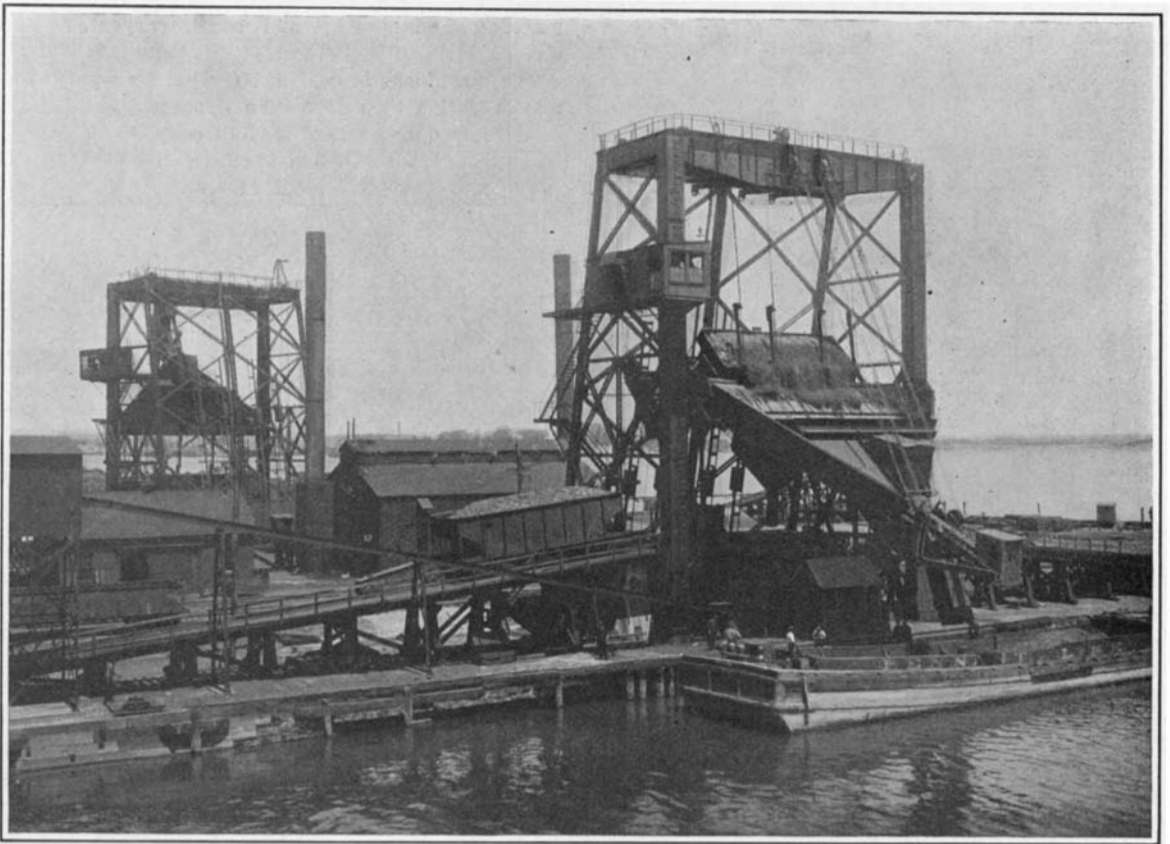


The Unloading of Coal From and To Vessels

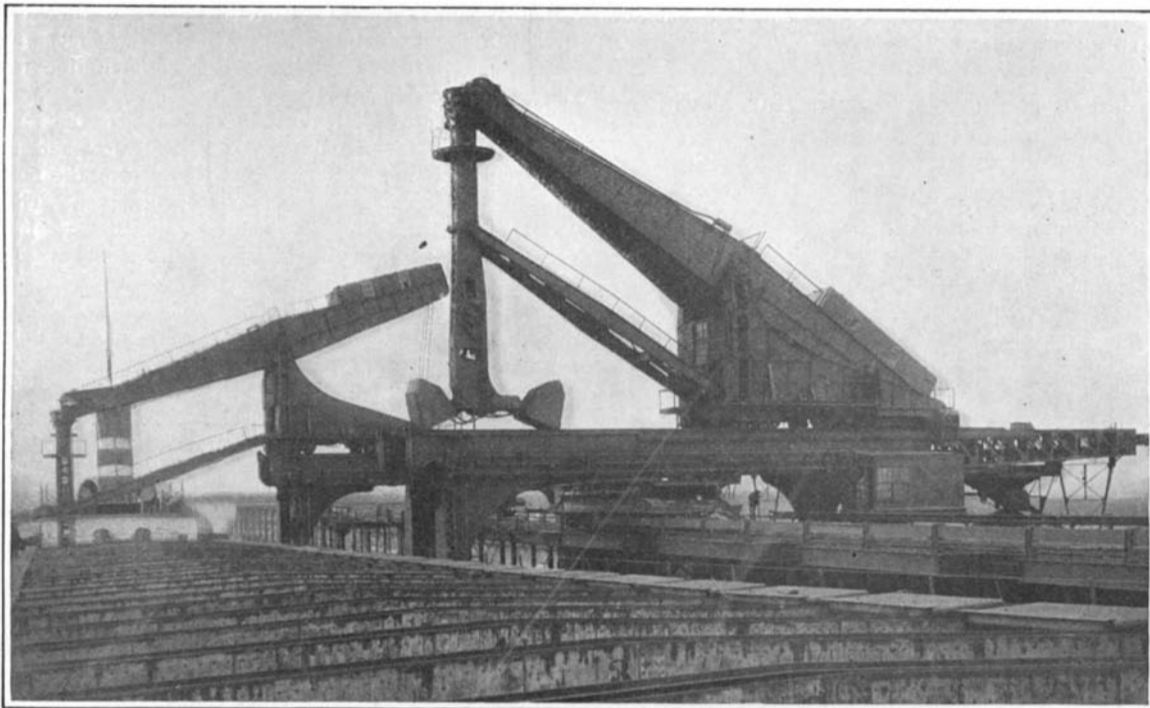
By J. F. Springer

WHAT is perhaps the most up-to-date method of unloading coal from a vessel is used in an installation at Fort Williams, Ont. For a number of years, the Hulett unloader has been in use in the United States in connection with the unloading of iron ore, especially from whaleback vessels. This same device constitutes the principal feature of the plant at Fort Williams.

Briefly, such an unloader consists of an immense beam pivoted near the center in such a way as to permit a movement in a vertical plane. At one end—the working end—a vertical leg is pivoted, at the bottom of which is the device for seizing a quantity of the material which is to be handled. At the other, or non-working end, is located the cab of the general operator. This man controls the vertical movements by which the vertical leg is let down through a hatchway into the hold and later on withdrawn, the load having been secured in the meantime. There is a loading operator who occupies a position in the lower part of the vertical leg and who manages the movements of the bucket which reaches out and gets the load. He is able to cause the bucket to swing round in an arc and to extend itself. So perfect is the whole operation that it has been found possible to secure mechanically up to 97 per cent of the load of iron ore. The entire apparatus, rocking beam and all, is supported on a carriage capable of movement on a second carriage underneath it. This "foundation" carriage may be moved back and forth on suitable tracks on the dock parallel



