(No Model.) 3 Sheets—Sheet 1.

O. W. GODKIN.

COMPRESSED AIR MOTOR.

No. 388,964. Patented Sept. 4, 1888.

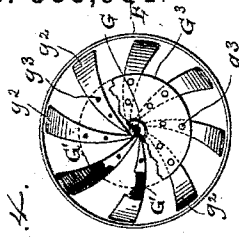


Fig. 4.



Fig. 5.

Fig. 1

Fig. 3.

Fig. 2.



Fig. 6 Fig. 7. Fig. 8

WITNESSES.

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(No Model.) 3 Sheets—Sheet 2.

O. W. GODKIN.

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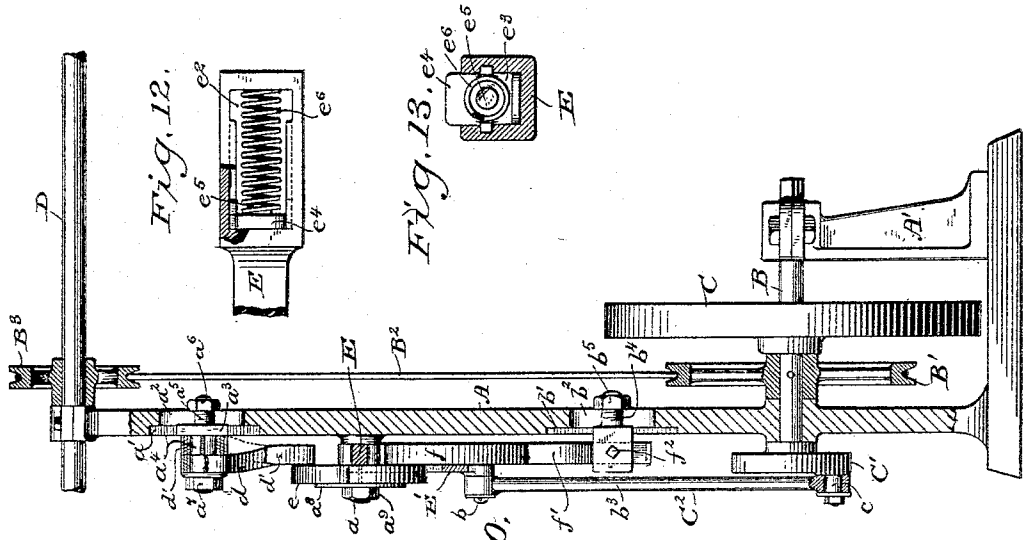


Fig. 12.

Fig. 13.

Fig. 10.

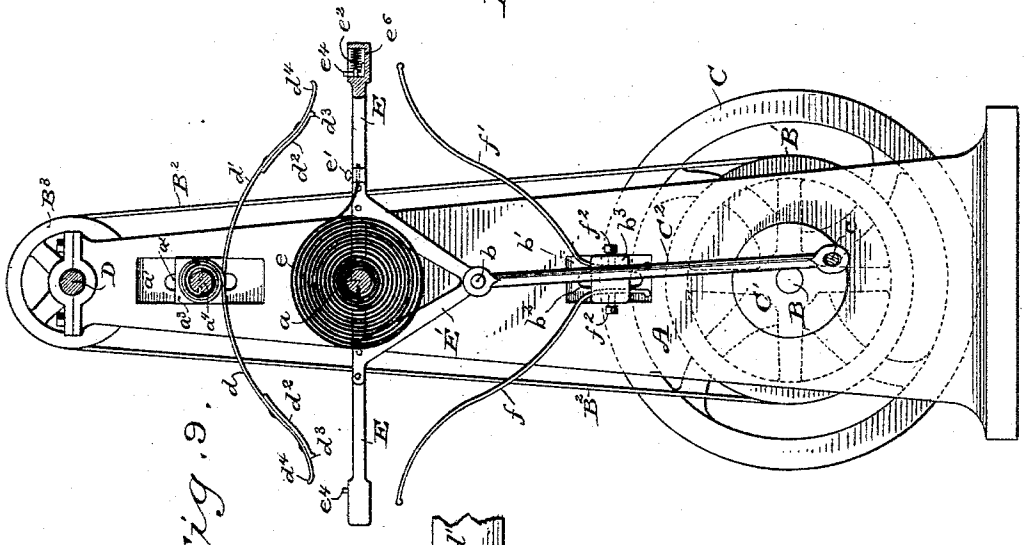


Fig. 9.

