

G. CHÉDRU.
 STARTING DEVICE FOR GAS ENGINES.
 APPLICATION FILED SEPT. 17, 1907.

998,157.

Patented July 18, 1911.

2 SHEETS—SHEET 1.

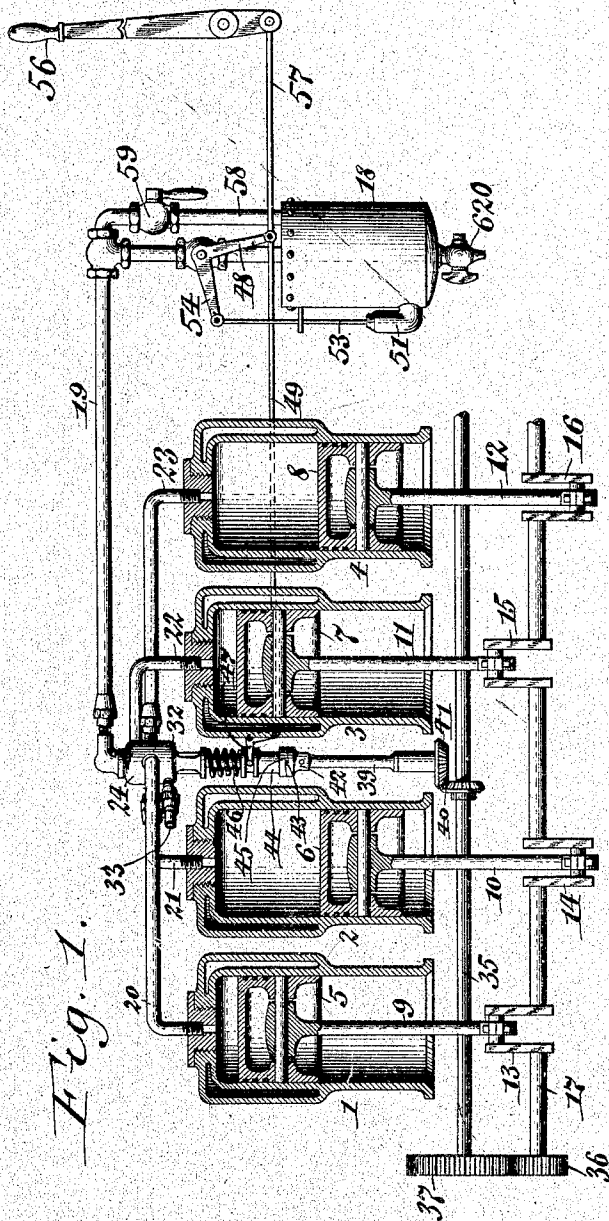


Fig. 1.

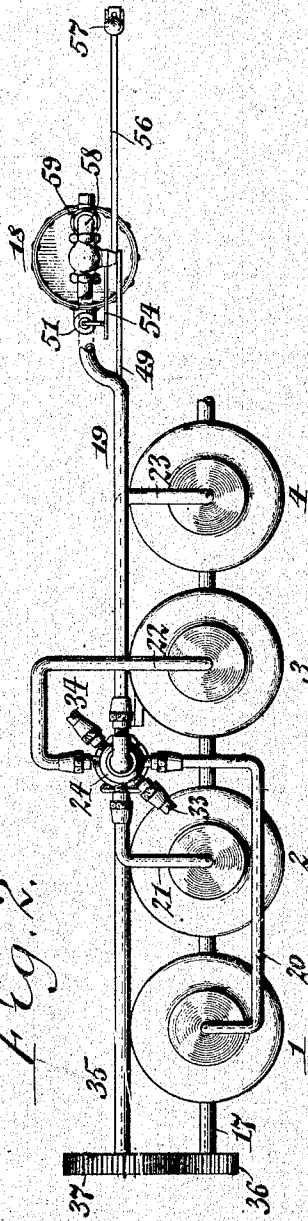


Fig. 2.

Witnesses:-
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 Gustav W. Howe.

