(No Model.) 2 Sheets—Sheet 1.

W. M. FRISBIE.

ELEVATOR.

No. 516,987. Patented Mar. 20, 1894.

Fig. 1.

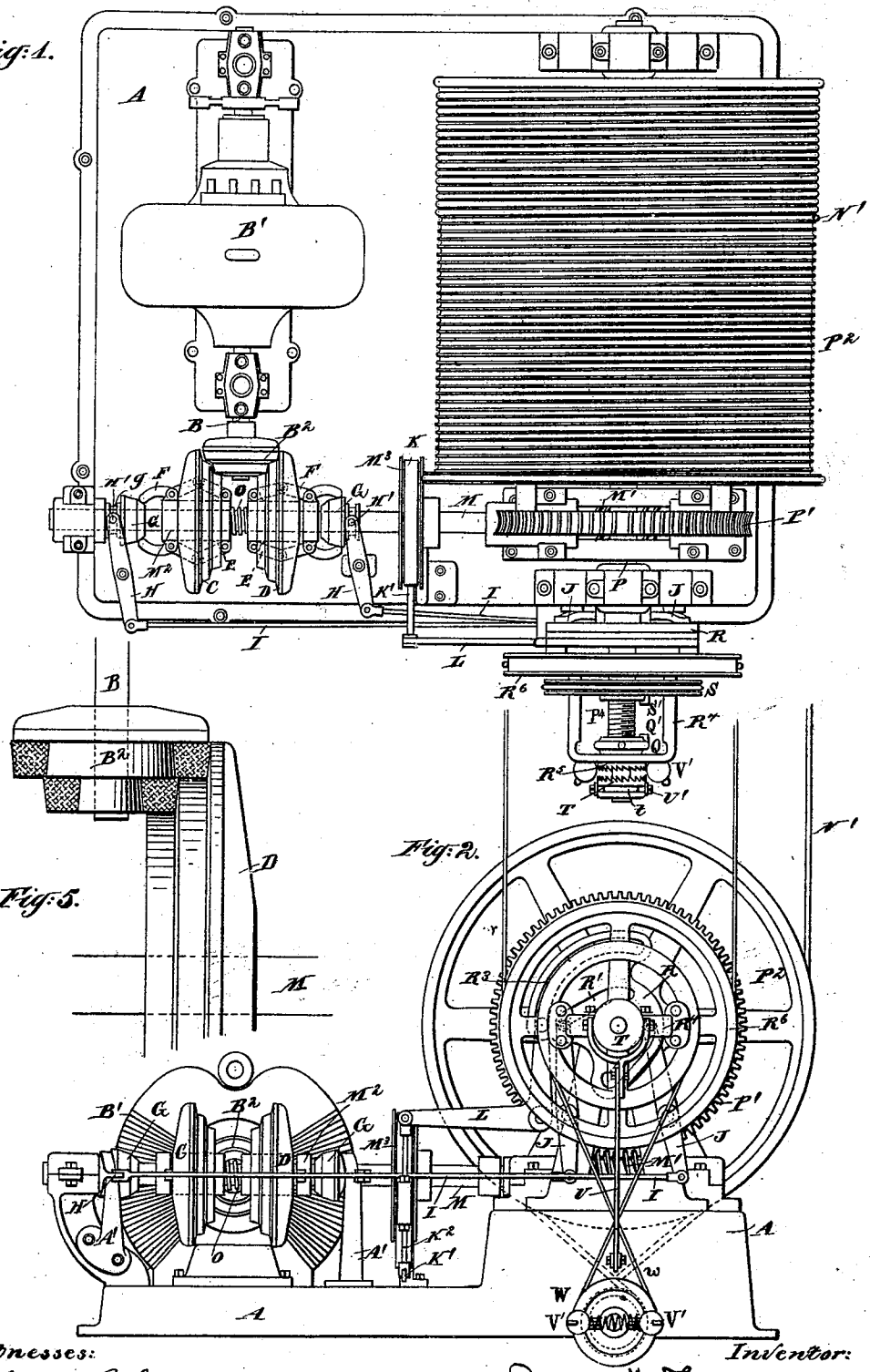

