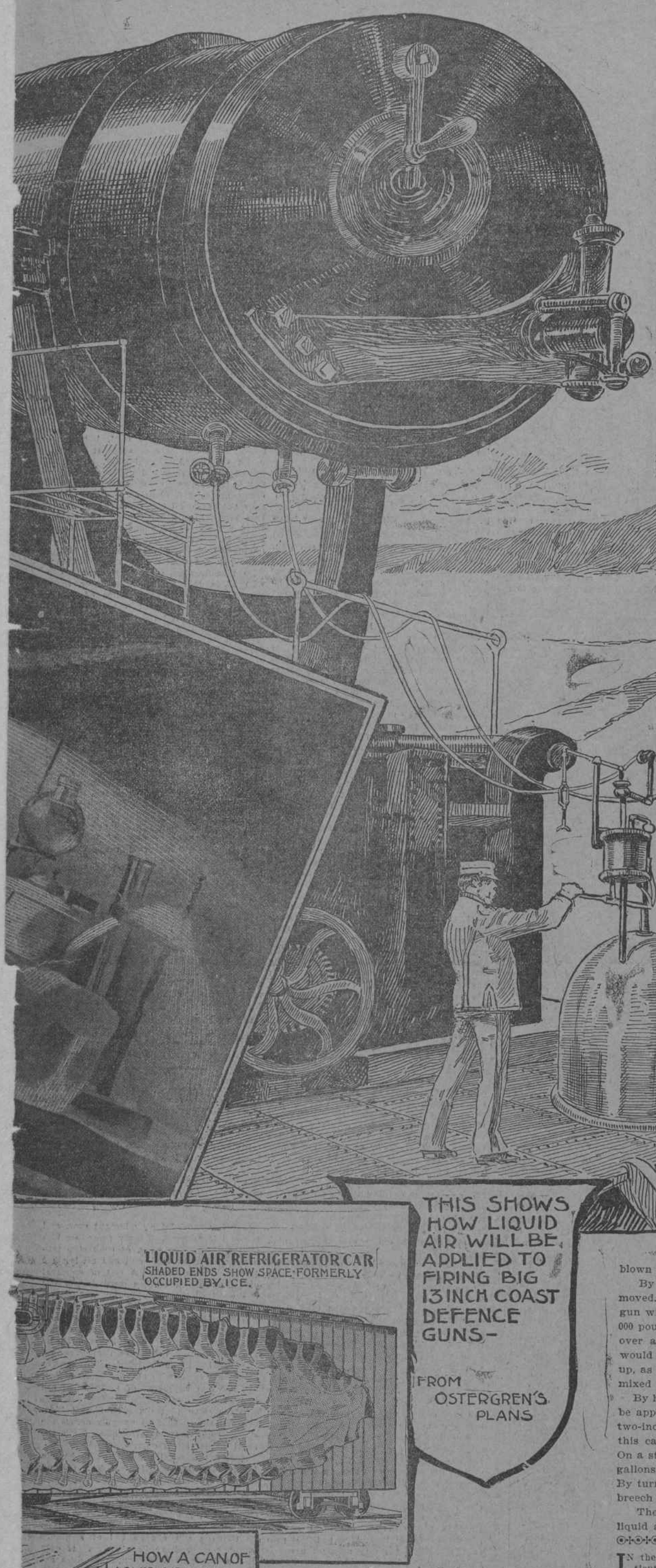
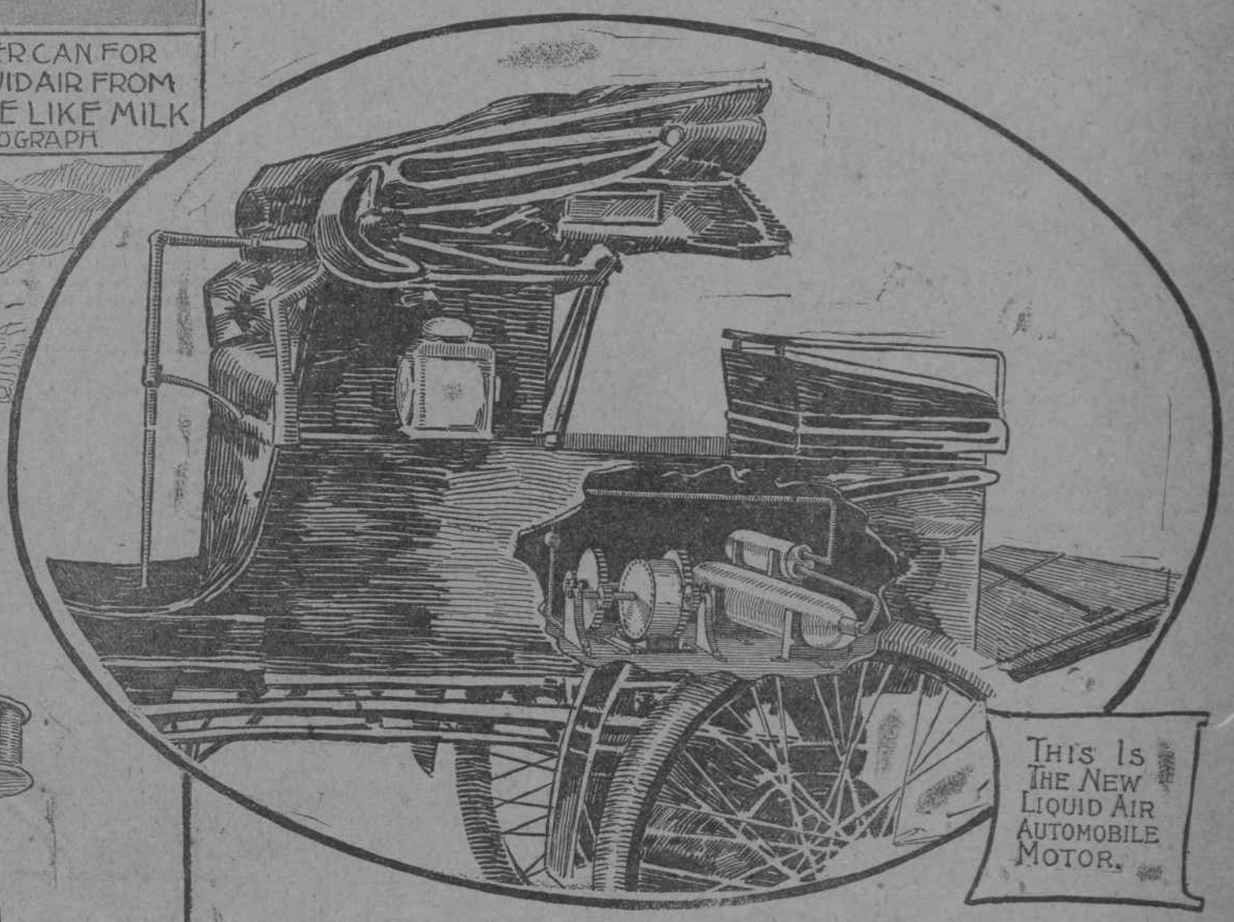
RCE IS BEING HARNESSED FOR EVERY DAY USE.

