No. 579,526. Patented Mar. 23, 1897.



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By his Attorney
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(No Model.)

5 Sheets—Sheet 2.

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ELECTROPNEUMATIC LOCOMOTIVE.

No. 579,526.

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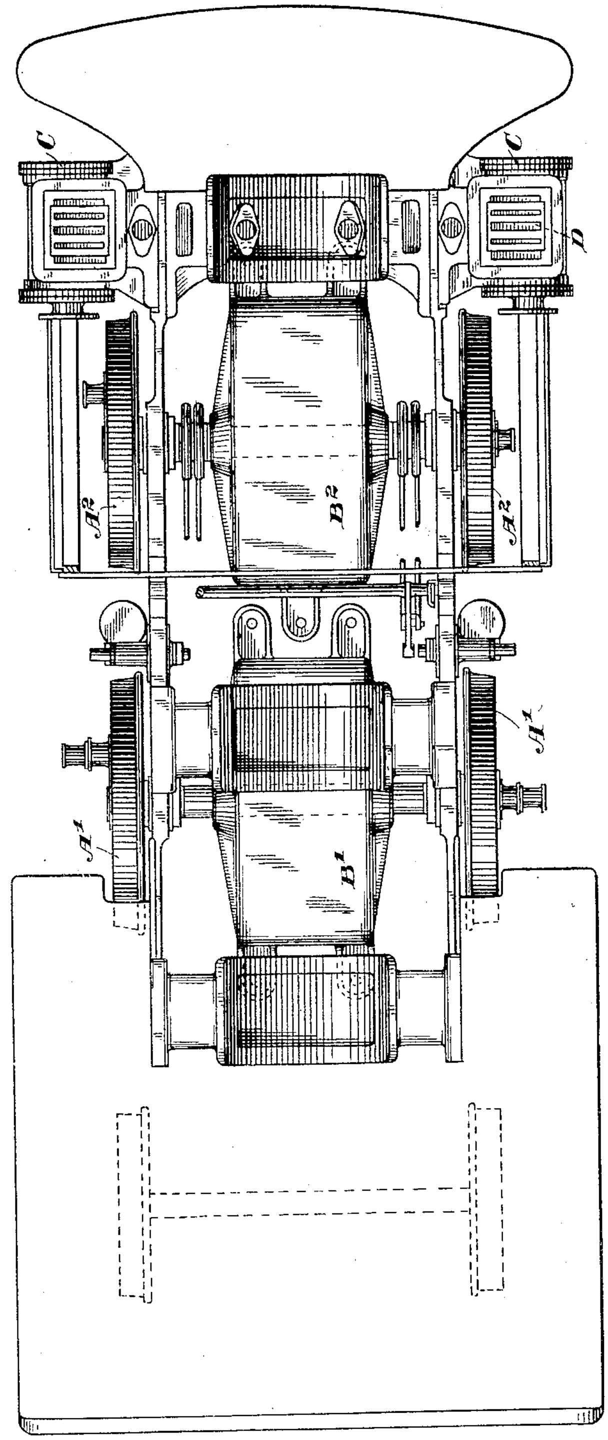
Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