Car dumper in action at a South Amboy pier, New York harbor.



Hulett unloaders at Fort Williams, Ontario. One of them has just released its load of coal; the other is down in the hold, grabbing eight tons of coal.

to the length of the vessel. The carriage to which the rocking arm is pivoted has a longitudinal movement perpendicular to this. By counting all possible movements, the unloader may be made to operate everywhere in the hold—fore and aft, port and starboard, high and low. The great efficiency of these machines with iron ore has no doubt been the reason why they are now being adopted for use with coal.

The Fort Williams plant is equipped with two unloaders, each capable of securing an 8-ton load of coal. There is in addition a rehandling and stocking bridge having a length of 475 feet. The unloading equipment is at the front of the dock. After an unloader has secured its load, the latter is discharged into a conveyor car belonging to the unloader. This car is discharged into either the scale lorries preparatory to a discharge into the bins or into a storage pit. There are thirty bins arranged in two parallel rows of fifteen each.

The cars to be loaded are run beneath the bins on two tracks at a lower level. Thirty cars may thus be loaded at one setting. It is not necessary that they be loaded simultaneously with the unloading of the vessel.

It is said that a vessel having a load of 12,000 tons may be unloaded by one of the unloaders in about twelve hours, the capacity of the unloaders being 450 or 500 tons per hour.

