(No Model.) 3 Sheets—Sheet 1.

A. F. WIKING.

HYDRAULIC STEERING MACHINE FOR SHIPS.

No. 564,265. Patented July 21, 1896.

Fig. 1.

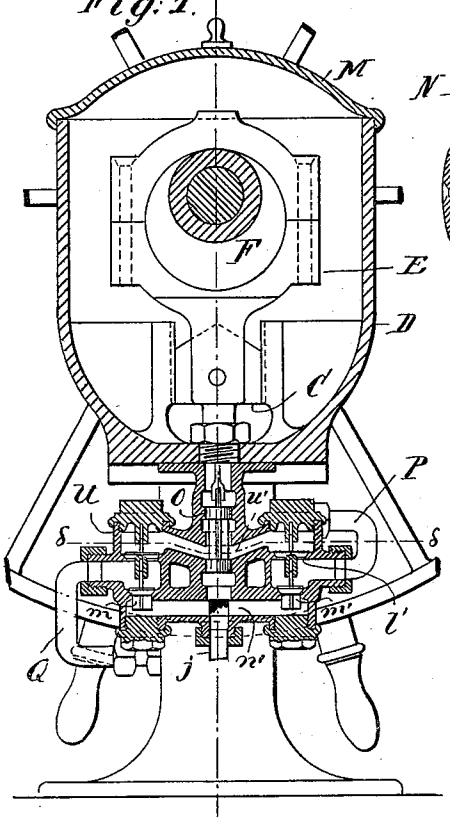

Fig. 2.

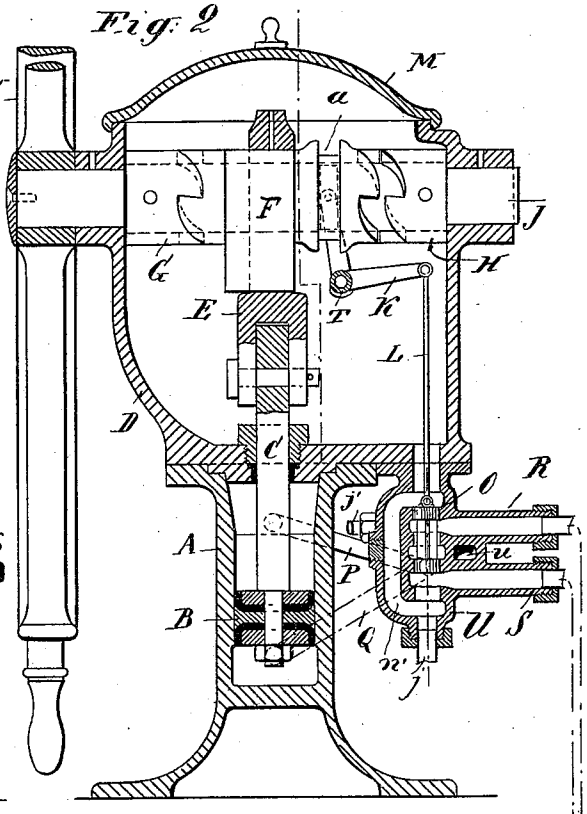

Fig. 3.

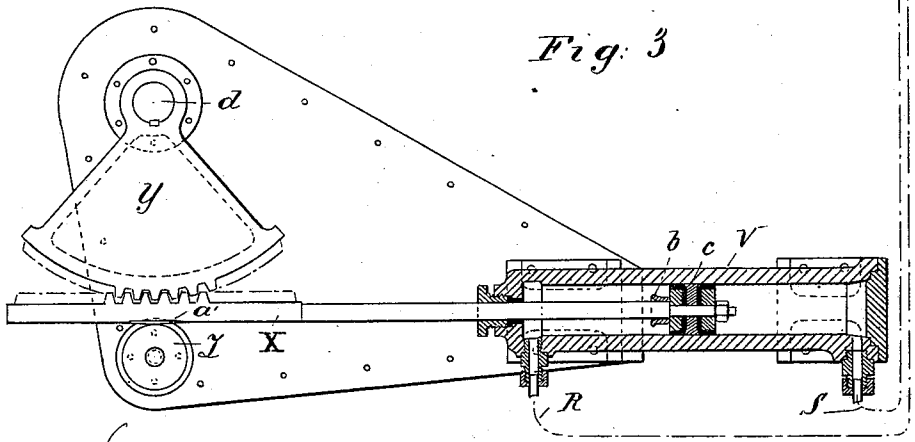

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Fig. 4.