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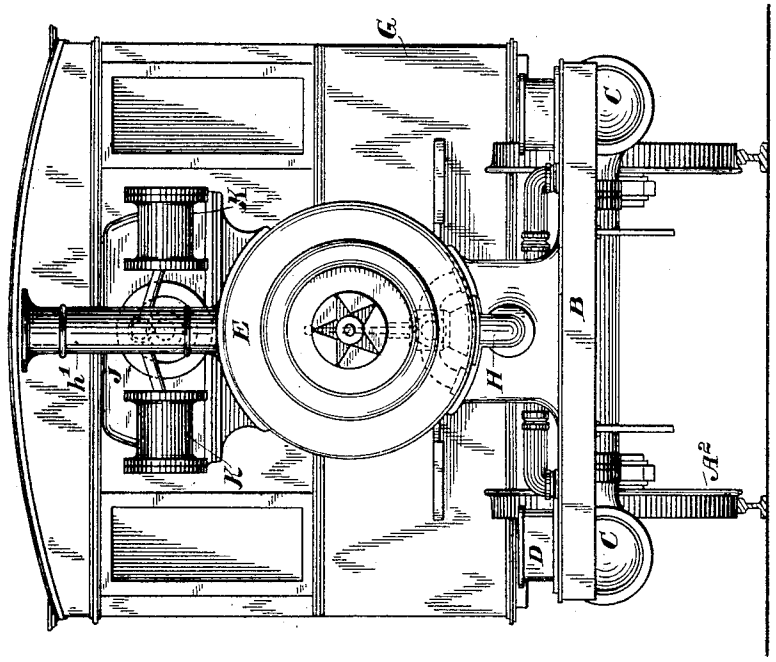
ELECTROPNEUMATIC LOCOMOTIVE.

No. 579,526. Patented Mar. 23, 1897.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

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ELECTROPNEUMATIC LOCOMOTIVE.

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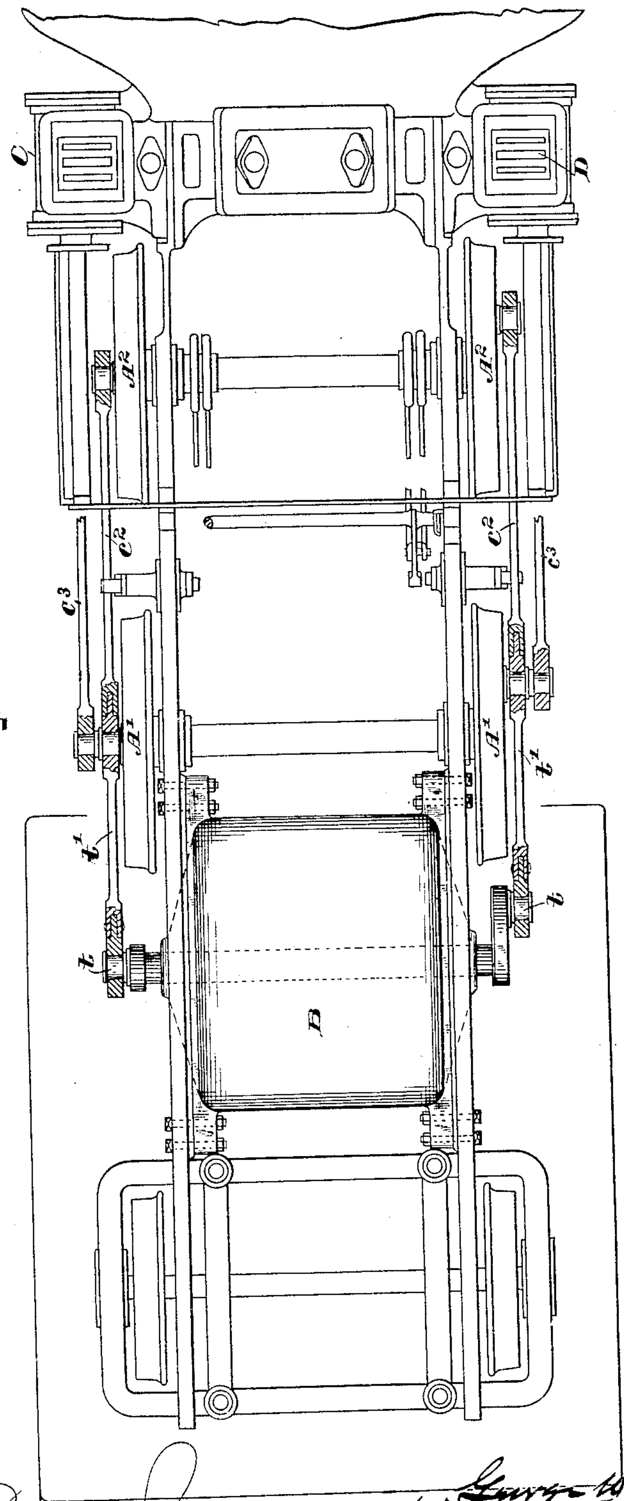

Fig. 4.

