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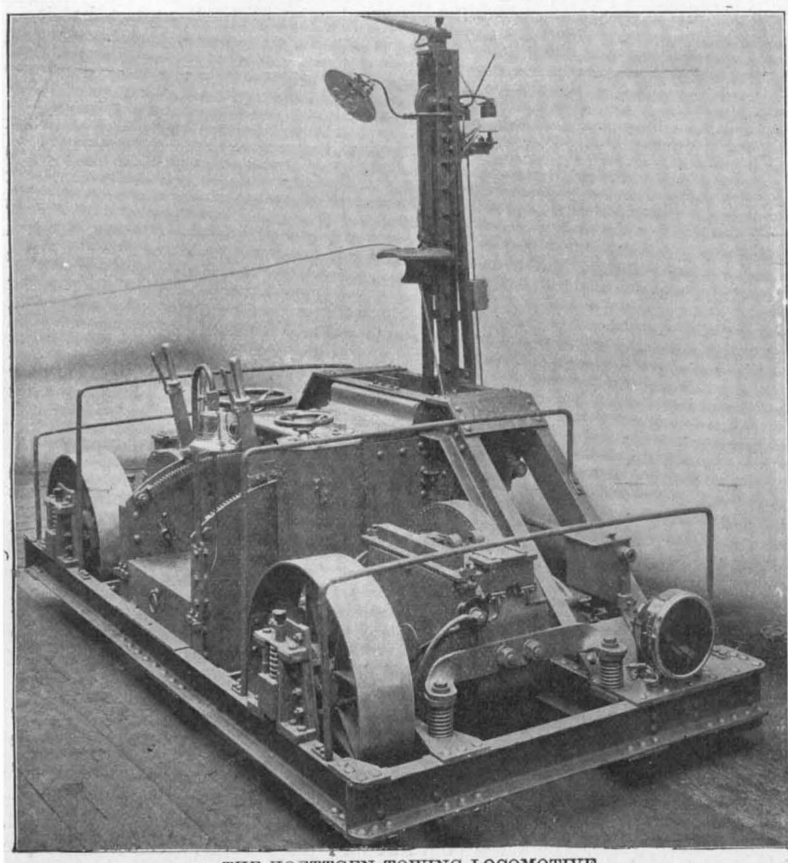
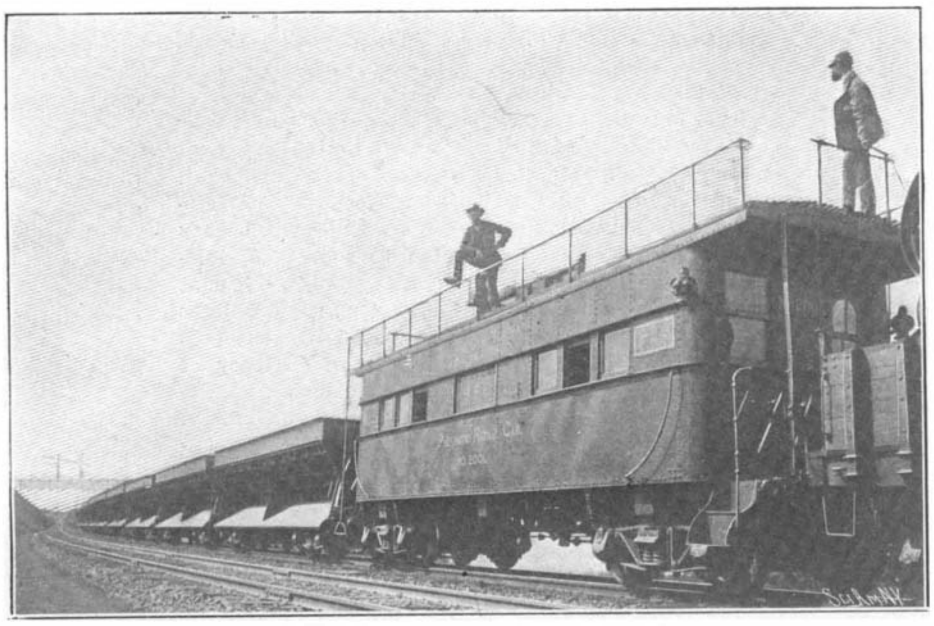


THE KOETTGEN TOWING LOCOMOTIVE.