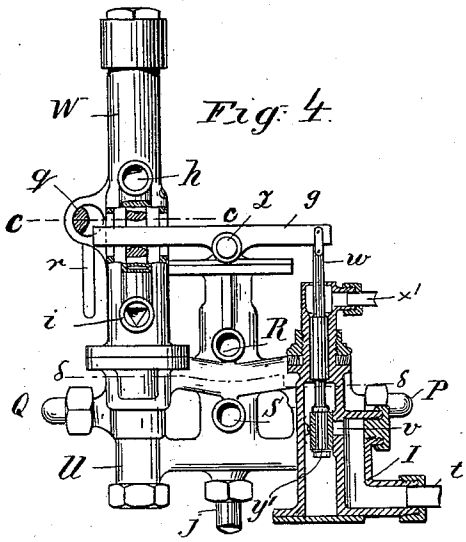


Fig. 5.

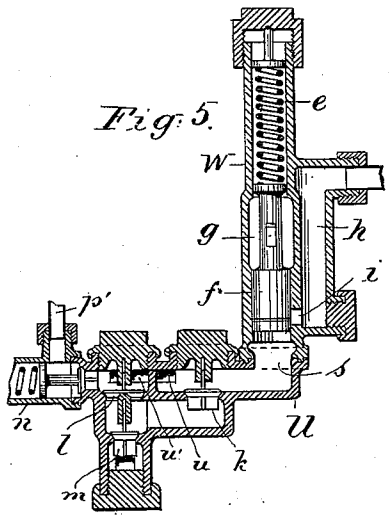


Fig. 6.

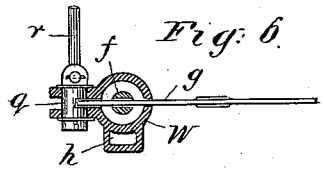


Fig. 7.

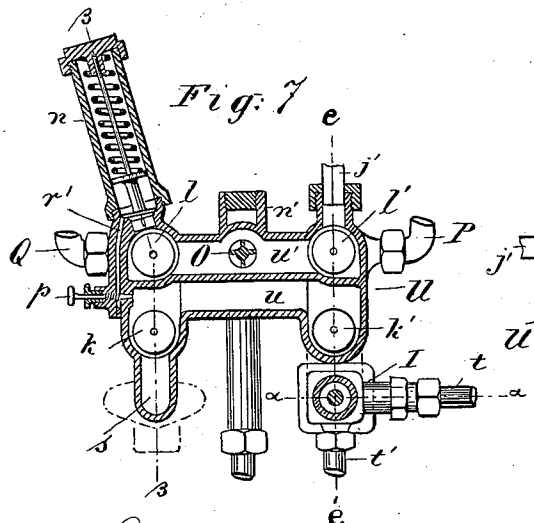
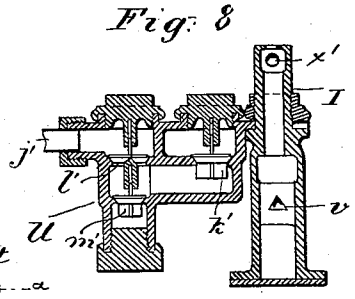


Fig. 8.



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A. F. WIKING.

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Fig. 9.