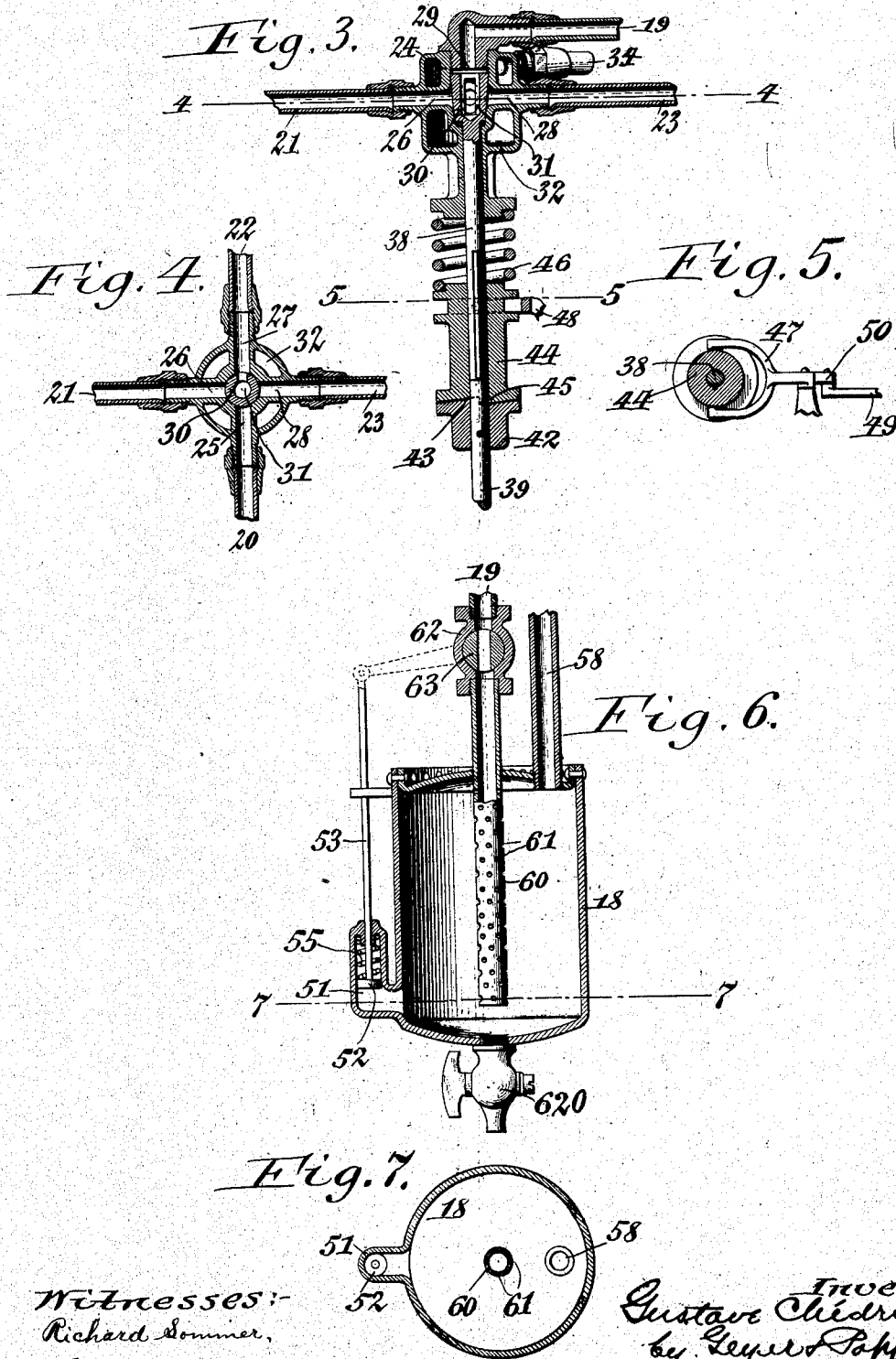
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UNITED STATES PATENT OFFICE.

GUSTAVE CHÉDRU, OF BUFFALO, NEW YORK, ASSIGNOR TO E. R. THOMAS MOTOR COMPANY, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

STARTING DEVICE FOR GAS-ENGINES.

998,157.

Specification of Letters Patent.