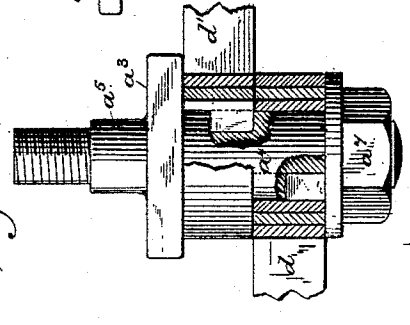


Fig. 11.

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Fig. 16.

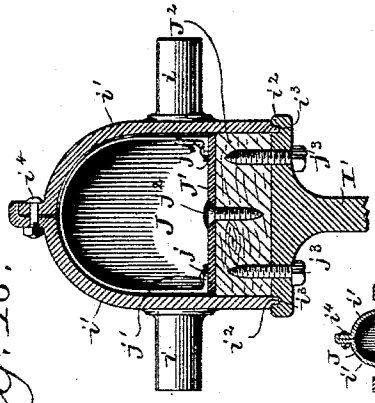


Fig. 18.

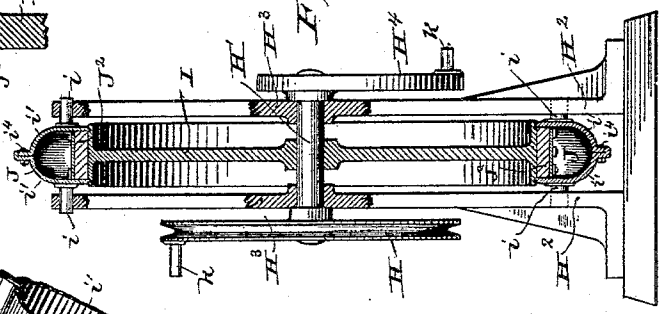


Fig. 14.

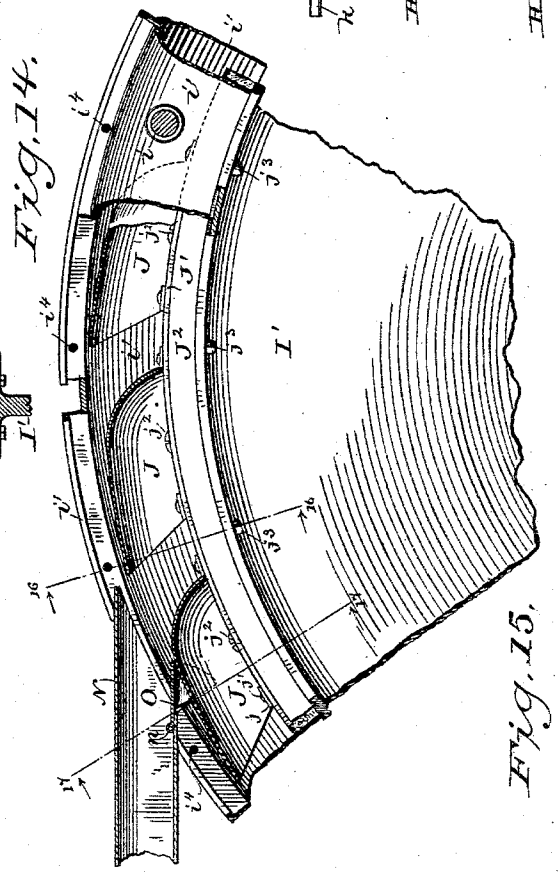


Fig. 17.

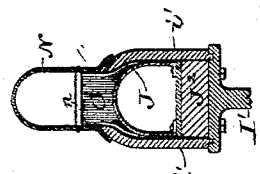
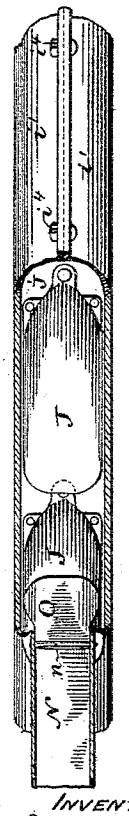


Fig. 15.