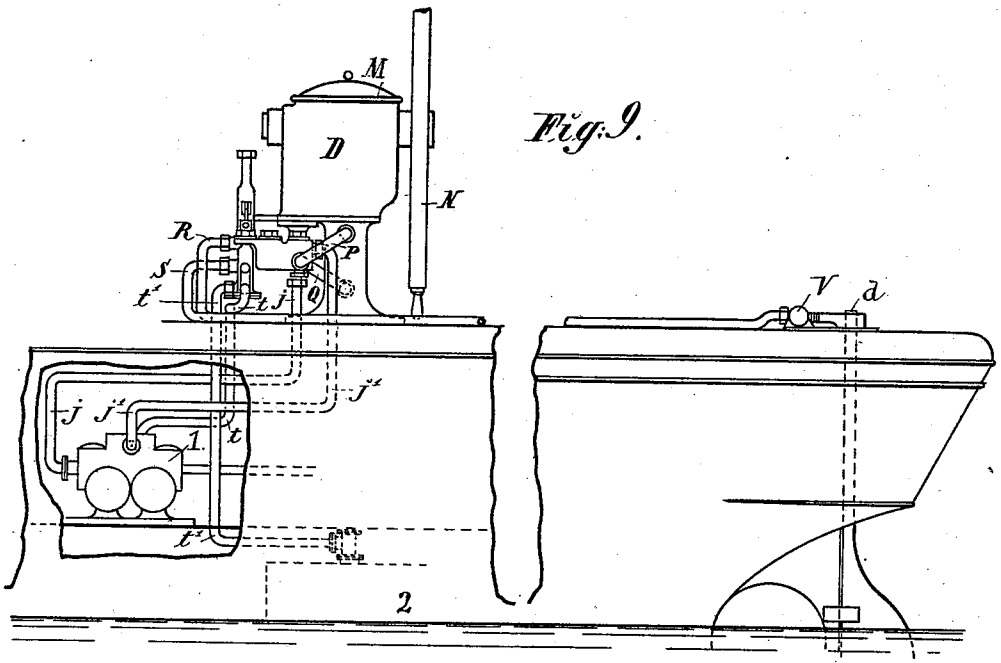
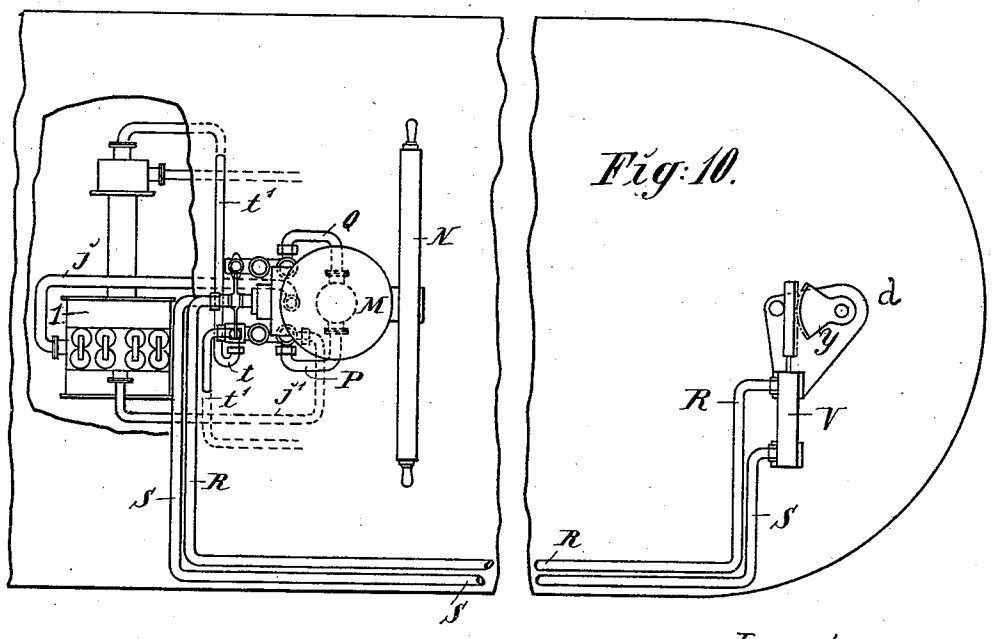


Fig. 10.



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UNITED STATES PATENT OFFICE.

ANDERS FREDRIK WIKING, OF STOCKHOLM, SWEDEN.

HYDRAULIC STEERING-MACHINE FOR SHIPS.

SPECIFICATION forming part of Letters Patent No. 564,265, dated July 21, 1896.

Application filed February 4, 1896. Serial No. 578,048. (No model.)

To all whom it may concern:

Be it known that I, ANDERS FREDRIK WIKING, a subject of the King of Sweden and Norway, and a resident of Stockholm, Folkungagatan 87, Sweden, have invented an Improved Hydraulic Steering-Machine for Ships, of which the following is a specification.

