

fires, and every precaution is taken to guard against these conflagrations. At most of the older workings, as well as at the new mines, there are complete systems of fire alarms, fire doors, and pipe lines; the employes are organized into thoroughly drilled companies of firemen; and steam fire engines and duplex fire pumps are provided. Supplementary to the regular alarm apparatus, connection between all the various workings of a mine is maintained by means of a system of electric bells and private telephones. That all possible precautions have not made the natural storehouses of copper invulnerable, however, is evidenced by the fact that some time ago one of the shafts of the Calumet and Hecla mine caught fire and burned fiercely for weeks, entailing a loss of \$15,000 a day, and this in spite of the fact that this mine has a private water works system which daily pumps two million gallons of water a distance of nearly five miles.

ELECTRIC AUTOMOBILE—KRIEGER SYSTEM.

One of the latest types of electric automobiles is the new two-place machine of the Krieger type, or "electrolette," as it is called. This is the smallest machine of this type which has been designed up to the present. In this system the front wheels turn at the end of a fixed shaft, and each is driven by a separate motor with reduction gearing, thus doing away with the differential and making a less complicated arrangement. This machine has been designed to meet the demands for a light electric automobile and to overcome the objection that an automobile must necessarily be heavy, on account of the weight of the accumulators, as well as costly. It has thus been necessary to design a vehicle which should be free from these objections; it should be light and easily operated, and should not require more than ordinary attention from its owner. It must also cover a considerable distance without recharging, in spite of the light weight of the vehicle, and its average speed should be somewhere near that of a petroleum automobile. M. Krieger, owing to his previous experience in this direction, has succeeded in solving the problem of a light electric vehicle, and the present machine is the result. As will be seen, it is a two-place vehicle, but as the carriage body is made removable, a four-place body may be substituted, in spite of the small size of the machine. The front axle, which is fixed, is carried well in front, and at each end the wheel turns like that of an ordinary carriage. The fixed axle supports near the wheel an electric motor of 3 horse power, which is of the latest design and entirely inclosed by its circular casting and end-pieces. The pinion comes out at the side next the wheel and engages with a large gear wheel which is fixed against it. The gear and pinion are inclosed in a tight case. Thus each wheel is turned independently by its own motor, and the result is a great gain in simplicity, owing to the suppression of the differential; it is this system which has made the Krieger type one of the most successful of the electric automobiles. The truck is supported upon the front shaft by a curved spring. The whole system turns about a central pin, and is steered by the hand-wheel above, by means of a pinion and toothed sector. The accumulators are contained in a box which is fixed in the truck below the carriage body and is arranged so that it may be easily slid out from the rear. The batteries are of the Fulmen type, and have a total weight of 800 pounds, allowing a run of at least 65 miles on a single charge. The two motors, each of 3 horse power, give a total of 6 horse power for the machine, which enables it to climb heavy grades without in-

juring the motors. The latter are arranged so as to be accessible from above, which renders their inspection and cleaning much easier than in the ordinary type of electric vehicle. The total weight of the machine, in spite of the 800 pounds of accumulators, is only 1,700 pounds, of which the motors represent 220 pounds. The mean speed on a level grade is 21 miles an hour, or 12 to 15 miles over an average road. The controller of the Krieger type has the advantage that



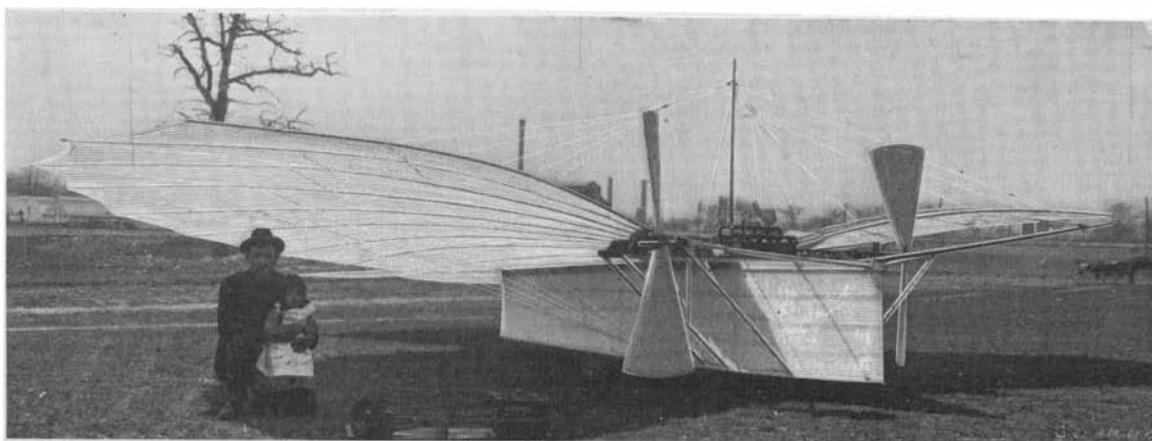
THE KRIEGER ELECTRICAL AUTOMOBILE.

the steering wheel and controller are mounted in a single device and the whole direction of the machine is brought to one point. The shaft of the steering wheel passes down through the carriage body, while surrounding it is a hollow shaft upon which is mounted the controller drum. The latter is turned about the main shaft by a handle directly under the steering wheel. The controller is formed of an insulating cylinder carrying a series of contact rings which rub against the contact spring-pieces at the side of the box. The controller may take 11 different positions, including start, slow, mean and high speeds, an extra speed, electric brake and reverse. The electric braking action is carried out by placing the motors in short circuit, thus giving a powerful brake upon the front wheels; besides this, the rear wheels carry a band-brake.