By the New Inventions It Can Be Carried from House to House Like Milk in Cans. It Can Be Used to Cool Rooms, to Take the Place of Ice in Ice-Chests and Refrigerator Cars, to Run Automobiles, and to Fire 13-Inch Guns.



THE NEW COPPER CAN FOR DELIVERING LIQUID AIR FROM HOUSE TO HOUSE LIKE MILK FROM A PHOTOGRAPH

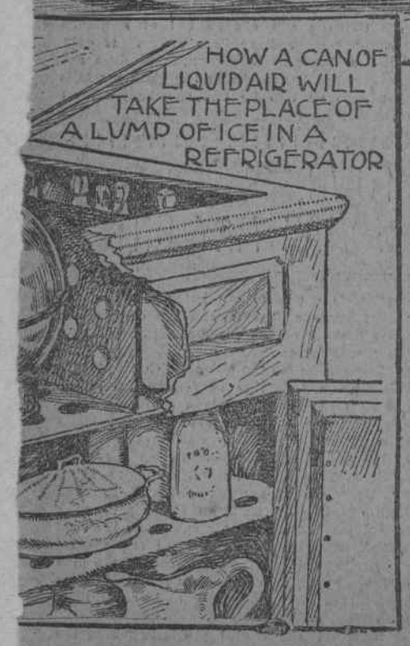


THIS IS THE NEW LIQUID AIR AUTOMOBILE MOTOR.

THIS SHOWS HOW LIQUID AIR WILL BE APPLIED TO FIRING BIG 13 INCH COAST DEFENCE GUNS.—

FROM OSTERGREN'S PLANS

LIQUID AIR REFRIGERATOR CAR
SHADED ENDS SHOW SPACE FORMERLY OCCUPIED BY ICE.



HOW A CAN OF LIQUID AIR WILL TAKE THE PLACE OF A LUMP OF ICE IN A REFRIGERATOR

Liquid air motors promise soon to be as plentiful as naphtha and gasoline motors are at present. It is claimed for liquid air motors that they can be made to run everything from sewing machines up to printing presses.