This invention relates to a machine for steering ships by means of hydraulic pressure as the transmitting medium between the wheel on the bridge and the rudder. By the use of this hydraulic pressure for transmitting, the following advantages are obtained, viz: The movement of the wheel is more speedily communicated to the tiller, the noise usually arising in common steering-gear connections is avoided, the connections between wheel and rudder may be placed in out-of-way places, and the rudder after being brought to a certain position will remain there without the aid of the wheelman.

In the accompanying drawings, Figure 1 is a vertical cross-section, and Fig. 2 a vertical longitudinal section, of that part of the machine that is to be placed on the bridge, (the bridge apparatus.) Fig. 3 is a horizontal longitudinal section of that part of the machine that is to be placed at the rudder, (the aft apparatus.) Fig. 4 is a front view of the valve-box with section of the steam-chest on *a a*, Fig. 7. Fig. 5 is a section of the same valve-box on B B, Fig. 7. Fig. 6 is a section on *c c*, Fig. 4. Fig. 7 is a section on *d d*, Fig. 4. Fig. 8 is a section on *e e*, Fig. 7. Fig. 9 illustrates, on a reduced scale, an elevation of my improvements, the steam-pump being shown in its connection with the other apparatus; and Fig. 10 is a plan of the same.

The bridge apparatus consists of a vertical pump-cylinder A, with the piston B, the piston-rod C of which is by means of an eccentric-strap E movable from the eccentric F, which is movable lengthwise on the wheel-shaft J. This shaft, with fitting, is inclosed by the reservoir D, containing the working and spare liquid, and covered by a cover M. On the shaft J two coupling-sockets G and H are secured, one on each side of the eccentric F. Those ends of these sockets which abut on the eccentric F are provided with teeth, as shown in Fig. 2, and on the ends of the hub of the eccentric F corresponding teeth are arranged. Thus the eccentric-hub, in connection with either of the sockets G or H, forms a clutch-coupling.

In Fig. 2 of the drawings the eccentric-hub is shown in connection with the socket G. If the wheel N is turned to the left, (supposing the wheelman is standing behind the wheel,) the eccentric will be pushed along the shaft away from the socket G and finally brought into connection with the other socket H. By reversing the motion of the wheel the eccentric-hub will again be connected to the socket G. The eccentric-hub, after having been brought in connection with either one of the two sockets G and H, will then be compelled to revolve with the socket and the wheel, providing the movements of the latter continue in the same direction, and the piston B will then also be put in motion by the eccentric.

On the hub of the eccentric there is an annular groove *a*, Fig. 2, in which works the forked end of the bell-crank K, which has for its fulcrum the shaft T. The other end of this bell-crank actuates the distributing-valve O through the valve-rod L. Both ends of the pump-cylinder A, through pipes P and Q, are in communication with separate chambers in the valve-box U, and these chambers communicate, through suction and pressure valves and the passage *w'*, with the distributing-valve O and its chambers. These latter chambers communicate again, through pipes R and S, with the ends of the cylinder V, Fig. 3, which cylinder is a part of the aft apparatus. This aft apparatus consists of the cylinder V, the piston *c*, and the piston-rod X, the outer end of which is formed as a rack engaging with the toothed sector Y, fastened to the rudder-head *d*. Z is a guide-roller for the rack on rod X. The connection between the piston and the rudder-head might also be made in some other suitable way.

The steering-machine works as follows: If the wheel is turned to the left, Fig. 2, (the wheelman standing behind the wheel,) the eccentric F will be pushed away from the socket G and brought in connection with the socket H. At the same time the bell-crank K pushes the valve O downward, Fig. 2. By continued motion of the wheel in the same direction the piston B will displace the liquid