TOWING BARGES BY ELECTRIC LOCOMOTIVES ON A GERMAN CANAL.—[See page 483.]

of all electric conductors, attention was turned to the open or uncovered wires. The line running from Berlin to Magdeburg, a distance of 93 miles, was selected. The comparison was made between a wire 2 mm. (.078 inch) in diameter and 93 miles long, and another of 3 mm. (.118 inch) in diameter and 111¾ miles long. Fig 2 shows the manner of equipping the former wire with the coils, as well as the double insulator. The coils were placed upon poles 2½ miles apart, and it was found that the assisted smaller wire far surpassed the work performed by the larger wire. In Fig. 3 we show a pole with a number of coils attached. These results prove that in the Pupin inventions, new means are provided for greatly increasing the speaking property of cables. The day may not be so very far in the future before New York and London, Paris, Berlin, Vienna, or St. Petersburg may be telephonically connected, and "Hello London," will be a common expression in Wall Street. The coils necessary to assist a wire are not too large to be placed in the sheathing of a transatlantic cable. Hence such a cable is by no means an impossibility. Such coils, if placed at proper intervals, may not exceed an inch in length with a diameter of half an inch. With the Marconi wireless telegraphic and the Pupin relay telephonic systems in working order, the era of quick and easy communication will have arrived.



A STEEL CABOOSE AND REPAIR CAR.

A STEEL CABOOSE AND REPAIR CAR.

BY GEORGE J. JONES.

With steel cars now coming largely into use, entirely new problems of maintenance and repair are encountered. When a wooden car is wrecked in a collision or other accident, the problem generally presented is that of getting the debris out of the way as soon as possible and to subject the following trains to the least possible delay. But in the case of the steel car the damage sustained is of an entirely different character. With the proper facilities at hand, it is necessary only to replace a few parts, to straighten out a few others, and the car is ready to proceed to its destination.

The Goodwin Car Company has been the first to meet these changed conditions by the construction of a combined caboose and repair car, which is designed to accompany trains of the dumping cars built by that company. Such a car is shown in the accompanying cut, and was built for the Carnegie Steel Company as part of a train which that concern is now operating in the vicinity of Pittsburg. One of the features of superiority of this car over the caboose of wood is its great strength. It has but two sills, which are of steel and form the backbone of the car, being situated on the line of the draft and pulling strains. The rigidity thus obtained is especially desirable where it is found necessary to make use of pushing engines on mountain grades. One of the most common forms of accident is the result of the collapse of the caboose in these trying circumstances. The sudden application of the brakes at the head of the train on a slight grade has been known more than once to smash the caboose into splinters, killing or maiming the occupants. The steel caboose has already been put to a test of this character in actual practice, and no fault whatever could be found with its behavior. As a repair shop, this car is fitted with the pneumatic tools which are necessary to remedy any ordinary damage that will be encountered on the road, and which are operated from the train-line pressure of the air-brake system. The car parts are all interchangeable, and the repair car is fitted out with duplicate parts. Where it is necessary, it will be a comparatively easy matter to cut out a broken part and substitute a new one. A special tool is provided on the car for doing this work quickly. By means of this tool the rivets are cut out so that new parts can be substituted. With the usual cold chisel and sledge hammer, it would be impossible to accomplish much in difficult places under the car.

The tool in question consists of an ordinary piece of hydraulic piping with a series of cutting teeth on one end, the other end being fitted to the drill ordinarily used with the pneumatic equipment. These teeth being allowed to operate on the head on the rivet, cut it away until it can be driven out with little difficulty.