Patented July 18, 1911.

Application filed September 17, 1907. Serial No. 393,371.

To all whom it may concern:

Be it known that I, GUSTAVE CHÉDRU, a citizen of France, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Starting Devices for Gas-Engines, of which the following is a specification.

This invention relates to a device for starting gas engines and has the object to provide a simple and efficient device for this purpose which is so constructed that part of the exploded charges of fuel during the ordinary operation of the engine are stored in a reservoir under pressure and are subsequently utilized as the motive agent for effecting the initial forward movement of the piston and starting the engine.

In the accompanying drawings consisting of 2 sheets: Figure 1 is a sectional elevation showing my improved starting device applied to a multi-cylinder four stroke cycle gas engine. Fig. 2 is a top plan view thereof. Fig. 3 is a vertical longitudinal section of the distributing or controlling valve and adjacent parts, on an enlarged scale. Figs. 4 and 5 are horizontal sections in the correspondingly numbered lines in Fig. 3. Fig. 6 is a vertical section, on an enlarged scale, of the pressure or storage reservoir and adjacent parts. Fig. 7 is a horizontal section thereof in line 7-7, Fig. 6.

Similar letters of reference indicate corresponding parts throughout the several views.

Although my invention is applicable to a single cylinder gas engine as well as to a multi-cylinder engine of any type, I have shown the same in the drawings in connection with a four-cylinder gas engine of the four stroke cycle type. 1, 2, 3, 4, represent the cylinders of the engine which are arranged in a row and have their pistons 5, 6, 7 and 8 connected respectively by rods or pitmen 9, 10, 11 and 12 with cranks 13, 14, 15 and 16 on a crank shaft 17. The cranks 13 and 15 are preferably arranged on one side of the crank shaft while the cranks 14 and 16 are on the opposite side of the crank shaft so that the pistons in the cylinders 1 and 3 move in unison and in a direction opposite to the pistons 2 and 4, which latter pair also move in unison. This engine may be provided with any suitable or approved fuel supplying, exhausting and igniting mechanism and such details have therefore not been shown in the drawings.

My improved starting device as shown in the drawings in connection with the four cylinders of this engine, as an example, is constructed as follows:

18 represents a storage tank, reservoir or chamber into which part of the exploded charges of fuel are conducted from the several engine cylinders and stored therein in a compressed condition so as to serve as a pressure medium which is subsequently conducted back into these cylinders for restarting the engine after the same has been stopped. The burned or dead gases are conducted from the several cylinders to this storage reservoir or chamber and then returned from the latter to the cylinders when required for use by a conduit which preferably comprises a main pipe 19 communicating with the storage reservoir or chamber and a plurality of branch pipes 20, 21, 22 and 23 communicating with the firing ends of the engine cylinders 1, 2, 3 and 4, respectively. As shown in the drawings, the main pipe communicates with the storage reservoir or chamber at the upper end thereof and the branch pipes communicate with the several engine cylinders through the heads at the upper ends thereof. Between the several branch pipes and the main pipe is arranged a controlling or distributing valve whereby the several engine cylinders are successively placed in communication with the storage reservoir or chamber so that a part of the exploding charge in each cylinder may at the proper time be conducted from each cylinder to the storage chamber and part of the compressed gases in the storage chamber may in like manner be returned to each of the engine cylinders for effecting the initial working stroke of its piston. The preferred form of valve for this purpose shown in the drawings consists of a casing 24 having a conical seat and provided on different quarters of its periphery with side nipples or ports 25, 26, 27 and 28 which communicate, respectively, with the four branch pipes leading to the several cylinders 1, 2, 3 and 4, and a main nipple or port 29 connected with the upper or large end of the casing and communicating with the main pipe and a conical plug 30 rotatable in the valve seat of the casing and having a distributing port 31 which opens at one end upwardly through the top of the plug so as to be constantly in communication with the main port and pipe

while its other end extends laterally to the periphery of the plug in line with the several branch nipples. Upon rotating the plug its distributing port is brought successively into register with each of the branch nipples of the valve casing, thereby placing the engine cylinders one at a time in communication with the storage chamber. The rotation of the valve plug 30 is so timed that its distributing port connects each cylinder with the storage reservoir or chamber while the piston therein is moving forwardly with a working stroke. In order to prevent this valve from becoming unduly heated and rendered inoperative by the hot gases passing through the same, means are provided for keeping the same cool which means preferably consist of a water jacket 32 surrounding the valve casing and having a water inlet 33 and a water outlet 34, whereby water may be circulated through the jacket.