on its top through the pipe P to the valve-box U. Supposing now that the load on the valve k' is heavier than the load on the valve l', Figs. 7 and 8, the liquid will be displaced through the valve l', Figs. 1 and 8, and through the valve-chamber communicating with the pipe S to this pipe. (It will be remembered that the valve O has been moved to its lower position.) Through the pipe S the liquid proceeds to the right-hand end of the cylinder V, thus pushing the piston c, with the rack X, to the left and turning the rudder. The liquid on the left-hand side of piston c will be brought back through the pipe R to the top of valve O, Fig. 2, and thence to the reservoir D or through the passage n', Fig. 2, the valve m, Fig. 1, and the pipe Q to the lower end of cylinder A. By continued motion of the wheel in the same direction the piston B will be pushed downward and displace the liquid in the lower end of cylinder A through pipe Q, valve l, which valve is supposed to be lighter loaded than the valve k, Fig. 5, and pipe S to the cylinder V. By reversing the motion of the wheel N the eccentric F will be pushed away from the socket H and brought in connection with the socket G. At the same time the valve O will be lifted to its position in Figs. 1 and 2. By continued motion of the wheel in the same direction the piston B will displace the liquid in the cylinder A through the pipe R to the left-hand end of the cylinder V. The piston c will thus be pushed toward the right and the rudder turned accordingly.

It has been supposed that the valves k and k', Figs. 5, 7, and 8, were heavier loaded than the valves l and l'. If this is not the case, but the valves l and l' are heavier loaded than the valves k and k', then these latter valves will open when pressure is brought on their lower sides from the piston B. The liquid will then from these valves be pushed through the passage s, Fig. 5, and up against the piston f, which will be lifted and allow the liquid to escape through the opening i, Figs. 4 and 5, and the passage and pipe h back to the reservoir D. As shown in Fig. 7, the liquid that passes through the valve k' will pass through the passage u on its way to the passage s. The immediate effect of the turning of the wheel will in this case be the raising of the piston f. This movement of the piston will be communicated, by means of the lever g turning on its fulcrum z, to the steam-valve y. Thus this valve y will allow steam to pass out from the steam-chest I through the orifice v, Figs. 4 and 8, and thence through the steam-pipe t to a steam-pump. (Steam enters the steam-chest I through pipe t', Fig. 7.) The opening of the orifices i and v will take place about simultaneously.

The steam-pump is shown on the drawings at 1 in Figs. 9 and 10, but might be placed anywhere in the ship, preferably in the proximity of the bridge apparatus, the boiler being indicated in Fig. 9. This steam-pump has for its suction the pipe j, Figs. 1 and 2, and the passage n', Fig. 2, direct from the reservoir D. The delivery will be effected through the pipe j', Figs. 7 and 8, the passage u', and through one or the other of the pipes R and S, depending upon the position of the distributing-valve O, to the cylinder V.

The pipe x' serves for the purpose of gathering and carrying away such steam that might leak out around the valve-rod w.

This arrangement of valves k and k', piston f, lever g, and steam-valve y' serves for the purpose of starting the steam-pump by giving it steam through orifice v in all cases when the pressure on valves k and k' is less than the pressure on valves l and l'. Now the pressure on valves l and l' is a direct consequence of and its value is in direct proportion to the pressure from the water on the rudder-blade. The pressure on valves k and k' again is dependent on the pressure from the piston f, which pressure is dependent on the pressure of the spring e augmented by the steam-pressure on the valve-rod w. Thus, when the pressure on valves l and l' from the water acting on the rudder-blade becomes higher than the pressure on valves k and k' then these valves will open and valves l and l' will remain closed. In consequence hereof the steam-pump will be started and the rudder will henceforth be moved by steam-power. The work of the wheelman will now consist in displacing liquid through the orifice i and thus keep the piston f more or less raised, depending upon the speed by which he turns the wheel. By keeping the piston f more or less raised the steam-outlet v will also be correspondingly more or less open, admitting more or less steam to the steam-pump and thus making this steam-pump work faster or slower and consequently thus causing the rudder to be turned faster or slower. From the above it is evident that the speed by which the rudder is turned by steam-power is proportionate to the speed by which the wheelman turns the wheel.

By stopping the motion of the wheel the spring e will push the piston f downward until it reaches the lower edge of the orifice i, where piston f will stop. The steam-valve y' follows piston f and closes the steam-outlet v, thus causing the steam-pump to stop for want of steam. The steam-pump will thus stop about simultaneously with the stopping of the motion of the wheel. By adjusting the force of the spring e the moment when the steam-pump will be put in action may thus be regulated.