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UNITED STATES PATENT OFFICE.

OTTO W. GODKIN, OF MILWAUKEE, WISCONSIN.

COMPRESSED-AIR MOTOR.

SPECIFICATION forming part of Letters Patent No. 388,964, dated September 4, 1888.

Application filed November 21, 1887. Serial No. 255,701. (No model.)

To all whom it may concern:

Be it known that I, OTTO W. GODKIN, of Milwaukee, in the county of Milwaukee, and in the State of Wisconsin, have invented certain new and useful Improvements in Compressed-Air Motors; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention relates to compressed-air motors; and it consists in certain peculiarities of construction, as hereinafter fully set forth, and pointed out in the claims.

In the drawings, Figure 1 is a side elevation of my device with parts broken away to better show the construction. Fig. 2 is a detail view of the generator-casing. Fig. 3 is a detail view of one of the generator-flanges. Fig. 4 is a plan view of the generator with the top of the casing removed. Fig. 5 is a detail section on line 5 5 of Fig. 1. Figs. 6, 7, and 8 are details of one of the valves. Fig. 9 is an elevation of the mechanism which starts the device and assists in driving the generator. Fig. 10 is a vertical central section through the parts shown in Fig. 9, certain of said parts being shown in full. Fig. 11 is a detail view of the upper spring mechanism shown in Fig. 9. Figs. 12 and 13 are details of one end of the walking-beam. Fig. 14 is an enlarged detailed view of part of one of the power-wheels, showing the air-chambers in section. Fig. 15 is a detail plan view of the same. Fig. 16 is a section of one of the said air-chambers on the line 16 16 of Fig. 14. Fig. 17 is a detail section on the line 17 17 of Fig. 14. Fig. 18 is a vertical section through the front or exhaust power-wheel.

A is the standard of the starting mechanism (shown in Figs. 9 and 10) rising from a suitable base, from which there rises another and shorter standard, A′, and in these standards is suitably journaled the shaft B of a fly-wheel, C, and on this shaft between this fly-wheel and the standard A is a belt-wheel, B′, from which extends a belt, B^2, to another belt-wheel, B^3, on the shaft D, journaled in the upper part of the standard A.

On the end of the shaft B is a crank-wheel, C′, having a wrist-pin, *c*, from which extends a connecting-rod, C^2, the other end of which is pivoted at *b* to the lower end of the yoke E′ of the walking-beam E, which in turn is pivoted on a stud, *a*, projecting from the standard A. The said standard is further provided with a groove or recess, *a′*, and slot a^2 in the upper part, and a similar groove or recess, *b′*, and slot b^2 in its lower part for the adjustment of certain springs, hereinafter described. One end of a coil-spring, *e*, is secured to the stud *a*, around which said spring is coiled, and the other end is adjustably secured at *e′* to one arm of the walking-beam E, the said stud *a* being screw-threaded at its end and the spring being held in place thereon by means of a washer, a^8, and nut a^9. Each end of this walking-beam is recessed, as shown at e^2, and there fitted with a slide, e^3, having an upward projection, e^4, and a pin, e^5, which receives one end of a spiral spring, e^6, the other end of which bears against the end wall of the recess e^2 and is held in place by another pin similar to the described pin e^5.

In the described recess *a′* there is fitted a sliding block, a^3, carrying rigid therewith a stud, a^4, and a rear shank, a^5, which latter projects through the described slot a^2, and has a screw-threaded end, by means of which the sliding block is firmly held at any point to which its shank may have been moved within the said slot by a nut, a^6. The stud a^4 is provided with recesses at opposite points, each to receive one end of the spring *d* and *d′*, which springs are coiled around said stud, one back of the other, and their free ends extended out, as shown in Fig. 9, and bent so as to be in the same horizontal and lateral planes and just above the walking-beam E. The stud a^4 is screw-threaded at its outer end, and a nut, a^7, keeps the springs in place thereon.