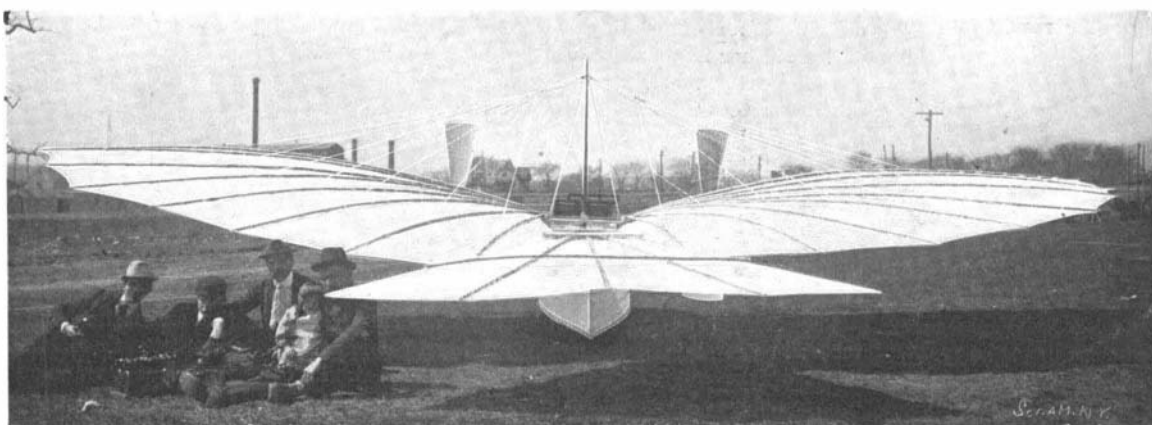
A NEW FLYING MACHINE.
A novel flying machine has just been completed by Mr. Gustave Whitehead, of Bridgeport, Conn., and is now ready for the preliminary trials. Several experiments have been made, but as yet no free flights have been attempted. The machine is built after the model of a bird or bat. The body is 16 feet long and measures 2½ feet at its greatest width and is 3 feet deep. It is well stayed with wooden ribs and braced with steel wires and covered with canvas which is tightly stretched over the frame. Four wheels, each one foot in diameter, support it while it stands on the ground. The front wheels are connected to a 10 horse power engine to get up speed on the ground, and the rear wheels are mounted like casters so that they can be steered by the aeronaut. On either side of the body are large aeroplanes, covered with silk and concave on the underside, which give the machine the appearance of a bird in flight. The ribs are bamboo poles, and are braced with steel wires. The wings are so arranged that they can be folded up. The 10-foot rudder, which corresponds to the tail of a bird, can also be folded up and can be moved up and down, so as to steer the machine on its horizontal course. A mast and bowsprit serve to hold all the parts in their proper relation.

In front of the wings and across the body is a double compound engine of 20 horse power, which drives a pair of propellers in opposite directions, the idea being to run the machine on the ground by means of the lower engine until it has the necessary speed to rise from the ground. Then the upper engine actuates the propellers so as to cause the machine to progress through the air to make it rise on its aeroplanes. The wings are immovable and resemble the outstretched wings of a soaring bird. The steering will be done by running one propeller faster than the other in a way analogous to the way in which an ocean steamer having twin screws can be turned, a special aeroplane being provided to maintain longitudinal and transverse stability.

The lower engine is of 10 horse power, and weighs 22 pounds. The diameter of the cylinder is 3 7-16 inches by 8 inches stroke. The upper engine is a double compound cylinder, the diameters being 2¼ and 3 7-16 inches with a 7-inch stroke. The engine weighs 35 pounds, and calcium carbide is used to develop pressure by means of explosions. The propellers weigh 12 pounds, and are 6 feet in diameter, with a projected blade surface of 4 square feet. With a draw-bar test, the upper engine being run at full speed, the dead pull was 365 pounds. The weight of the body and wheels is 45 pounds. The wings and tail have 450 square feet of supporting surface, and the weight is 35 pounds.



WHITEHEAD'S FLYING MACHINE, SHOWING ENGINE AND PROPELLERS.



WHITEHEAD'S FLYING MACHINE, SHOWING AEROPLANES.

Messrs. William Jessop, the famous steel manufacturers of Sheffield (England), are about to establish extensive steel works in this country. This decision has been caused by the American Steel Combine and the high prohibitive tariffs imposed upon foreign steel. Messrs. Jessop have a large business connection on this side, and by the establishment of local works, owing to fuel being cheaper, they intend to force the market, and thus to oppose the Steel Trust. The proposal has excited the greatest interest in the steel circles of Sheffield, and other manufacturers who also have an American connection contemplate a similar step. The enterprise is being substantially supported financially. Already several English manufacturing firms have established works in foreign countries protected by heavy tariffs. Notably is this the case with Russia, and the enterprise has been attended with signal success.