In the construction of the steel cars, bolts are used instead of rivets on all parts which are most liable to damage while on the road by reason of accident. These parts can then be removed and replaced merely by the use of a monkey wrench, which feature further simplifies the matter of repairs on the road.

The steel caboose also can be used as an observation car, being supplied with a cupola and a railing around the top of the car. From this point the operation of the entire train can be observed. By opening an air-valve at one end of the car, any car or the whole train can be dumped either at the side of the track or in the center. This feature is of great advantage in trestle filling and storage purposes, mineral transportation and for filling work.

The dahlia is a plant prized solely for its bloom, yet were all the Irish potatoes to be destroyed, it is possible that this plant would to some extent replace them. Roasted, the dahlia bulb is wholesome and toothsome and makes a not bad substitute for the potato. When first introduced into Europe, it was not for its flower, but as a vegetable that it was valued. —G. E. M.

ELECTRIC HAULAGE ON CANALS.

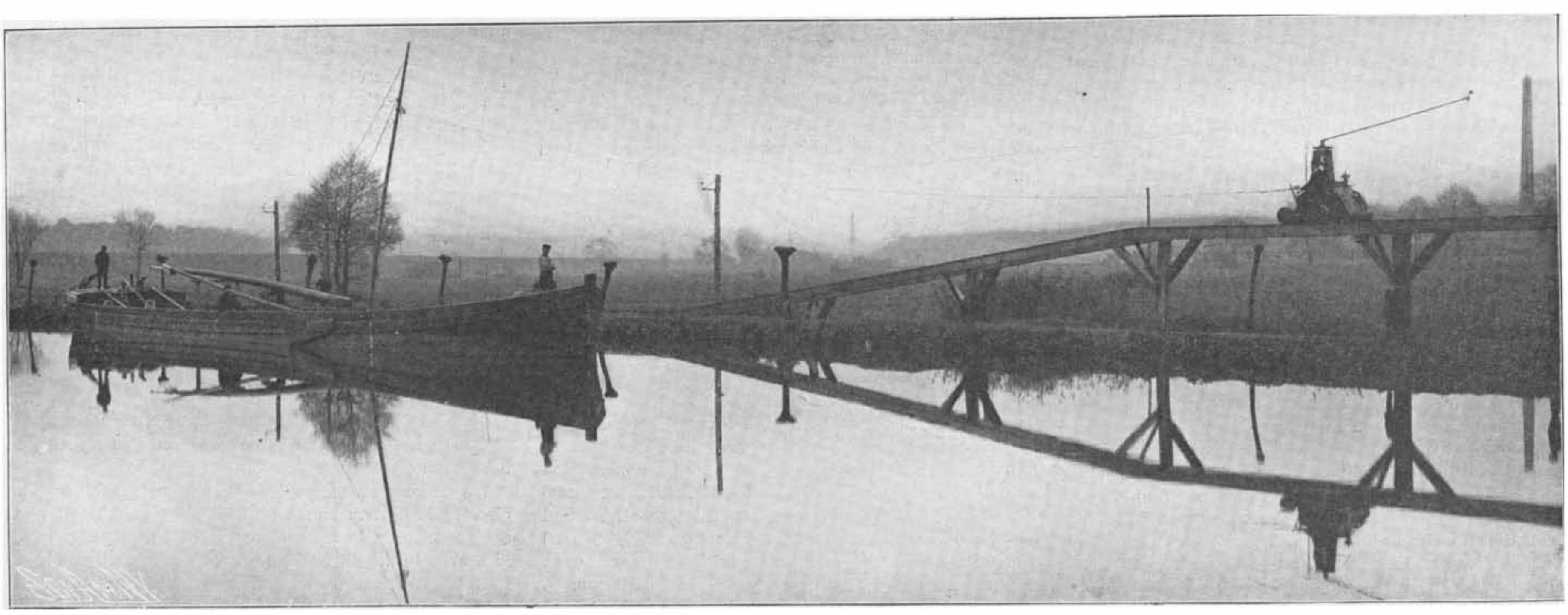
BY FRANK C. PERKINS.