Fig. 3.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

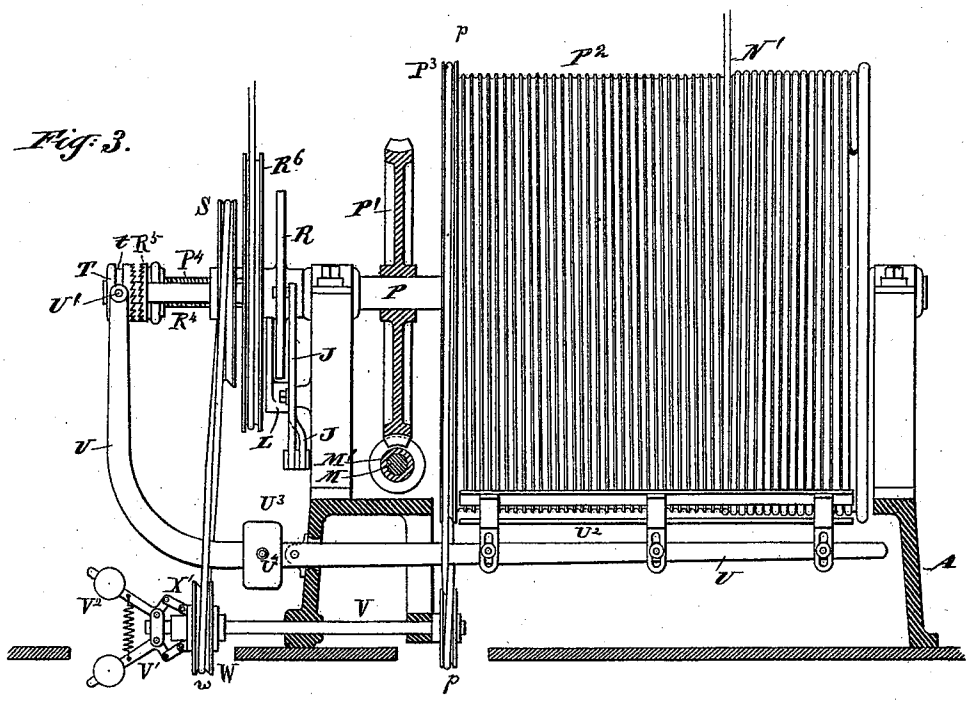
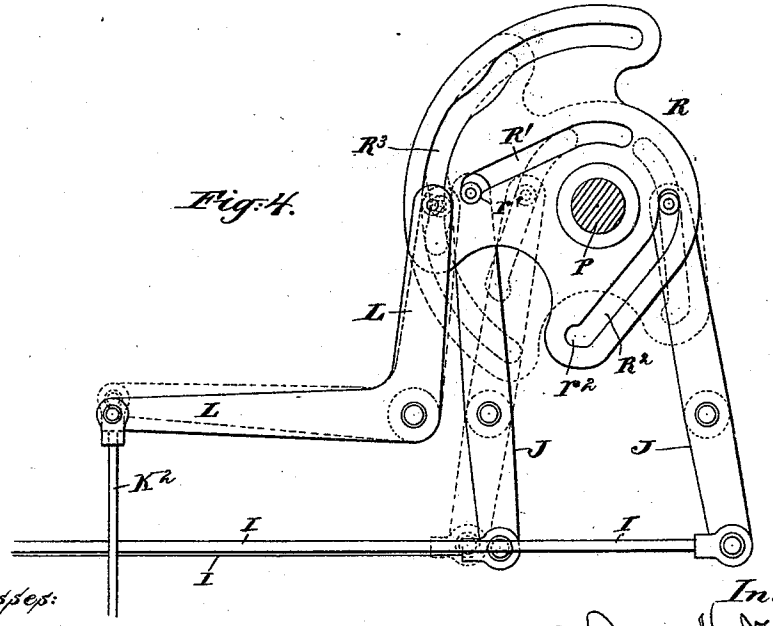


Fig. 4.