The means for driving the valve plug 30 of the distributing valve shown in the drawings consists of a cam or counter-shaft 35 arranged parallel with the crank shaft and driven from the latter at the rate of one turn of the crank shaft to two turns of the cam or counter-shaft by means of a spur pinion 36 arranged on the crank shaft and meshing with a spur gear wheel 37 on the counter-shaft, a valve shaft composed of an upper section 38 which is connected with the small end of the valve plug 30 and a lower section 39 which is operatively connected by a pair of intermeshing miter gear wheels 40, 41 with the counter shaft and a clutch for connecting and disconnecting the valve shaft sections, comprising a collar 42 secured to the lower shaft section 39 and provided on its upper side with clutch teeth 43, a clutch sleeve 44 splined on the upper shaft section and provided at its lower end with clutch teeth 45 and a spring 46 bearing at one end against a collar on the distributing valve casing and at its other end against the top of the clutch sleeve and operating normally to hold the clutch teeth of the latter in engagement with those of the collar 42 for coupling the shaft sections. While storing a part of the gaseous products from the several engine cylinders in the storage chamber and accumulating pressure in the latter and also while conducting the compressed gases, the several cylinders for starting the engine, the shaft sections 38, 39, are coupled by the clutch between the same, so that the distributing valve becomes operative and places each cylinder in turn in communication with the storage chamber, but when the engine is running normally and a full charge of compressed dead gas is contained in the storage chamber the clutch sleeve 44 is raised so as to uncouple the shaft sections, thereby arresting the rotation of the dis-

tributing valve plug and avoiding undue wear of the same. At this time the storage chamber is also preferably cut-off from the distributing valve and cylinders by means of a cut-off valve 62 preferably arranged in the main pipe, thereby holding the charge of pressure medium in the storage chamber under constant pressure and avoiding interference with the working of the engine at this time. The clutch and the cut-off valve are preferably operated simultaneously so as to disconnect the valve shaft sections and close the main pipe when the desired pressure in the storage chamber has been obtained and to couple the valve shaft sections and open the main pipe when it is desired to transfer the pressure medium from the storage chamber to the engine cylinders for starting the same.

Means are also provided for automatically uncoupling the clutch and closing the cut-off valve when the pressure in the storage tank has reached the normal or predetermined point and automatically coupling the clutch and opening the cut-off valve when the pressure in the storage chamber drops below the normal or predetermined point. The means for this purpose shown in the drawings consists of an elbow lever having an upper bifurcated arm 47 engaging with an annular groove in the clutch sleeve, an elbow lever connected with the rotary plug 63 of the cut-off valve and having a lower arm 48 connected by a rod 49 with the lower arm 50 of the clutch elbow lever, a cut-off cylinder 51 having one of its lower ends communicating with the interior of the storage chamber, a cut-off piston 52 reciprocating in the cut-off cylinder, a piston rod 53 connecting the cut-off piston with the upper arm 54 of the cut-off valve lever and passing through the upper end of the cut-off cylinder, and a spring 55 arranged to move the cut-off piston toward the inlet of the cut-off cylinder. For the purpose of permitting the cut-off valve to be opened and the clutch to be coupled by hand for starting the engine various means may be provided, that shown in the drawings consisting of a hand lever 56 and a rod 57 connecting the hand lever with the lower arm of the cut-off valve lever.