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(No Model.) 5 Sheets—Sheet 5.

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ELECTROPNEUMATIC LOCOMOTIVE.

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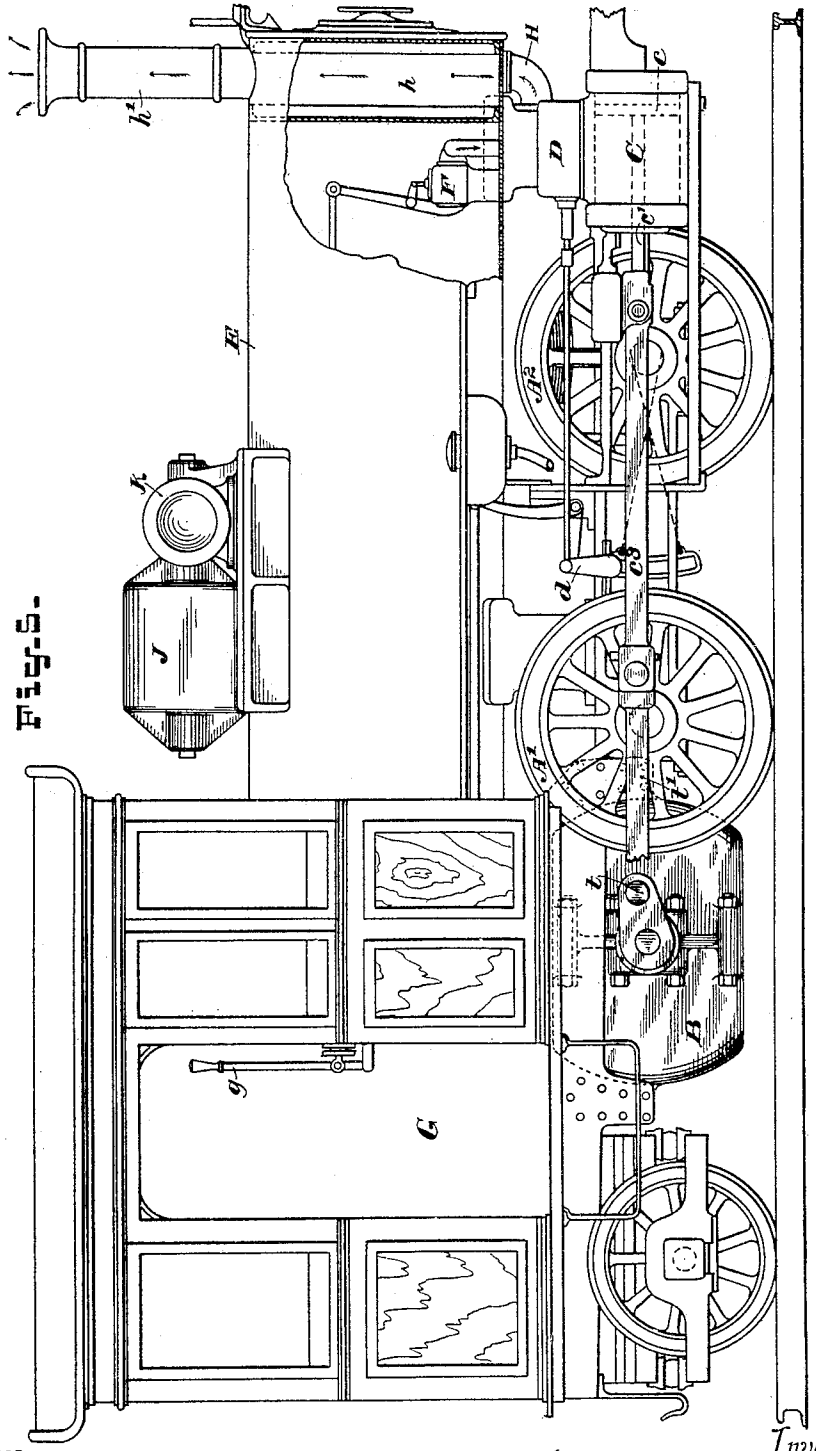

Fig. 5.