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THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM M. FRISBIE, OF NEW HAVEN, CONNECTICUT.

ELEVATOR.

SPECIFICATION forming part of Letters Patent No. 516,987, dated March 20, 1894.

Application filed October 24, 1892. Renewed February 17, 1894. Serial No. 500,576. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. FRISBIE, mechanical engineer, a citizen of the United States, residing in the city and county of New Haven, in the State of Connecticut, have invented a certain new and useful Improvement in Elevators, of which the following is a specification.

The invention applies to the entire class of elevators used to raise and lower passengers and freight in hotels, stores, manufactories, &c. It may be operated by a steam engine or any other power, but it is peculiarly adapted for an electric motor. I will describe it as applied for the carrying of passengers up and down in a high building by the action of an electric motor of the familiar type, rapidly revolving but with slight force.

The accompanying drawings form a part of this specification and represent what I consider the best means of carrying out the invention.

Figure 1 is a plan view. Fig. 2 is a side elevation. Fig. 3 is a vertical section partly in elevation. Fig. 4 is an elevation showing certain portions on a larger scale. Fig. 5 is a plan view partly in section of a portion on a still larger scale.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A is the stationary frame-work, of cast-iron or other suitable material, certain portions being designated when necessary by super-numerals.

B′ is an electric motor, and B the rapidly revolving shaft thereof, carrying on one end a friction gear-wheel B^2. This shaft is caused to revolve constantly in one direction by the action of a current of electricity from a dynamo or other source, not shown. When it is not desired to operate the elevator either to raise or lower the car, the remainder of the mechanism is disconnected and the motor shaft B, with its friction gear-wheel B^2 runs idly.

C and D are friction wheels feathered on the screw shaft or worm shaft M, which engages by its threads or worm M′, with a worm-wheel P′ on the shaft P, which latter carries the elevator drum P^2 to operate the hoisting rope N′ of the elevator. The wheels C and D revolve with the shaft M, but each is adapted to be moved endwise thereon, and is so moved by mechanism and operating means therefor, worked alternately. When one friction wheel C is in use revolving the shaft M, the other friction wheel D is so conditioned by its set of mechanism as to be idle. The two sets of mechanism for moving the two wheels C and D endwise on the shaft M are similar each to the other; a description of one will suffice for both.

E E are links knuckled to the outer face of the wheel C and each connecting therefrom to one of the levers F which latter are pivoted on a collar M^2, carried on the shaft M. The opposite end of each lever F is presented to the conically shaped end of a block G, which is loose on the shaft M, and is moved endwise thereon by a lever H pivoted on the stand A′ and engaging by fingers H′ in a groove *g*, the lever being turned at the proper times by a rod I, which engages with a lever J pivoted on the frame-work, and actuated by a cam to be described farther on. When it moves the block G in one direction the conical end of the latter turns the levers F in the direction to bring these levers and the connected links E into approximately straight lines parallel to the shaft M, the relations constituting what are sometimes termed toggle-joints. This straightened position of the toggles holds the wheel C firmly in contact with the wheel B^2, and thus conditioned revolving motion is communicated from the motor shaft B to the screw-shaft M, the revolutions of the latter being slower than those of the motor only in the ratio of the difference of the diameters of the wheels B^2 and C. I have shown this ratio as about two to one. If the motor shaft B turns twelve hundred revolutions per minute the screw shaft M turns about six hundred.

The worm-wheel P′ may be made of any size according to the conditions for force and speed, the worm-shaft M M′ being correspondingly arranged. I have shown the worm-wheel P′ as of considerably less diameter than the drum P^2. The quick revolutions of the shaft M result, through the action of the worm M′, in giving a slower but strong rotation to the drum P^2. The rope being connected to the elevator car N in the obvious manner, the

turning of the drum in one direction raises the car and in the other direction lowers it. The two friction wheels C and D being brought alternately into engagement with the rapidly revolving motor-wheel B^2 the car is raised or lowered according as one or the other is engaged and the other disconnected. When both wheels C and D are moved out or away from their engagement with the wheel B^2 there is no motion communicated to the worm-shaft M. The friction of the worm M′ in its engagement with the worm-wheel P′ may be sufficient to forbid the car running down by its own gravity, but the momentum of the shaft M and its connected wheels C and D, links E, levers F and blocks G G, is sufficient to keep it in motion for a little time after these wheels are disengaged. I provide a brake in the form of a strap K, encircling a large pulley M^3, fixed on the shaft M. This brake is tightened and relaxed again at each change of the motion of the elevator, through the medium of a horizontal lever K′, being operated by an upright link K^2, connected to a bell-crank lever L, turning on a center held on the fixed frame.