Let it be assumed that the storage reservoir or chamber contains a charge of pressure medium and that the clutch has been coupled and the cut-off valve opened by the hand lever 56, as indicated in Figs. 1 and 6. In this position of the parts the pressure medium will be conducted from the storage chamber into the upper end of that engine cylinder whose piston is in a position to effect its working stroke whereby this piston will be moved forwardly and the crank shaft will be turned. In doing so another engine piston will be brought into position

to effect its working stroke and the distributing valve will be turned so as to admit the pressure medium into the cylinder containing the last mentioned piston and cut off the pressure medium from the previous cylinder; whereby the next engine piston will also be moved forwardly with a working stroke. This operation is repeated for each of the succeeding engine cylinders so that the pistons therein are also moved forwardly during their initial working stroke by the pressure medium from the storage chamber. After the engine has completed the first cycle of operations a charge of fresh gas is drawn into and ignited in the engine cylinder which was first supplied with the pressure medium, thereby causing the piston therein to be moved forward with a working stroke under the action of the exploded charge of fuel in its cylinder, which operation is repeated successively in several cylinders in the order in which they were supplied with the pressure medium from the storage chamber, thereby causing the engine to run normally. In thus starting the engine by opening the cut-off valve, the cut-off piston is moved downwardly toward the inlet of the cut-off cylinder. After the engine has been started and is running under the explosions of fresh gaseous fuel each of these cylinders is in turn placed in communication with the storage reservoir or chamber by the distributing valve while an explosion of fuel is occurring in that particular cylinder, whereby a portion of the exploded fuel is conducted from this cylinder to the storage chamber and is stored under pressure in this chamber. As each cylinder in succession contributes a portion of its exploded charge in this manner to the storage chamber the pressure in the latter gradually rises or increases and when the pressure in the storage chamber has reached a normal or predetermined point the cut-off piston is moved upwardly or forwardly overcoming the resistance of its spring and closing the cut-off valve, thereby preventing the further admission of exploded gases from the engine cylinders into the storage reservoir or chamber. At the same time the clutch is uncoupled so as to avoid turning of the distributing valve. This charge of gaseous pressure medium is now retained in the storage chamber for use in starting the engine the next time after it has been stopped.

When the pressure in the storage reservoir is very high it may be very difficult to open the cut-off valve by means of the hand lever owing to the resistance which the cut-off piston encounters. To permit at such times of easily placing the reservoir in communication with the engine cylinders a valved by-pass is provided which extends around the cut-off valve, the same preferably con-

sisting of a pipe 58 connected at one end with the main pipe above the cut-off valve and at its lower end with the top of the reservoir, and a hand operated by-pass valve 59 arranged in the by-pass pipe, as shown in Fig. 1. Upon opening the valve 59 the pressure medium passes from the reservoir 18 to that engine which is connected by the distributing valve with the reservoir, causing the piston in that particular cylinder to be propelled with a working stroke. The escape of pressure medium from the reservoir for effecting the movement of the first engine piston permits the cut-off piston 52 to immediately descend and couple the clutch so as to cause the distributing valve to be turned and connect the other engine cylinders successively with the reservoir. While the pressure of the air is below normal in the chamber 18 the clutch is held in its coupled position by the spring 46, the tension of which is properly adjusted for this purpose. After the engine has been started the operator closes the by-pass valve so that the automatically operated cut-off valve is the sole means of communication between the engine cylinders and the storage chamber, thereby permitting exploding charges from the engine cylinders to reënter the storage reservoir or chamber and automatically close the cut-off valve when the pressure in the storage chamber has reached the normal.

In order to direct the compressed charge from the pressure reservoir or chamber into one of the cylinders of the engine in starting the same it is necessary to turn the crank shaft by hand so as to bring the distributing part of the distributing valve into register with one of the branch ports of its casing.

The main pipe preferably has a terminal 60 which extends downwardly through the top of the storage chamber into the central part of the same and is provided with a plurality of perforations 61 extending from its bore to its periphery. By this means the burned gases delivered from the engine cylinders into the storage chamber are distributed uniformly over the same and divided into a plurality of minute jets whereby any moisture contained in the gaseous product is caused to separate more readily therefrom and drop to the bottom of the storage chamber. The liquid accumulating on the bottom of the storage chamber due to the separation of this moisture from the exploded gases is drawn off from the storage chamber from time to time through a drain cock or valve 620 applied to the bottom thereof.