Near the free ends of the springs *d* and *d′* they are provided on their under sides with plates d^2 d^2, each having a contact-point, d^3, (for engagement with the projections e^4 of the slides e^3 in the recessed ends of the walking-beam E,) and beyond these points the ends of the said springs are curved upward, as shown at d^4 d^4. In the described lower recess, *b′*, there is another sliding block, b^3, having a shank, b^4, which extends through the slot b^2, and is screw-threaded at its end to receive a nut, b^5, to tighten it to place after adjustment. This sliding block b^3 is provided with two ver-

tical slots or perforations, which receive the lower ends of two curved springs, $f f'$, which springs may be adjusted within said slots, as desired, and fastened at the proper points by means of the set-screws $f^2 f^2$.

F is the hollow standard of the generator, (shown in detail in the Figs. 1 to 8, inclusive,) and F′ the generator-casing, which is a continuation of said standard, and which casing has an opening, f^3, which may be wholly or partially closed at any time by the sliding door f^4, to regulate the admission of outside air within the casing, and along the upper edge of this opening there is arranged a continuous hood, f^5. (Shown partly broken away in Fig. 2.)

G is a vertical spindle situated within the generator-casing and stepped in a seat, g, which has flanges extending to the inner walls of the base of the said casing, so as to leave a free air-passage all around said seat, and just above this seat is a ring, g', and around this spindle the inner edges of eight fan-leaves or flanges, G′, are spirally wound, as shown (with one of said leaves) in Fig. 3, the upper end of each leaf being secured to the upper part of the spindle, and projections on the lower part of each leaf being secured to the lower part of said spindle and to the ring g'. Each of these eight leaves is of the same shape, with a spiral twist at its inner edge, and thence extending toward the casing F′ and conforming in shape thereto, and each leaf has a cap, g^2, extending over its top and down its outer edge to another ring G^2, to which these leaves are secured, the cap running to a vanishing-point just above said ring, and again to a like point at the spindle, and being widest at a point in line with the widest part of the generator-casing. On top these leaves are covered by a round plate, G^3, secured to the said leaves by bolts passing through holes $g^3 g^3$ in said plate and leaves, the said plate having an opening to allow the spindle G to pass therethrough and being keyed to it. These leaves G′ have each a flattened angular portion, g^4, in the upper part, being otherwise concaved, as shown, and below this are shallow concaved depressions $g^5 g^5$, hammered into the metal of which the said leaves are formed.

The spindle G extends up through the casing F′ and carries at its top a pinion, G^4, which meshes with a bevel gear-wheel, D′, on the shaft D, hereinbefore named, and adjacent to this gear-wheel is a belt-wheel, D^2, on the same shaft, D, from which a belt, h, extends to another pulley, H, on a shaft, H′, journaled in standards H^2 H^2, which support between them on said shaft the exhaust-power wheel I, the said standards H^2 having cross-arms H^3, the said standards and their arms being perforated to receive pins i i, projecting from opposite sides of the annular casing i' i', surrounding the power-wheel I, and which contains a series of air-chambers, J, of a construction hereinafter described. This casing is made, preferably, in two parts united by bolts i^4, as shown, and has on its inner annular edges reduced guiding-flanges i^2 i^2, which fit in corresponding annular grooves, i^3 i^3, in the periphery of the said power-wheel I, as best shown in detail in Fig. 16, (which, although a detail of the main power-wheel I′, is of precisely the same construction, differing only in size,) and the air-chambers J (in both wheels) are secured to a continuous band of metal, J′, (by means of screws j', passing through inturned edges j of the base of the said air-chambers, which thus form practically a series of buckets,) and the metal band J′ is in turn secured to the tire J^2 of the wheel I (or I′) by screws j^2, and said tires are secured to the periphery of the wheels by screws j^3 j^3, though it is immaterial whether I use an extra tire of wood and metal plate, as represented at J^2 J′, or merely plane the periphery of the wheels I and I′ into shape and secure the air chambers or buckets directly thereto.

The power-wheels I and I′ are represented in the drawings as having a plain continuous portion solid with the flange or periphery; but instead of this the said wheels may have spokes, if desired, or be made partially open for lightness.