Since the prize competition for an electric canal haulage system to be used on the Teltow Canal, considerable attention has been drawn to what has been done in the same field during the past decade. The Teltow Canal, nearly forty miles in length, it is said, would carry nearly five million tons per annum, connecting as it does the rivers Spree and Havel. The committee in charge of the competition offered prizes of about $3,000 for the best electric system of canal haulage. A score of applicants took part in the competition.

It may be of interest to consider some of the work done in electric canal haulage before going into the details of these tests. In Germany, France, America, and other countries experiments have been made with electric canal haulage systems with varying success during the past ten years or more. Recently it has been seriously questioned whether the railroads would be able to supersede the canals entirely or even compete successfully against them, when electrically equipped, for moderate speed transportation of freight. The general tendency is to enlarge canals to accommodate larger boats. The Erie Canal has been somewhat enlarged and will undoubtedly soon be reconstructed, and equipped for handling immense quantities of freight. The Oder-Spree Canal was enlarged for boats of 450 tons. The Dortmund-Ems Canal boats have a capacity of 750 tons. Large boats are also to be found on the great Mittelland Canal.

Lamb's aerial system was tested in America on the Erie Canal near Buffalo some years ago and on the Finow Canal near Eberswald, Germany. A strong steel cable is used in this system for supporting the motor carriage. The current is received from an overhead trolley wire and travels along the suspended cable. The steel cables are all supported on posts along the bank of the canal. The propelling mechanism consists of a revolving drum which winds itself on and along a second steel cable provided for the purpose. The length of the system installed for this test was somewhat less than half a mile.

The motor used was of about 1 ton weight, 500 volts pressure, and of 5 horse power capacity, while the speed attained was about 13,000 feet per hour, or 3.6 feet per second. On canals of many curves and turns the suspended system of haulage is open to the objection that many supporting posts are required. The weight of the heavy cable is said to be an objection; besides, many engineers contend that the cost of maintenance would be high. One of the advantages claimed for this system is that it leaves the bank free.



TOWING CANALBOATS BY ELECTRIC LOCOMOTIVES (KOETTGEN SYSTEM).

The Koettgen electric canal haulage system employs one rail in some cases and two rails in others where tests have been made as on the Finow Canal. The electrical equipment was supplied by Siemens & Halske of Berlin. The length of track used was about 3,300 feet and an electric locomotive is employed for hauling the canalboats. The single rail is placed farthest from the canal so as to impede other traffic on the canal as little as possible. Two of the locomotive wheels are grooved, are small in diameter, and carry more than three fourths of the weight. These small grooved wheels rest upon the rail. A pair of broad tire wheels, spring suspended, are employed on the side toward the canal, rolling along the tow path, on the ground.

This single-rail locomotive has a 15 horse power electric motor operated at 500 volts pressure, the direct current being supplied from an overhead trolley. This hauling locomotive is said to have made a speed of 5½ miles per hour, the normal speed being about 3 miles per hour. The motor weighs about 4,000 pounds. The locomotive is low, an upright carrying the trolley pole as shown in the accompanying illustrations.

Where two rails were used on the Finow Canal test, with the Koettgen electric locomotive haulage system, a one-meter gage was employed, and the two rails were supported on cement blocks in place of the usual ties employed in track construction. During these tests the locomotive was able to haul three loaded barges with a 700,000-pound load at a speed of 3 miles per hour, also two loaded and two empty barges at the same rate of speed. It has been estimated that with a traffic of 10,000,000 tons per year the cost with this electric system would be 0.0029 cent per ton-mile, and with 3,000,000 tons per year, 0.0038 cent per ton-mile, while with steam power under like conditions the cost would be 0.0042 cent and 0.0058 cent respectively.