The reverse procedure, that of transferring coal to a vessel, might not seem at first blush to involve any especial difficulty. However, the amounts to be handled are so enormous and economy of time and operation are so important that the most highly perfected methods of to-day have been the result of a long period of development. The most up-to-date provisions are to be found no doubt upon our Atlantic Coast. Here we have four harbors—New York, Philadelphia, Baltimore, and Norfolk—which are already provided with fifty-

six coaling plants, and in two of which four more plants are under construction. In New York harbor alone, there are thirteen separate ports and twenty-nine coaling plants. In the year 1911, a total of 1,000,000 carloads of coal were discharged by the coaling plants of these four harbors into vessels of various types. These four harbors have a daily coaling capacity of more than 11,000 carloads, although none ever operates at capacity for any considerable length of time.

The coal is handled in various ways. In many cases, it never encounters anything which would usually be termed a mechanical device. In others, the mechanical apparatus is a very prominent feature. In still others, there is a combination of mechanical devices and pier operation.

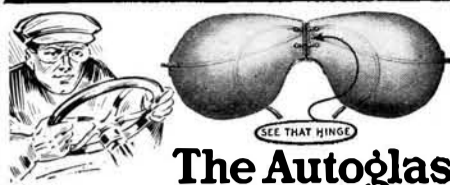
Indeed, one may choose to regard the arrangement of the levels and grades of a pier and of the storage bins and discharge chutes as a gigantic piece of apparatus, the whole being run by locomotives and gravitation. And who could deny that we have here the essentials of a machine? In one case, you will have the railway tracks on a pier arranged on a gentle up-grade as the outer or sea-end is approached. The loaded coal cars are simply pushed out onto the pier by a locomotive operating from the rear. When the cars have been discharged into the bins beneath the tracks, the down-grade toward the shore end becomes of service

(Concluded on page 122.)



Head frames of coal car elevators at shore end of great pier of Norfolk and Western Railroad, Hampton Roads harbor, Va.

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LUBRICANTS



The Opening of the Cape Cod Canal

(Concluded from page 112.)

the shipper and the vessel owner, and in abolishing this burden the canal will confer a benefit that will be widely felt.

Appreciating its great commercial value, as many business men must have done, it is rather incomprehensible that the cutting of the Cape Cod Canal should have been delayed so many years, and the only explanation seems to be that those who investigated the matter in recent years were probably too strongly impressed and frightened by the ancient reports of engineers who based their opinions on primitive methods that have been entirely superseded by modern machinery and extended experience in later undertakings. It is, therefore, greatly to the credit of the intelligence and enterprise of the individuals who have successfully carried to a conclusion this much discussed project, and thanks are due them for a public improvement of widespread value.

The Unloading of Coal

(Concluded from page 117.)

in providing a means for the return of the empty cars. They do not necessarily come back on the same track. Here we have gravitation helping in the operation of the pier. This idea of a gentle grade is applied in several different ways in accordance with the surrounding conditions. In some cases, it has seemed necessary or advisable to employ a steep grade in connection with a gentle one. The explanation of this is to be found in part in the necessity to get the cars ultimately to a high level above the water. That is to say, the tracks at the point of discharge should be from 33 to 43 feet above the level of the highest hatches of the vessels at mean tide. As gravitation is to do the work of carrying the coal from the bins to the ship, there must be sufficient drop to enable this to be done, and at the same time accomplish a horizontal reach. The steep grade may, if it is not too steep, be overcome by the use of ordinary locomotives. In other cases, where space does not permit a long approach, the grade may have to be so steep as to require the use of a cable and barney.

Some of the piers are very long. The very longest are in New York harbor. Thus at South Amboy, N. J., the Pennsylvania Railroad has a pier 1,800 feet long. The same railway has one at Harsimus Cove, N. J., which is 1,750 feet in length. The Central Railway of New Jersey has two piers 1,600 and 1,700 feet in length, respectively, at Port Liberty, N. J., which may be used from both sides. But none of these piers have any very especial capacity, despite their great length, except that at Harsimus Cove, which is capable of discharging 300 cars per day of ten hours.