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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

ELECTROPNEUMATIC LOCOMOTIVE.

SPECIFICATION forming part of Letters Patent No. 579,526, dated March 23, 1897.

Application filed March 4, 1892. Serial No. 423,741, (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., a citizen of the United States, residing in Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Electropneumatic Locomotives, of which the following is a specification.

My invention relates to certain improvements in the construction and operation of locomotives for electric railways.

The object of the invention is to provide means for relieving a stationary engine or a locomotive from undue strain in starting from a state of rest.

In operating many forms of engines, electric motors, &c., it is often the case that a much greater amount of energy is required in starting than during the continued operation of the apparatus. This is particularly noticeable in railway-trains, and while the invention is applicable to general uses it will for convenience be more particularly described in connection with locomotives, and especially that class of locomotives driven by electric motors.

Heretofore it has been found impracticable to employ a single electric locomotive for the movement of a number of cars or a train upon a standard steam-railway.

This invention provides means which are useful not only in connection with the ordinary electric street-cars, but more especially as a substitute for the ordinary steam-railway systems.

The invention involves the utilization of compressed-air apparatus in connection with other forms of engines or driving apparatus, and particularly with an electric locomotive, the compressed-air apparatus being so organized as to assist the electric motor when called upon to do an excessive amount of work.

In practicing the invention in connection with an electric locomotive a suitable reservoir for storing compressed air is placed upon the locomotive, and connections are made therefrom to the driven wheels of the locomotive in any convenient manner. For the purpose of charging the compressed-air reservoir and for maintaining the charge therein an independent electric motor may be employed for driving an air-compressor. The apparatus is so organized that compressed air from the reservoir may be admitted to a suitable compressed-air-motor apparatus at will. An ordinary steam-locomotive may be conveniently remodeled for utilizing this invention.

When a locomotive or steam-engine is fitted in the manner above referred to and the reservoir is charged with air under pressure, the locomotive and train may be started by the admission of air to the cylinders in essentially the same manner as if steam were employed, and thus the locomotive and its train may be put in motion by air-pressure alone, or at the same time that the air-pressure is applied electrical energy also may be utilized, so that the two forces combine to give the initial speed to the train. Usually, however, it is desirable to employ air-pressure principally in starting, because in this manner the loss of electrical energy may be largely avoided.

The valve-gear of an ordinary locomotive may be utilized in such manner that the steam-cylinders which serve to drive the locomotive may also be used for compressing air and delivering it to the reservoir when the train is in motion. In this manner the energy consumed in stopping the train may be advantageously expended in restoring the pressure in the air-reservoir.

A locomotive having compound cylinders may be most advantageously employed in carrying out this invention, as it is very efficient in compressing air and also more efficient in the utilization of the air after being compressed.

Instead of, or in addition to, charging the compressed-air reservoirs by means of the momentum of the train suitable electric motors may be employed for driving air-compressors.

A locomotive of this general character is particularly applicable for use in operating trains where frequent stoppages are required. In some cases it may be found convenient to employ the principal engine to operate the air-compressor while the train or other machinery is at rest, and this may be a sufficient means in some instances for supplying all the required compressed air.

In cases where it may be desired to temporarily disconnect the air-compressing appa-

ratus, as, for instance, when a continuous long run is had, the axles of the driving-wheels may be made hollow, and the crank-axles, to which the connecting-rods of the engine are attached, may be extended through these hollow axles. Suitable clutching devices may then be used to engage and disengage the driving-wheels of the crank-axles, so that when engaged the two will turn together and when disengaged the crank-axles and pistons may stand at rest.

The accompanying drawings illustrate the application of the invention to an electric locomotive, and the method of applying it to stationary engines and elsewhere will be evident therefrom.