The liquid air cannon which Mr. Ostergren has invented is the acme of destructiveness. It will not only hurl a thirteen-inch shell a distance of twelve miles, but the shell itself will be charged with liquid air, which will explode on striking with the blasting effect of one of the cruiser Vesuvius's dynamite guns. Those were the fearful shots which terrorized the Spaniards at Santiago a year ago. They declared that the Vesuvius threw earthquakes.

The devastation wrought by those projectiles, tearing up the earth for a radius of hundreds of feet of the striking point, levelling all buildings, causing instant death from shock to all human beings within half a mile, was frightful in the extreme. There were some defects in the Vesuvius's guns, however, that rendered them almost useless in an attack on hostile war ships.

Their range, by pneumatic or compressed air power, was short, from one and a half to two and a half miles at the utmost. Moreover the dynamite or guncotton with which the shells were charged was so explosive that naval officers feared that the slightest concussion of an enemy's shot on the hull of the Vesuvius would cause her to be blown up by her own explosives.

By using liquid air both these disadvantages are removed. The charge that will send the projectile from the gun will be as great as the best smokeless powder, or 50,000 pounds pressure to the square inch, enough to carry it over a range of twelve miles. At the same time there would be no danger of a ship's magazines blowing up, as liquid air does not become explosive till confined or mixed with some other substance.

By his patented device Mr. Ostergren says liquid air can be applied to any coast defence gun or naval rifle from a two-inch piece up to a thirteen-inch turret rifle. Just how this can be done is shown in the accompanying picture. On a standard near the gun is a receptacle holding several gallons of liquid air, and a smaller one containing alcohol. By turning a valve a quantity of alcohol is forced into the breech of the gun just behind the projectile.

The movement of a lever then pumps a quantity of liquid air into the same space, completely filling it. This mixture of liquid air and alcohol is a combustible as powerful as nitroglycerine. But it will not explode till ignited by a spark. The gun will be fired by flashing an electric spark in it.

The discharge is absolutely smokeless and the projectile is started on its twelve-mile course. This shell is so made that it is bound to explode on striking. It is loaded with a gallon of liquid air contained in a bronze globe and tube. Surrounding this is a filling of charcoal.

The instant the head of the projectile strikes any object it ignites an ordinary powder cap. The impact at the same time mingles the liquid air and charcoal, forming a combination as explosive as that of liquid air and alcohol with which the gun has been fired. The bursting of the shell which follows is as terrific in its effects as were the Vesuvius projectiles. Beside the devastation wrought it envelopes the whole scene with blinding smoke.

This is due to the union of the charcoal and liquid air. So, curiously enough, liquid air can produce a smokeless discharge at one end and a bewildering cloud of destructive flame and smoke at the point of striking, wtih all the resulting terror and confusion which such a combination is likely to cause.

To provide a supply of liquid air for each warship it would only be necessary to install a small liquid air plant in connection with the electrical apparatus. At forts on shore the liquid air machinery could be set up with the same power plants now used for hoisting the disappearing guns.

Liquid air could be made at an hour's notice when needed. In this way the storing of large quantities of dangerous explosives near the large cities could be avoided. At the same time the expense of keeping millions of dollars worth of powder and dynamite on hand would be saved.

Hundreds of other inventions for applying liquid air to everyday uses are now being tested. Distillers have found that by alternate freezing and thawing of whiskey it can quickly be "aged." Wine has been clarified by a similar process.

Some enthusiastic chemists have declared that the perfume of flowers can be condensed into a fluid extract by liquid air, and the essence of fruits made into liquid in the same way. Physicians and surgeons are experimenting with liquid air as a germ killer. It is believed that it can be used as a consumption cure, owing to the large amount of ozone that it generates. Embalmers state that it can be used for solidifying bodies and killing the microbes that decompose the tissues. Other uses without number are now being suggested by ingenious minds in nearly every trade and profession.

A New Anaesthetic Which Preserves Consciousness While Killing Pain.

IN the Royal Hospital of Kiel, Germany, the other day, a patient lay upon the operating table and placidly read the morning paper while surgeons cut off his leg at the thigh. He had been rendered incapable of feeling pain by a new method, which, while leaving the patient's mind perfectly clear, entirely abolishes the sensation of pain. This was accomplished by injecting a very small amount of solution of cocaine into the sac surrounding the spinal cord.

Dr. Leonard J. Corning, of New York, the authority on nervous diseases, is the inventor of this daring method of producing insensibility to pain. This fact is known to the leading surgeons of this country and is proved by Dr. Corning's book on the subject. American surgeons, therefore, are somewhat incensed to find that the German medical papers are attributing the discovery to Dr. Quincke, of Vienna, and its application to Dr. Bier, of Kiel. They say that nearly every discovery made by American surgeons lately has been impudently laid claim to by some foreign doctor.