Instead of utilizing a part of the exploded charges of fuel in the cylinders as the pressure medium in the storage chamber the latter may be charged with any other

pressure medium such as carbonic acid gas in which case the controlling valve will be used only for distributing the pressure medium among the several cylinders of the engine and will not be utilized for connecting the several cylinders with the storage tank and accumulating therein parts of the exploding charges of the several cylinders.

I claim as my invention:

- 10 1. A starting device for gas engines comprising a reservoir for storing a pressure medium, a conduit for connecting said reservoir with the engine cylinder, a valve for controlling said conduit having a casing provided with ports opening toward the reservoir and the engine cylinder, respectively, and a plug rotatable in the casing and having a port adapted to connect and disconnect the ports of the casing, means for driving the plug from the crank shaft of the engine comprising a counter-shaft intermeshing spur gears connecting the crank and counter shafts, a valve shaft composed of two sections one of which is connected with said plug, intermeshing miter gears connecting the other section with the counter shaft, and a clutch for connecting and disconnecting the sections of the valve shaft, consisting of a toothed collar arranged on one section, a toothed sleeve splined on the other section, and means for moving said sleeve so as to engage its teeth with or disengage the same from those of said collar consisting of a spring operating to move the sleeve in the direction for coupling the clutch, and a lever engaging with the sleeve and adapted to move the same in the direction for uncoupling the clutch, substantially as set forth.
- 20 2. A starting device for gas engines comprising a reservoir for storing a pressure medium, a conduit for connecting the reservoir with the engine cylinder, a cut-off valve arranged in said conduit, and having a rotatable plug, and means for automatically opening and closing said valve consisting of a cut-off cylinder communicating with the reservoir, a piston arranged in said cylinder and adapted to be moved forwardly by the pressure in the cylinder and reservoir, a spring operating to move the piston backwardly, an arm connected with said cut-off valve, and a rod connecting said arm and piston, substantially as set forth.
- 30 3. A starting device for gas engines comprising a reservoir for receiving a pressure medium, a conduit for connecting said reservoir with the engine cylinder, a cut-off valve arranged in the conduit, means for automatically operating said cut-off valve by the variation of pressure in the reservoir, a controlling valve arranged in the conduit an operating device for said controlling

valve embodying a clutch, and means interposed between said clutch and cut-off valve and operating to uncouple said clutch when the cut-off valve closes and vice-versa, substantially as set forth.

4. A starting device for gas engines comprising a reservoir for receiving a pressure medium, a conduit for connecting said reservoir with the engine cylinder, a cut-off valve arranged in the conduit, and having a rotatable plug, a cut-off cylinder communicating with the reservoir, a piston arranged in the cut-off cylinder and operatively connected with the cut-off valve plug, a controlling valve arranged in the conduit and having a rotatable plug, a driving device for said controlling valve plug having a sectional shaft, a clutch for coupling and uncoupling the sections of the sectional shaft, and a connection between said clutch and the plug of the cut-off valve which causes these parts to operate in unison, substantially as set forth.

5. A starting device for gas engines comprising a reservoir for storing a pressure medium, a conduit for connecting said reservoir with the engine cylinder, a valve arranged in the conduit, a piston connected with said valve and operated upon by the pressure within the reservoir, a handle connected with said valve a by-pass extending around said valve and a valve arranged in the by-pass, substantially as set forth.

6. In combination with an internal combustion motor, a tank, and a control valve with connections to said tank and to each of the cylinders of the motor, said valve having provisions for admitting gas under pressure from the tank to each of the cylinders in succession, and for permitting the products of combustion generated in the cylinders to create pressure in the tank.

7. In a gas engine in combination, a reservoir for storing a pressure medium, a conduit for connecting the reservoir with the engine cylinder, a cut-off valve arranged in said conduit, and means for automatically opening and closing said valve consisting of a cut-off cylinder communicating with the reservoir, a piston arranged in said cylinder and adapted to be moved forwardly by the pressure in the cylinder and reservoir, a spring operating to move the piston backwardly, an arm connected with said cut-off valve, and a rod connecting said arm and piston.

Witness my hand this 14th day of September, 1907.

GUSTAVE CHÉDRU.

Witnesses:

HERMAN J. HASS,
JOHN KRUCHTEN.