The two sets of mechanism for moving the friction wheels C and D alternately endwise on the shaft M are actuated by two levers J, (see Fig. 1,) each with its proper connecting rod I leading to its proper lever H, (see Fig. 2.) These two levers J J, and the lever L, are actuated by cam-slots R′ R^2 R^3 in a wheel R, which is mounted loosely on the extended shaft P, and is capable of being partially revolved in one direction or the other independently of the revolutions of such shaft. Each of the cam-slots R′, R^2, R^3, has one or more portions of its length concentric to the center of motion so that a part of the turning motion of the wheel imparts no motion to the corresponding lever. The cam-slots R′, R^2, have the concentric portions at their inner ends. The remaining portions of each of these cam-slots R′, R^2, are straight, and arranged slightly divergent to each other, as shown, and each formed with a notch on the inner side of its extreme end, as plainly shown in Fig. 4. The cam-slot R^3 has two considerable portions, one at each end, which are concentric to the axis of motion. A portion at the mid-length is adapted to deflect the lever which is engaged in it. This wheel R is turned in one direction or the other by the wheel R^6 rigidly fixed on the same sleeve, and turned by means of the ordinary wire rope r extending up and down through the elevator car and subject to the control of the attendant in the ordinary and long approved manner. When the wheel R is partially revolved in one direction it acts by the straight portion of the cam-slot R′ on one of the levers J to force the wheel C into engagement with the wheel B^2 and cause the elevator car to rise; the other cam-slot R^2 producing no effect during this movement because its lever is simply traversed in the concentric portion of such cam-slot. When it is turned in the opposite direction the cam-slot R′ moves its lever out of engagement and allows the wheel C to retreat, being driven back by the force of the spring O. When this turning motion in the opposite direction has proceeded until the central position is reached, the cam-slot R^3 actuates its lever L to apply the brake. Next by a further turning of the wheel R in the same direction the cam-slot R^2 actuates its lever J and its connections to force the friction wheel D into engagement with the wheel B^2. During this latter portion of the turning motion in this direction, the cam-slot R′ is ineffective because it holds its lever J in its concentric portion. The brake is also liberated by reason of the brake-lever L being in a concentric portion of the cam-slot R^3. Now the elevator is conditioned to lower instead of raise the car, and the work proceeds.

The brake performs an important function at each change of motion by arresting the previous rapid rotation of the shaft M, bringing it nearly or quite to a state of rest preparatory to engaging the opposite friction wheel and initiating the motion in the opposite direction. The four operations are in fact performed in so rapid succession as to be almost simultaneous;—the moving out of contact of the friction wheel C, the applying of the brake, the taking off of the brake, and the moving into contact of the friction wheel D. A notch r' is produced in the inner side of the outer end of the straight portion of cam-slot R′ and a similar notch r^2 is produced at the inner side of the outer end of the straight portion of cam-slot R^2. These notches r' r^2 receive the respective pins or rollers on the corresponding levers J J when the wheel R has been turned to its extreme position and aid to hold the wheel R and all the parts reliably in that position until a change is induced by the proper operation of the mechanism. The cam-slot R^3 carried on the same wheel R is properly formed to first hold the lever L out of use, afterward to put it momentarily in use to apply the brake and finally to move it again out of use and hold it so conditioned at each partial revolution of the wheel R in either direction. There is a screw-thread P^4 on the prolonged shaft P which engages with internal screw-threads on a wheel S. There is also on said shaft P a collar Q having a stop Q′ which under certain conditions strikes a corresponding stop S′ on the adjacent face of the wheel S. The wheel S has open slots which engage with the parallel bars of the frame R^4 fixed on the wheel R. It will be understood that a partial revolution of the wheel R induced by any cause acts through the cams R′ and stops the machine. The parts are so adjusted that the revolutions of the shaft P in raising the elevator car to the top of the building acts through the screw-threads P^4 to carry the wheel S endwise until it presents its stop S′ in the path of the revolving stop Q′, which