One object in view in introducing special machinery into plants which deliver coal to vessels is to save space. That is the reason cars are mechanically pushed up steep inclines instead of gentle ones. The plants which depend most upon mechanical arrangements are all located in the ports of New York and Philadelphia, where the price of land is presumably at the highest level. The Pennsylvania Railroad has two such installations at South Amboy, N. J., in New York harbor and one at Greenwich in Philadelphia harbor. Apart from minor differences, all these are operated upon the following plan. The car loaded with coal is received by a cableway, which takes it up a short steep incline to a "cradle." This is a movable framework, big and strong enough to receive and hold fast the car and its load. The cradle and car are then lifted and overturned sideways with the result that the load is spilled into a large apron. The carload of coal, say forty tons, runs or flows down the face of the apron into a chute, to the mouth of which the sides of the apron converge. Once in the chute, the coal is guided to the point in the hold at which it is desired finally to dump it. From the moment the car is overturned, the coal flows under the influence of gravitation alone. The apron may be raised and lowered, and the chute may be dis-

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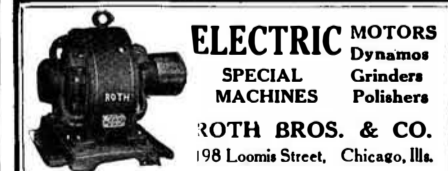
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posed in a variety of ways. The empty car returns to the yards by gravity. Power is employed in this plant (1) to get the loaded car up the steep incline into the cradle; (2) to lift the cradle and car vertically; and (3) to overturn the whole. The car is taken up the incline and the vertical lift is made in order to get a sufficient elevation above the vessel to enable gravitation to complete the work. The Baltimore and Ohio Railroad has a plant of this kind at St. George, Staten Island, and the Delaware, Lackawanna, and Western Railroad has two at Hoboken, N. J., all three in New York harbor. The latter railroad has another mechanical plant at Hoboken in which the coal when dumped is received by a hopper. An endless chain conveyor takes the coal from the hopper and elevates it to a considerable height, from which it flows down into elevated bins. From the bins it flows down through chutes, finding its way at last into the hold of the vessel.

In a number of cases on the Atlantic coast, the plants delivering coal to vessels consist of a combination of the pier and mechanical appliances. Of the four new plants now under construction, two belong to this combination variety, and one to the excessively mechanical type. So that the trend seems in the direction of mechanical methods. In Norfolk harbor, that is, at Lamberts Point and at Newport News, two of the biggest plants are being constructed for the Norfolk and Western Railroad and the Chesapeake and Ohio Railroad. The piers in both cases will have a length of 1,200 feet. They will be operable from both sides. The height above the water in both cases is something over 91 feet. The daily capacity of either will be 600 cars of bituminous coal. Either pier will be equipped with more than 60 chutes. When they are completed, Norfolk harbor will have a total daily capacity of 3,180 cars, making it the second greatest coal harbor on the coast. These plants will operate by means of a car dumper, an elevator, and an incline for the return of empties. The railway car with its load will first be run up a short incline into the cradle of a dumper. The contents will then be dumped into a special dock car. This car will be carried up the elevator to the deck of the dock. It will then move out on the dock by gravity or under its own individual power to the point where it discharges its load into the pockets and chutes of the pier. When empty, the dock car will be returned down a steep incline under the control of its brakes. These two plants will be the leaders of all those operating on the Atlantic seaboard.