The English aerial electrical canal haulage system, devised by Thwaite & Cawley, provided a method which would not interfere with the use of horses and was designed to prevent the waste of energy incurred with a screw propeller. The aerial railway provided in this system consists of two steel rails of channel section braced together at one side to form a rigid girder. These were supported about 10 feet above the tow path by cast iron brackets or by wooden posts placed about 30 feet apart. Each of these rails was used for supporting electric locomotives of small size having four wheels. Two of the wheels were operated on the upper surface and two pressed upward against the lower surface, the motive power being supplied by an electric motor geared to the four axles by worm gearing, running in oil. A direct-current series-wound motor was used, the tractive force required for towing a barge of 100 tons at 2½ miles per hour being estimated at 250 to 300 pounds. The small locomotive was controlled from the barge, no operator being required except on the boat. The current required was said to be 15 amperes at 500 volts when starting up to a speed of 4 miles per hour. Mr. A. H. Allen, in reference to this system, gives the following as the cost per ton mile and time occupied in transit with horses and electric power. With horses at 2½ miles per hour and 15 hours as time occupied in transit, 0.077d.; with electric haulage at same rate of speed and 12 hours, 0.032d.; while with electric haulage at 4 miles per hour and time occupied during transit 7½ hours, the cost of same per ton-mile is given as 0.041d. The advantages of the electric haulage system are that the delays in passing are avoided, bridges and tunnels give no difficulty, power can be supplied to private consumers, cost of haulage is reduced, and time of transit as well.

The Galliot system employed on the Burgundy Canal employs an electric tricycle which is operated along the towpath. A 6-kilowatt motor is utilized, which receives the current from a suspended trolley wire, a towrope being used for hauling the barges. The tricycle locomotive weighs 4,000 pounds and tows a number of boats with 700 tons at a speed of 1¼ miles per hour. The power required is stated as follows by Van der Wallen: With a load of 387 tons at the above speed the power utilized is 3.45 kilowatts; with 186 tons, and a speed of 1.37 miles per hour, 1.8 kilowatts; and with the tricycle alone at a speed of 3.75 miles per hour, 0.9 kilowatt.

The Bougie system of chain haulage has also been tried on the Burgundy Canal. A motor is placed upon the barge, which drives a chain haulage gear, and the current is supplied by means of two trolleys and two trolley wires. With this system the cost is said to be 0.67d. per ton as compared to 0.98d. per ton for steam haulage, the distance being somewhat less than four miles, half of which is in tunnel. The system has been fully described in the SCIENTIFIC AMERICAN.

On the Charleroi Canal to Brussels, which is 50 miles in length, the Gerard system is employed. The power house is located at Oisqueroq, 16½ miles from Brussels. The total engine and boiler equipment has a capacity of 450 horse power, three-phase alternators being operated by the engines with cotton belts. The pressure on the line is 6,000 volts, and the high-tension line as well as a secondary three-phase low-tension conductor are carried on poles, the former being 36 feet from the ground and the latter 18 feet. The pressure of the low-pressure line is 600 volts. Substations are located at intervals of three miles along the canal, in which transformers of 36 kilowatts capacity are installed.

The electric locomotive or tractor is of the four-wheel type, and runs along the towpath without the use of rails. It is supplied with a 5-horse power three-phase motor, which will handle a maximum load of 20 horse power when necessary. This locomotive is about 3½ feet wide, a trifle less than 8 feet long, and weighs about 4,000 pounds. A triple trolley is used, and when meeting other boats, the trolleys are exchanged, or the towropes are exchanged and the tractor returns over the same section. Each tractor runs over a section with five barges, each with loads of 20,000 pounds, the speed being 2½ miles per hour. The current is also sold to factories and other consumers along the canal for light and power service.