Hitherto the only way of painlessly performing such a serious operation as the removal of a leg has been to produce total insensibility of the patient by the use of chloroform or ether. This procedure is sometimes very dangerous, for it is unsafe to give chloroform to a person with a weak heart, while ether is equally risky in affections of the kidneys. Ever since the discovery of chloroform doctors and surgeons have sought for some method of producing insensibility to pain while let leaving the patient in possession of his other faculties. Hypnotism has been tried, but this has the objection that the patient does not know what is going on.

Dr. Corning's discovery was made during the course of his researches into the anaesthetic qualities of cocaine. He observed that the injection of a solution of cocaine along the track of a nerve deadened the ensation, and was of great value as a method of treatment in some painful nervous diseases. The spinal cord is practically a very large nerve from which other nerves branch, and he argued that if the anaesthetic could be brought into contact with the spinal cord it ought to produce insensibility to pain.

After most exhaustive experimentation, Mr. Corning decided that this same treatment could be successfully and safely applied to man. It had, up to that time, been considered as almost a surgical axiom that interference with the spinal cord was in the highest degree dangerous, so that it can be seen that it required considerable courage to undertake such an operation.

The patient who was selected for the first test of this form of anaesthesia was aware that he was a pioneer, but he had faith in Dr. Corning. After the usual surgical preparation a fine needle was passed through the skin in the small of his back, thence between two of the spinal bones, and so into the sac surrounding the spinal cord. The patient was perfectly aware of what was going on, but he told Dr. Corning that he felt nothing after the first prick of the needle. A weak solution of cocaine was then injected through the needle.

In a few minutes the patient said that his legs felt dead. Test with an electric battery showed a decrease in sensibility to pain, which steadily progressed until, at the end of ten minutes, the man could feel no pain whatever. Curiously enough, however, he was still able to know when anything touched him, and could tell whether a substance applied to his leg was hot or cold, but he could feel no pain. When a needle was placed against his leg he could feel the touch, but when it was thrust into his flesh he was only conscious of the sense of pressure used in pushing it in. Similarly he knew that a red hot wire was hot, but was unconscious of the pain of a burn.

Other experiments were made and it was found that no pain could be felt below the place at which the injection had been made. The patient's mental faculties were unimpaired, and, aside from a slight temporary numbness in the feet, he experienced no discomfort or ill effects from the operation.

The reason for the success of this extraordinary method of producing insensibility to pain is interesting. The spinal cord is enclosed in the spine. It begins, in man, at the base of the skull and ends in the small of the back. It is usually eighteen inches long and weighs about an ounce and a half. It does not nearly fill the canal in which it is contained. Anatomically described, it extends from the upper border of the atlas—the bone on which the head turns—to the bottom of the first lumbar vertebra. There it ends in a slender thread of gray substance which is extended almost to the end of the spine.

The use of the spinal cord is to transmit messages from the brain to the muscles and vice versa. It might be compared to a "trunk line" in a telephone system, the brain being the main office and the muscles being the subscribers. Then by the spinal cord there is practically no other nervous communication between the brain and the muscles; hence through it must come all the nerve impulses which pass to or from the brain. In other words, every impulse that is felt and every motion that is willed—perception and volition being attributes of the brain—must be conducted through the spinal cord to the brain and vice versa.

Issuing from the cord along its course are thirty-one pairs of nerves communicating with the various parts of the body. The spinal cord is surrounded and supplied by a great many veins, but the circulation in them is very sluggish. This is believed to be the reason why the action of the cocaine is only exhibited in a downward direction.

Three membranes envelop the spinal cord and between two of them is a space filled with a liquid which doctors call the "cerebro-spinal fluid." It is into the sac containing this fluid that the solution of cocaine is injected with a hypodermic needle.

It can therefore be seen from the foregoing that in injecting a powerful anaesthetic into the space surrounding the spinal column the operator practically—to continue the telephone simile—spoils the conductivity of the wire between the subscribers and the main office. However anxious the nerves of the skin may be to tell the brain that some one is jabbing them with knives and things, they cannot get a message to that effect over the wire. The brain, not being acquainted with what is going on, is utterly untroubled thereat, and, as the brain is the seat of sensation, the possessor of it feels no pain while the surgeons are operating.

This is why, in the German Hospital, a patient was able to read the morning paper while his leg was being taken off. Surgeons say that the new method of anaesthesia can be used for all kinds of operations except those upon the head itself.