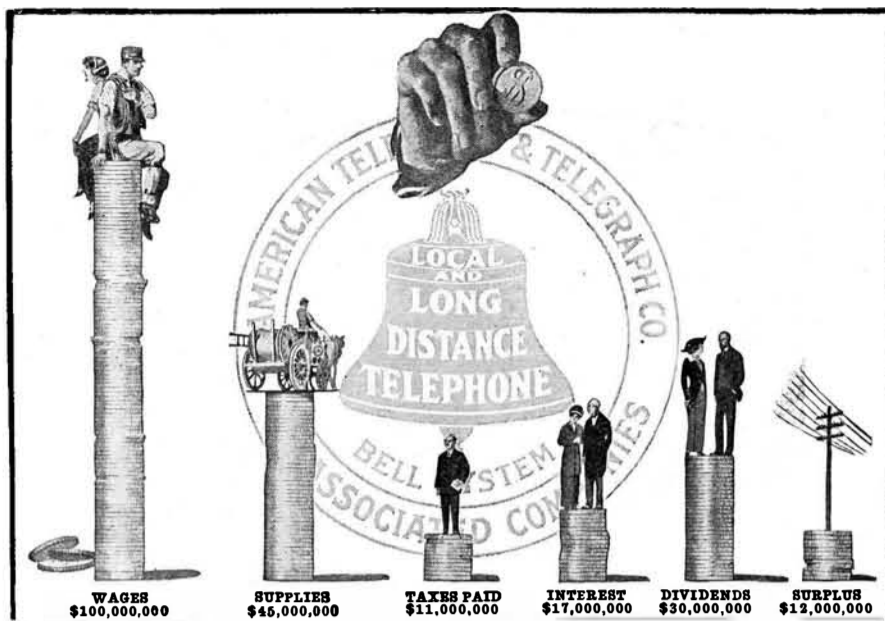
German Artillery in the War

(Concluded from page 116.)

while that on either side is an air reservoir. The recoil brake differs from the type adopted in connection with field guns. The gun is not connected to the brake cylinders, but to the piston rod. Consequently, it is the piston rod and the piston which move in the recoil of the gun, the brake cylinder remaining stationary. The air reservoirs consist essentially of an air cylinder, a ram with piston rod and piston, and valves.

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Searchlights of the German Fleet

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A NEW form of optophone constructed to enable totally blind persons to read ordinary books and newspapers, by means of the ear, has been invented by Dr. E. E. Fournier d'Albe. A perforated disk rotates in front of a Nernst lamp, and produces a bright line consisting of dots giving flashes of different musical frequencies. An image of this line is thrown on the type, which reflects the light upon a selenium bridge. Each letter gives a characteristic sound, which is heard by means of a telephone attached to a Brown telephone relay.

Aeroplane Motor Cars for the Russian Army

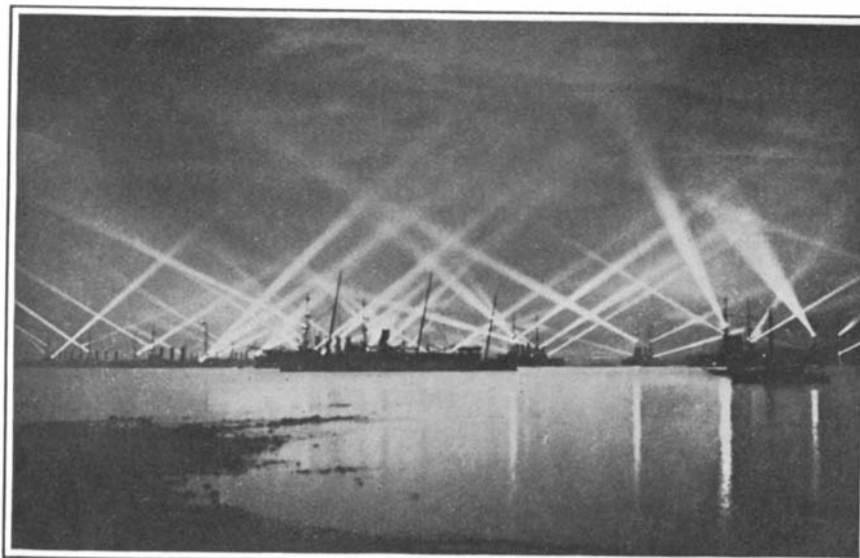
A LARGE number of motor cars, designed to comply with special requirements, were recently supplied to the Russian army by a prominent Swiss firm. These comprise a complete aeroplane squadron, ambulance vehicles and a workshop car. The touring cars of the aeroplane squadron are mainly intended to serve as means of rapid conveyance for the officers, a special feature being that they carry two folding stretchers which, in cases of emergency, are readily lifted into the car from the rear. Each car is designed as a tractor for an aeroplane-carrying trailer, and accordingly is fitted at the rear end of the frame with a spring draw-bar and suspension device for a two-wheeled trailer. In one of our photographs we show an aeroplane motor unit in which the tractor is a motor truck designed for a load of two tons. The wooden arches of the body are designed to be lowered, thus reducing at will the total height of the vehicle, so that it will pass through tunnels when transferred to railway cars. The two-wheeled trailer, as shown in the photograph, is at the front end fitted with four resilient diagonal stays, joined in a pyramid at the point of suspension, so that an entirely safe and elastic connection between the tractor and aeroplane carrier is insured.