In reference to the various systems of electric canal traction, Mr. L. Gerard is authority for the following, calculating the efficiency as the ratio of the power actually developed in the towrope to the electrical power applied. (In Science Abstracts, p. 657, 1901, from Soc. Belge Elect. Bull.) "The Koettgen track system on the Finow Canal showed a maximum efficiency of 0.704 when towing a 100-ton barge at 3.75 kilometers per hour; the tractor working up to 20 e. h. p. at most, with an expenditure of 5¾ e.h.p., running light at 7.5 kilometers per hour. The Denefle tricycle (old form) on the Aire and Deule gave an efficiency of 0.414 when towing a barge of 293 tons at 2.8 kilometers per hour, with a maximum power of 9.3 e. h. p. Running light at 3.74 kilometers per hour, the tricycle took 4.17 h. p. A new pattern of the tricycle gave an efficiency of 0.44 with the same load at 2.64 kilometers per hour. The Gerard tractor gave 0.534 at 3.6 kilometers, towing two 70-ton barges, and took 5.5 h. p. at 4.4 kilometers empty. The Gerard screw propeller system gave an efficiency of 0.322 at 3.2 kilometers, the screw making 375 revolutions per minute when towing two 70-ton barges, and took 5.4 h. p. at 8.2 kilometers empty. This result is compared with steam practice, for which a maximum efficiency of 0.294 is given." Gerard maintains that with electric haulage a large increase in the number of voyages may be obtained over animal haulage, and the electrical distribution of power for dredging, pumping, and other power purposes as well as for lighting should not be disregarded in connection with the electrical system.

The results of the Teltow Canal competition are of particular interest, and refer to the first cost and the working cost per ton-kilometer on a canal 37 miles in length and with one and one-half million tons of freight traffic per year as a basis. The first cost of the Siemens & Halske system was two and one-half million marks, and the working cost per ton-kilometer was given as 1.07 pfennigs; and while the first cost of the Feldmann & Zehme system of electric canal haulage was not given, the working cost per ton kilometer was 0.667 pfennig. The Rudolph system of the Kanaltauerei Gesellschaft is given as 2,597,000 marks, and the working cost 0.61 pfennig per ton kilometer; while the system having the lowest first cost as well as the lowest working cost was that of Ganz & Co., of Budapest, Austria-Hungary. The working cost was 0.43 pfennig per ton-kilometer, and the total first cost only about seven thousand marks over one million marks, or less than half of the first cost of the other systems above mentioned.

The Kite Principle in Aerial Navigation.

BY GARRETT P. SERVISS, JR.

When the problem of aerial navigation, with machines heavier than the air, and supported by mechanical means, was finally put upon a firm scientific basis by the experiments of Tatin, Langley, and others, it became evident that man was physically incapable of supporting himself in the air by his own exertions.

Attention was then directed toward the perfection of light motive powers, until at the present day, thanks to the wide popularity of the air-cooled gasoline automobile engine, experimenters may obtain on the market engines perfectly suited to the requirements of aerial machines.

Up to within a few years, however, the would-be inventors of flying machines have devoted the greater part of their ingenuity to the propelling features of their usually fantastic creations, and have neglected the problem of maintaining stability. The few machines which have passed the speculative stage, and have been experimented with, have invariably proved wofully deficient in the ability to keep on an even keel in any except the most steady air conditions.

It seems, however, that this problem has remained unsolved so long simply because of this lack of attention to the mechanical principles involved, and not to the difficulty of the problem itself. The kite has been showing inventors the way to secure stability for centuries, but apparently its lesson has been unheeded, as there has never, to the writer's knowledge, been a machine constructed which was even designed to maintain equilibrium on the principle which keeps the kite on an even keel. Let us see what this principle is, and how inventors have neglected it heretofore.

A kite is acted upon by only two forces, one passing through the center of pressure of the aeroplane surface and normal to it, the other acting at the point of attachment of the string and in a direction tangent to the string at this point. If the wind shifts, the kite veers around, always facing the wind and keeping the horizontal component of the string force in line with the wind. It is to this veering of the kite, which results in its always presenting the same edge of its plane to the wind, that we must attribute its stability.

Nearly every aëroplane machine ever designed or built has consisted, besides its particular arrangement of supporting surfaces, of one or two air propellers with their axes *fixed* in a direction to drive the machine ahead, and an arrangement of horizontal and vertical rudders.