latter by acting against the stop S′ partially turns the wheel S, and this by the action of its slots on the parallel arms of the frame R^4 turns the latter, and with it the wheel R and stops the machine. This effectually prevents over-winding. It is more reliable than when the apparatus is operated through a long cord or other extended mechanism liable to failure from various sources. A rim R^5 concentric to the shaft P on the outer face of the frame R^4, is toothed as shown in Fig. 2. The extended end of the shaft P has a sleeve T feathered thereon correspondingly toothed.

U is a bell-crank lever, the horizontal arm of which extends under the drum P^2, and the upright arm of which is forked and engages by fingers U′ in a groove *t* in the sleeve T. When from any cause, as a sufficient obstruction, the descent of the car is temporarily arrested and the drum continues to revolve the rope N′ is slackened, and the moment a coil descends sufficiently below the drum P^2 to press on the lever U, it instantly tips this lever and engages the toothed sleeve T with the toothed rim R^5. Thus conditioned the revolution of the sleeve T partially turns the frame R^4 and consequently the wheel R, and stops the machine. The lever U is so nearly balanced that only a slight force is required pressing downward on the portion under the drum to effect the movement and arrest the action. Three bars U^2 U^2 extending longitudinally of the drum and at a slight distance therefrom are mounted adjustably on the horizontal arm of the lever U, and serve as means of more promptly and effectually receiving the contact of the rope when it slackens. The weight of this arm of the lever and the attached parallel bars is partially balanced by the weight U^3 which is mounted on the lever the other side of the fulcrum. This weight may be adjusted outward and inward and held in the desired position by a pinching-screw U^4. This weight should be adjusted so that there is a slight preponderance raising the horizontal arm and its attached bars, but it should be so slight that when the rope slackens a gentle contact of one or more coils of the rope with the bars U^2 will tilt the lever and engage the toothed sleeve T with the toothed rim R^5. When the wheel R is caused to perform its partial revolution it operates through the cams R′, R^2 to throw the friction wheels C and D into the idle position out of contact with the wheel B^2, and through the cam-slot R^3 and its connections to apply the brake K. This effectually stops the elevator.

P^3 is a grooved pulley formed on the drum P^2 or adjacent to it and revolving therewith. This pulley carries a round belt *p*, which, when the machine is working, communicates motion to a corresponding grooved pulley on a governor shaft V, carrying loaded levers V′, contracted by a spring V^2.

W is a pulley or grooved wheel mounted loosely on the shaft V, and connected by a round belt *w* with the wheel S, the periphery of the latter being grooved to accommodate such belt. Against the inner side of the wheel W is a fixed collar. On the outer side of this wheel is a friction-clutch X, actuated by links X′ connected to the inner ends of the levers V′. So long as the velocity of the mechanism either in raising or lowering the car is moderate, this governor is of no effect, but the moment the velocity exceeds the prescribed limit, the centrifugal force of the levers V′ overcomes the tension of the spring V^2 and causes them to move apart. A slight movement apart,—the velocity of rotation remaining the same,—increases the centrifugal force and the loaded levers now move apart with force, and in doing so they straighten the toggles formed by the inner end of each lever V′ and a connected link X′ and engage the friction-clutch X with the previously loose wheel W. This causes the latter to commence to turn; the motion being communicated through the belt *w* to the wheel S turns the latter and consequently the frame R^4, and the wheel R, and stops the machine.