The aeroplane carrier contains a number of interesting constructional features. Its dimensions far exceed the usual limits, the bridge body being about 25 feet long by 7 feet wide, and nearly 10 feet in clear height. The aeroplane to be transported can thus be introduced without dismantling anything (apart from the planes). The height of the vehicle can, however, be reduced as required by lowering the wooden arches. The platform rises only to a height of about 16 inches above the ground, thus allowing aeroplanes to be introduced in as simple and convenient a manner as possible. As the suspension device in front of the aeroplane can be removed, aeroplanes can be loaded at will from the front or rear.

Our other photograph shows a transportable repair shop. In view of the constant additions to the automobiles owned by army authorities, a want has been keenly felt for such transportable repair shops allowing any repair work on motor cars or aeroplanes to be done in the field. The very substantial body of the car, which is mounted on a $3\frac{1}{2}$ -ton chassis equipped with a 30 horse-power motor, has a sailcloth roofing. The upper halves of the side and rear walls likewise consist of sailcloth, while the lower halves are substantial planks, which can be folded down to form a platform on which the men can work. The equipment comprises a lathe, drill, band saw, milling

machine, field smithy and anvil, carpenter's bench, etc.

The machinery is designed for hand as well as electric operation by means of a dynamo installed in the car. This dynamo is driven directly from the motor of the chassis through a silent-tooth chain-drive, and can be thrown in and out at will. The total weight



German fleet turning night into day.

of the vehicle, inclusive of its equipment, is about six thousand kilogrammes.

Bureau of Standards Furnace for Testing Building Materials

By Hartley M. Phelps

WHAT is probably the most efficient furnace for the testing of the fire-resisting qualities of building materials ever constructed in this country is being completed by the United States Government at the Pittsburgh, Pa., station of the Bureau of Standards. It is also to be used for load-testing under immense heat. The conditions of the tests will be as near as

of building materials; so it is of the utmost value to Uncle Sam to know just what these materials will stand in the way of wear and tear under all kinds of stress. In the new furnace such commodities as fireproofing and hollow-tile material; gypsum and cement blocks, concrete, metal laths, and other forms of structural substances will be exhaustively tested under various heats. Standards of heat endurance will be ascertained and formulated for all refractories. Such valuable information to contractors and those contemplating building is made available through the bulletins published by the Bureau from time to time.

The furnace is in the form of a parallelogram, and is built of fire-brick, two big piers of solid brick taking up the lower part of the interior. There is an ingenious system of flues, the heat being applied by burners in which natural gas, mixed with compressed air, is burned. One side of the inclosure is open, and here a panel 8 by 6 feet is built up of the material which is to be tested, the panel, held in an iron frame suspended from I-beam travelers, forming in fact the other wall of the furnace. By suspending it the panel may be moved away from the furnace and tested for the action of water, which is sent against it through a hose or several streams.

A feature of the work will be the testing of safes and filing cabinets to see whether papers contained in them are damaged by fire. Any manufacturer may send such objects and have them tested free if such testing is in line with the work being done by the Government.

For the testing of loads under high heat the material to be tested—a column of concrete, cement, etc.—is placed on the brick piers, and on top of the material hydraulic jacks of great power are set. These jacks exert both a downward and an upward pressure, the upper pressure being against a heavy steel beam.

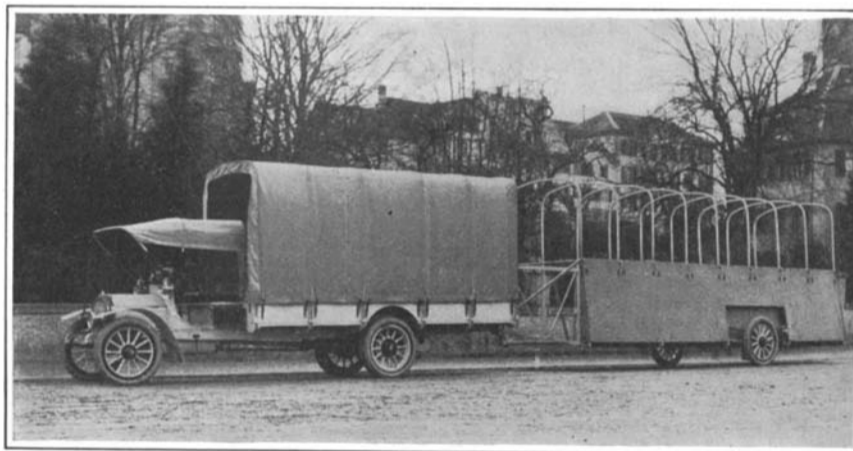
The furnace is to be in charge of Walter A. Hull, expert in testing fire-resisting qualities of building materials. He entered the Government service recently, after wide experience in fire-brick plants in the South and elsewhere. P. H. Bates is head of the Bureau of Standards branch at Pittsburgh.