By combination of hand and steam steering, as set forth, the advantage is obtained that the steering by hand-power only will continue as long as the power of the wheelman suffices, and thence steam will automatically be brought in as the working force. By varying the force of the spring e the point where the power of the wheelman is insufficient for steering the ship can be discovered, and the

spring may then be left with that tension. By this arrangement steam is saved and not wasted when the wheelman's power is sufficient for steering the ship.

n, Figs. 5 and 7, is a safety-valve for maintaining the pressure in the passage *u'*, Figs. 1 and 7, under a determined limit. The escape of the liquid from that valve takes place through the pipe *p'*, Fig. 5, to the reservoir D.

In order to disconnect the steam-pump, the eccentric *q*, Figs. 4 and 6, is turned about three-fourths of a revolution by means of the lever *r*, and is then brought to bear on the end of the lever *g*, keeping this down and thus preventing any movement of the piston *f* and of the steam-valve *y*. In order to hereby allow the piston *f* to pass by the lower edge of orifice *i*, the screw-plug *p*, Fig. 7, is opened, permitting the liquid under the piston *f* to pass from the passage *s*, through the passage *r'*, to the safety-valve *n*, and thence through pipe *p'*, Fig. 5, to the reservoir D.

The rack X on its back and on about the middle of its length is provided with a curved projection *a'*, Fig. 3, which serves for the purpose of keeping the teeth of the rack well pushed up against the teeth of the sector Y, and thus preventing any noise that otherwise might arise when the rudder is in a central position.

In order to keep the rudder locked in a certain position, the valve O is moved to its central position, when it covers both end chambers of the pipes R and S.

The pump A is here described as double acting, but might also be constructed as a single-acting one, in which case only one pipe P or Q will be required.

By excluding the valves *k* and *k'* the machine will be suitable for hand-power only.

Instead of connecting the steam-valve *y'* with the piston *f* by means of a lever that steam-valve might be constructed as a direct continuation of piston *f*.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. A steering apparatus for ships, comprising in combination, a hydraulic cylinder with a piston acting on a rudder, a distributing-valve for the said cylinder moved and reversed by the steering-wheel, a hand-pump, the chest of said valve having chambers in communication through valves in a valve-box with said hand-pump, a separate set of delivery-valves through which said hand-pump is also in communication with a separate chamber, and a loaded piston movable over an escape-opening for the hand-pumped liquid and connected to a steam-valve, which when opened by the said piston, admits steam to a steam-pump, for the purpose of pumping liquid from the reservoir into the said cylinders, substantially as described.

2. In hydraulic machinery for steering ships by steam or hand power, the combination of the following sets of devices: namely: an apparatus adapted to be placed on the bridge, and consisting of a pump-cylinder and its piston, an eccentric-strap serving to actuate said piston, a shaft turned by the steering-wheel and carrying a toothed eccentric for actuating said strap and adapted to move lengthwise on said shaft, a clutch mechanism on the shaft and on the faces of the eccentric: a distributing-valve worked by said eccentric, a valve-box communicating with the pump and from which the liquid is guided by said valve, and two pipes extending aft to one or the other of which the liquid is guided: and an apparatus composed of a cylinder and its piston, said cylinder being in communication at each of its ends through one of said pipes with said distributing-valve, and a piston having a piston-rod acting on the tiller, and whereby upon turning the bridge-wheel, the bridge-pump may cause said piston to move one way or the other, depending on the position of the distributing-valves, and thus effect the turning of the rudder.

3. In combination with the pump-cylinder and its piston, and with the piston *f*, steam-valve *y*, and cylinder V, distributing-valve O and valve-box, a set of delivery-valves for the liquid from the pump, through which valves communication is established between the pump and piston *f*, and which piston by being acted upon by the pressure from the liquid, will move and uncover an escape or opening for the liquid, and at the same time move valve *y*, by which steam is admitted to a steam-pump, and whereby the apparatus delivers the liquid to the distributing-valve which guides the liquid to one or the other end of the cylinder V, substantially as and for the purpose set forth.

4. In combination, the cylinder A, pump-piston B, eccentric-strap E, eccentric F, and its clutch-couplings, valve O, valve-box U, pipes P Q, pipes R S, cylinder V, and its piston *c*, rack-rod X and sector Y on the rudder-head, the combination being and operating substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANDERS FREDRIK WIKING.

Witnesses:
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BIRGER LINDH.