My electric motor is revolved during the periods while the elevator is not in use, by a very small expenditure of electric energy. When it is required to do work the momentum of the rapidly revolving motor is drawn upon to overcome resistance and start the train of mechanism. The strength of current required to run my elevator after it is started is about the same as to run the ordinary elevators, but my invention gives a great advantage in the act of starting. Instead of finding the parts at rest and requiring a large amount of extra current to serve for a little period in overcoming the resistance, my elevator, having the motor constantly in motion at a high velocity overcomes the resistance in starting with only a slight current.

The spring O performs its functions with ease without much taxing its elastic capacity because while one friction wheel is being moved into position for work the other is always being moved out of such position and the spring has only to transmit force with the very slight elastic action required to compensate for differences in the motion.

Modifications may be made without departing from the principle or sacrificing the advantages of the invention. I prefer making the friction wheel B^2 and the corresponding wheels C and D in the manner set forth in the patent to George F. Evans, dated April 9, 1889, No. 401,018, but this may be varied. I propose to use plain conical wheels made partly or entirely of wood, leather, raw-hide, or other tolerably frictional material adapted to endure the conditions.

Instead of making the gearing frictional I can use toothed gears nicely cut or otherwise accurately formed, of any metal, or partly in metal and partly in wood or other material. In such case the wheels corresponding to C and D would be kept constantly in gear, running in opposite directions, so long as the

motor shaft B is revolving, and the wheels instead of being constantly connected are alternately connected to and set free from the shaft M by Frisbie clutches or other efficient and easily worked friction clutches which will give the required gentle, noiseless and practically instantaneous connection and disconnection.

Although I have described the motor B and consequently the driving gear wheel B^2 as constantly revolving, there may be a switch not shown, to throw the current off whenever it is known that the elevator is to remain a considerable period, as an hour or more, unused.

I do not in this patent claim the combinations of the different means for operating the partially revolving yoke R^4, because such are made the subject of a separate application for patent, filed August 14, 1891, Serial No. 402,600.

I claim as my invention—

1. In an elevator, a motor constantly revolving in one direction, a worm and worm wheel, and a drum operated thereby, in combition with each other, and with two sets of friction gears and operating levers therefor, the wheel R with oppositely arranged cam slots R', R^2, each having a portion concentric to the axis, which holds the lever motionless while the other lever is being moved, and each having a portion oblique to the axis, equipped with a terminal notch r', r^2, provisions for operating such wheel by hand to raise and lower, and further provisions for throwing such wheel and its connections into the inert position automatically, as herein specified.

2. In an elevator, a motor constantly revolving in one direction, a worm and worm-wheel and a drum operated thereby in combination with each other and with two sets of friction gears and operating levers therefor, the wheel R with oppositely arranged cam-slots R', R^2 each having a portion concentric to the axis which holds its lever motionless while the other lever is being moved, and each having a notch r' r^2 at the opposite end, provisions for operating such wheel by hand to raise and lower, and further provisions for throwing such wheel and its connections into the inert position automatically, and a brake and provisions for applying and removing it automatically at each reversing of the elevator, as herein specified.

3. In an elevator, having a motor constantly revolving in one direction, a drum operated thereby through a worm- and worm-wheel, and two sets of connecting gears, provisions for engaging them alternately to revolve the drum to raise and lower, and also for holding them in a neutral position without motion, a governor arranged to arrest the elevator when it moves too rapidly, composed of the shaft V revolved by a connection from the drum and varying in speed therewith, the loaded levers V' and links connecting them to a friction clutch X, and a pulley W loosely mounted on the shaft V, and connection from such pulley to throw the mechanism into the inert condition, all combined and arranged for joint operation, substantially as herein specified.

4. In an elevator having a drum shaft P and controlling wheel R the positively acting clutch composed of the frame R^4 and toothed rim R^5 and sleeve T feathered on the shaft, in combination with each other and with the bent lever U loosely engaged with said sleeve, and a weight with provisions for adjusting it on such lever to induce a delicate balance arranged to operate the controlling wheel R and to revolve it in the direction to stop the elevator on a slackening of the cable, substantially as herein specified.

In testimony that I claim the invention above set forth I affix my signature in presence of two witnesses.

WILLIAM M. FRISBIE.

Witnesses:
H. A. JOHNSTONE,
M. F. BOYLE.