Schaumann Armor Plate

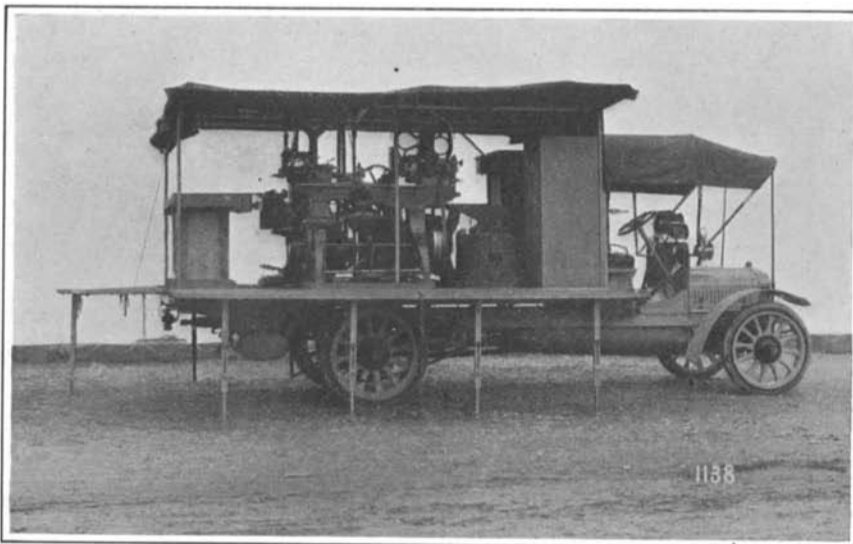
FOR several years the German naval administration has been experimenting with a new type of armor plate, invented by the Koenigsberg engineer, Schaumann, which appears to possess considerable merit. The special advantages claimed for it, in comparison with other armor plate, include diminished cost of production, reduction of weight by one half, and increased power of resistance to projectiles. The Schaumann plate is not homogeneous, but is composed of an outer plate of nickel steel and an inner plate of soft metal, connected with each other at intervals. When the outer plate is struck by a shot, it is not perforated because the inelastic backing prevents it from yielding beyond its elastic limit.

The *Kriegstechnische Zeitschrift* describes experiments in which Schaumann armor plates were repeatedly subjected to the impact of projectiles of the "S" type. These projectiles, fired from a distance of 500 meters, perforate a $3\frac{1}{2}$ -millimeter plate of nickel steel, but produce little effect on a Schaumann compound plate of the same weight, composed of 2 millimeters of nickel steel and 3 millimeters of soft metal.

A Schaumann plate composed of $2\frac{1}{2}$ millimeters of nickel steel and 5 millimeters of soft metal is not perforated even when the range is shortened to 75 meters. Schaumann plates are particularly well adapted for army use, as they are light enough to be used in the construction of shields for machine guns, and even perhaps for rifles, as well as for field pieces. The shields now used for field pieces are 3 to 5 millimeters thick and weigh 50 to 60 kilogrammes, and a reduction of weight is desirable in the interest of portability. The Schaumann plates successfully resist infantry fire at very close range, and they will probably afford good protection against shrapnel. The experiments hitherto published were made with plates of small thickness. The superiority for thick armor plates remains to be proven.



Russian aeroplane motor unit, consisting of a two-ton truck and aeroplane trailer.



A motor repair car of the Russian aeroplane corps.

possible those obtaining at a fire, and where streams of water are being played on the heated material. For the housing of the furnace a building of light structural iron framework on which are sheets of corrugated iron for the walls, has been erected; the building and furnace representing a cost of about \$5,000. The Government is a large consumer of all kinds