H^4 is an eccentric secured to the shaft H′ of the power-wheel I on the opposite end from that which carries the pulley or belt wheel H, and both the eccentric H^4 and the pulley H are provided with crank-pins k, to which are jointed connecting-rods K, which in turn are connected with piston-rods K′ K′, terminating in valved piston-heads K K, (shown in detail in Figs. 6, 7, and 8,) wherein k k are hinged valves opening inwardly. The said piston-heads work in a double cylinder, K^3, divided by a partition, k^2, which may be either horizontally disposed, as shown in Fig. 1, with one chamber above the other, or vertically arranged so as to have the piston-chambers side by side, the said cylinder communicating at its rear with the hollow post F of the generator and reduced at its front end and terminating in the pipe L, provided with suitable valve or cock, L′, and leading to the spiral reservoir M, (which has a pressure-gage at the point M′,) and from the upper end of this reservoir another pipe, N, having suitable valve or cock, m, leads into the annular casing i', which surrounds and contains the air chambers or buckets J on the periphery of the main power-wheel I′, there being a valve, O, hinged at n to said pipe N and falling over the buckets J, so that air cannot escape backward, but must always move forward, and thus impel said buckets and the power-wheel to which they are attached in the proper direction. At a point below the entrance of said pipe N into the casing i' of the main power-wheel I′ the said casing is tapped to receive one end of another pipe, P, which extends up a suitable distance and thence along to the exhaust power-wheel I and enters its casing i' at relatively the same point as the pipe N, just described, entered the casing of the wheel I′,

and the pipe P at this point is fitted with a precisely similar valve for the same purpose, and similarly below the point where the said pipe P enters the casing of the wheel I the said casing is tapped to receive one end of another pipe, Q, which leads up to and enters a perforation, *q*, in the casing F′ of the generator. The main power-wheel I′ is supported on a shaft, R, between a pair of standards, S, having cross-arms S′, and pins *i* on the casing *i′* of the said power-wheel I′ enter suitable perforations in said standards and cross-arms to support the said casing, as hereinbefore described. The shaft R may be provided with a crank-arm, T, with pin P′, as shown, or fitted with a belt-pulley, as preferred, and the power of this motor is transmitted from this shaft R and these attachments.

The operation of my invention is as follows: Power is applied to the shaft B in any suitable manner, (as by turning a hand-crank or pulley on said shaft,) and the belt B^2, extending from pulley B′ on this shaft B to pulley B^3 on the shaft D above, transmits the power to said shaft D and revolves it, and also revolves the gear-wheel D′ and pulley D^2 on said shaft, and the wheel D′ moves the generator-spindle G, to which it is geared, and thereby puts all the spiral leaves or flanges G′ of the generator in motion, while the belt *h*, extending from the said pulley D^2 to the pulley H on the shaft H′ of the power-wheel I, transmits the power from said shaft D and revolves said pulley H and its shaft H′ and the eccentric H^4 on the other end of said shaft H′, thereby putting in motion the piston-heads K^2 K^2 in the cylinder K^3, whose rods K′ K′ are connected to pins on the said pulley H, and eccentric H^4, and thus, while the revolution of the fan-leaves of the generator is drawing in the outside air through the opening f^3 of the generator-casing and creating a whirlwind and forcing said air down through the hollow post F to the cylinder K^3, the piston-heads K^2 K^2, working within said cylinder, are sucking and pushing this air forward through the pipe L into the spiral reservoir M, the cock *m* closing the pipe N until the gage M′ indicates a pressure of, say, fifty pounds in the said reservoir M. The arrangement of walking-beam E and springs *d d′* and *f f′*, (shown best in Fig. 9) greatly assists in driving the generator, because in the movement of said walking-beam, caused by the connecting-rod C^2, pin *c*, crank-wheel C′, and shaft B, the said walking-beam comes constantly in contact with the ends of the said springs, (the described spring-slides in the ends of the beam preventing too abrubt contact,) and the impact of the said spring ends keeps the walking-beam constantly moving up and down, thereby always sending the wrist-pin *c* beyond a dead-center, and greatly aiding in the rotation of the shaft B, and lessening the amount of power required for revolving both this shaft and the shaft D, belted to it, and the described slots and recesses in the standard A enable the springs to be nicely adjusted with relation to the walking-beam. The function of the spring *e* is merely to balance the walking-beam. There being a sufficient quantity of compressed air in the reservoir M, the cock *m* is turned and the air under pressure admitted through the pipe N to the casing *i′*, surrounding the power-wheel I′, which air enters the chambers or buckets J and impels them forward, the valve O preventing any of the air escaping backward, and said buckets being secured to the periphery of the power-wheel I′ they of course carry the wheel around with them, and in this revolution, as the buckets reach the opening for the described pipe P, the air escapes through said pipe P and enters the casing *i′* of the exhaust power-wheel I, where, after a similar passage through the air chambers or buckets within this casing, it reaches the opening for the pipe Q and travels through said pipe to the generator-casing F′, entering through the described opening *q* and mingling with the rapidly-moving air within said casing, and being again carried through the machine with it, as before. The compressing of the air is effected not alone by the piston-heads in the cylinder, but mainly by the rapid revolution of the spiral generator-leaves, hereinbefore described.