In the drawings, Figure 1 is a side elevation of an electropneumatic locomotive embodying the features of the invention. Fig. 2 is a plan view of the same. Fig. 3 is an end elevation, and Figs. 4 and 5 illustrate a modification.

Referring to the drawings, $A' A^2$ represent the driving-wheels of a locomotive, and $B' B^2$ suitable electric motors for driving the same. These electric motors may be applied to the axles of the locomotive B in any convenient manner, and electric currents may be delivered thereto through the rails or through overhead conductors or in any suitable manner. In Figs. 1, 2, and 3 of the drawings the motors are represented as having their armatures fastened upon the axles and the field-magnets surrounding the same sleeved upon the axles and having their ends flexibly supported by springs *b*, held in position by rods *b'*.

The piston-cylinders C of the locomotive are employed for the utilization of compressed air for operating the pistons *c* and the piston-rods *c'*, and thus in turn the coupling-rods c^2 coupling the driving-wheels A' A^2. The valve-chest D is of the usual construction employed in a steam-locomotive. It is equipped with the usual reversing device *d* for driving the wheels A^2 forward or backward, as required. Instead of employing steam for operating the piston compressed air is used, and this is contained in the reservoir E, which may occupy the usual position of the boiler of an ordinary steam-locomotive. A suitable valve F serves to admit the compressed air from the reservoir through the valve-chest D to the piston-cylinder, as required. The valve F may be controlled from the cab G of the locomotive by means of a system of levers *g* or in any other convenient manner. The exhaust from the cylinder C may pass through a tube H into an exhaust-chamber *h* and thence through the stack *h'* in order to muffle the noise. For the purpose of charging the reservoir E an independent electric motor J may be employed. This, in the present instance, is shown as being mounted upon the top of the reservoir E, and it is supplied with electric currents in any convenient manner. It operates an air-compressor K of any well-known suitable construction. This air-compressor delivers the compressed air to the reservoir E. The air-compressor may be operated continuously or only at intervals, as required.

The charging of the reservoir E may be aided or entirely accomplished by causing the pistons *c* to be driven to and fro in the piston-cylinders C by the momentum of the locomotive, as, for instance, when the locomotive is going downgrade or is stopping. When the pistons and piston-cylinders are to be thus used for compressing air, it is advantageous to have the diameter of the piston so proportioned with reference to the maximum pressure employed in the reservoir and to the normal friction of the wheels that the required compression will be given to the air without causing the wheels to slip upon the rails. To accomplish this, it may in some instances be desirable to make the cylinders and piston somewhat smaller in diameter than are ordinarily employed in steam-locomotives.

In Figs. 4 and 5 a modification is illustrated in which a motor B is mounted not directly upon an axle, but is suspended from or upon the frame of the locomotive in any convenient manner. The armature-shaft of this motor carries at each end a crank with a pin *i*, to which are coupled connecting-rods *i'*. The other ends of these rods are coupled with the crank-pins of the driving-wheels. Connecting-rods c^3 connect the wheels with the piston, so that the piston may be either driven by the motor through the wheels or by the momentum of the locomotive to charge the air-reservoir, or the pistons may be employed for driving the locomotive through the instrumentality of the compressed air.

I claim as my invention—

1. The combination with an electric motor, of a vehicle driven thereby, an air-compressor, a supplemental electric motor for driving the air-compressor, a compressed-air reservoir and a fluid-motor for assisting in driving the vehicle operated by air under pressure from said reservoir.

2. The combination with an electric motor, of a vehicle driven thereby, an air-compressor, a supplemental electric motor for driving the air-compressor, a compressed-air reservoir, a fluid-motor for assisting in driving the vehicle normally operated by air under pressure from said reservoir, and means whereby said fluid-motor may be made to act as a pump for charging said reservoir, substantially as described.

In testimony whereof I have hereunto subscribed my name this 1st day of March, A. D. 1892.

GEO. WESTINGHOUSE, JR.

Witnesses:
CHARLES A. TERRY,
JAMES WM. SMITH.