Power is transmitted from the shaft R of the power-wheel I′ by any suitable attachment thereto, as described, and it is not intended to utilize the power from the exhaust power-wheel I for any other purpose except to operate the pistons and aid in driving the generator.

The object in making my reservoir in spiral form is to guard against condensation of the compressed air by cold, and to enable heat to be readily applied to the whole body of said reservoir, if necessary. After the stored hand-power has become exhausted of course fresh outside power is applied to the shaft B, as before.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a compressed-air motor, the combination, with suitable standards, of a shaft supported thereby, a fly-wheel, pulley, and crank-wheel keyed thereto, a generator-shaft supported in one of said standards and carrying a pulley belted to the first-named pulley, a balanced walking-beam mounted on a stud of said standard and connected to a wrist-pin on said crank-wheel, and a pair of leaf-springs attached to this standard above and another pair attached to said standard below said walking-beam, whereby when the parts are in operation there will be a succession of impacts between the ends of said walking-beam and the ends of all of said springs, substantially as and for the purpose set forth.

2. In a compressed-air motor, a generator consisting of a suitable casing supported upon a hollow post and having an opening for the admission of outside air, a spindle supported within said casing, a series of fan-leaves or

flanges spirally attached to said spindle, and mechanism for rapidly revolving said spindle and its attached blades, substantially as set forth.

3. In a compressed-air motor, the combination of a generator-casing supported upon a hollow post terminating in a cylinder, a spindle supported within said casing and having a series of fan-leaves or flanges spirally attached thereto, a valvular-headed piston or pistons working within said cylinder and connected by suitable belts, pulleys, and connecting-rods to the shaft that rotates the said generator-spindle, a reservoir for the compressed air, and a pipe leading from said cylinder to said reservoir, substantially as set forth.

4. In a compressed-air motor, the combination of a power-wheel secured to a shaft journaled in suitable standards and carrying on its periphery a series of air chambers or buckets, a stationary annular casing surrounding said wheel and supported by the said standards and provided with inlet and outlet openings, and pipes communicating with said openings for admitting compressed air within said casing and air-chambers and permitting its escape therefrom, substantially as set forth.

5. In a compressed-air motor, the combination of a generator casing supported upon a hollow post terminating in a cylinder, a spindle supported within said casing and having a series of fan-leaves or flanges spirally attached thereto, a shaft geared to said spindle and communicating motion thereto, a pulley carried by said shaft, an exhaust power-wheel secured to a shaft journaled in suitable standards and carrying a series of air chambers or buckets on its periphery, and a stationary annular casing surrounding the same, a pulley on one end of this power-wheel shaft belted to the last-named pulley, and an eccentric on the other end of this shaft, valvular headed pistons working within the described cylinder and connected to crank-pins on the pulley and eccentric on the shaft of the exhaust power-wheel, a reservoir for the compressed air, and a pipe connecting the cylinder with said reservoir, a main power-wheel located adjacent to said reservoir and provided with air chambers or buckets secured to its periphery, and a surrounding stationary casing, a pipe leading from the compressed-air reservoir to this casing, an exhaust-pipe leading from this casing to the casing of the exhaust power-wheel, and a pipe leading from the last-named casing back to the casing of the generator, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand, at Milwaukee, in the county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

OTTO W. GODKIN.

Witnesses:
H. G. UNDERWOOD,
WM. KLUG.