How far this arrangement differs in its action from the kite under a shifting wind becomes evident upon a moment's consideration. Suppose such a machine to be facing a wind, and suppose this wind suddenly to shift in direction. It is evident that the machine will not now be in equilibrium, and in order to re-establish its stability it will be necessary to instantly face it around, so that it again presents the front edge of its plane normal to the wind. That this could not be done by any form of rudder is evident, since the turning movement which a rudder is capable of producing depends entirely upon the relative motion of the rudder and the medium in which it acts, and when this medium is the air, shifting its direction of motion continually, it is easily seen that the rudder would prove very untrustworthy.

Let us now see if we cannot design an aeroplane arrangement which, while carrying its own motive power, will perform automatically the exact evolutions of the kite in a variable wind.

To begin with, assume that we have constructed an arrangement of supporting planes, which we know by its similarity to the kite design will fly successfully when a cord is attached to it in a given manner. The problem is then reduced to that of replacing the cord force by the two forces with which we must deal in the practical machine, i. e., the weight of the machinery and occupants, and the pull of the propeller. If we so arrange the machine that both of these forces are applied at the point of attachment of the cord, the weight of the body, machinery, etc., furnishing the vertical component, and the pull of the propeller the horizontal component, their resultant will be a force directed downward and inclined forward exactly like the pull of the cord.

If now the propeller is mounted upon a shaft with a universal joint, the vertical plane in which this resultant acts may be shifted around as we please. The kite, it will be remembered, veers around so as to bring this plane parallel to the direction of the wind; and in our machine, if we shift the axis of the propeller so as to bring it nearer to the new wind direction, it is evident that the machine will veer around exactly as the kite does.

It only remains then to make this shifting of the propeller automatic, and this can easily be done by an arrangement like a weather vane, which, in always pointing at the wind, carries the propeller with it—an arrangement which is used in some wind mills.

If the machine is in motion, the action is just the same as above described, except that by wind we then mean the motion of the air with relation to the machine and not with relation to the earth.

There is one more point worth taking up in this connection, and that is in regard to the amount of the two forces acting on the kite. A change in the strength of the wind acting upon a kite is of course instantly met by a corresponding change in the pull of the string. In the proposed machine this equality might not be secured instantly. But this is of no consequence, since a change in amount of one of two forces holding a body in stable equilibrium cannot destroy this equilibrium, but will simply produce an accelerated translation in the line of the forces.

In the above discussion the word *aeroplane* is not intended to be confined in its meaning to mathematical planes, but includes curved surfaces sometimes called aerocurves.

We have not attempted to analyze stability and classify it as transverse and longitudinal stability, as such reasoning is mere straw splitting, when the kite is stable in its flight and we are apparently able to imitate its action perfectly in a practical machine.

That a machine built on the lines suggested would prove stable in full flight can hardly be doubted; but it is not claimed that such a machine would completely solve the problem of aerial navigation, since there are two more problems confronting the inventor, that of starting up from the ground and that of alighting safely. These problems do not readily lend themselves to a theoretical solution, and will probably have to be worked out by practice with an actual machine.

That these problems increase in difficulty with the size and unwieldiness of the machine is certain; and it seems that success is most certain to follow experiments with a small apparatus built to carry one man. Furthermore, we know that nature has never constructed flying creatures weighing over about forty pounds; and although the reasons for this limit are not perfectly obvious, yet the fact in itself must carry some weight.

With engines developing more power per unit of weight than any animal, and with high-grade steels capable of withstanding greater unit stresses per pound of weight than any organic material, it seems that we ought certainly to be able to raise this limit of weight until it includes one man and his machine, and perhaps eventually to construct machines of far greater capacity.

New Ethnic Type Found in Menton Grotto.

The grottoes of Baoussé-Roussé, near Menton, are now being explored for prehistoric remains under the direction of the Prince of Monaco. M. de Villeneuve has been carrying on the excavations, which have yielded some interesting finds, especially of fossil human remains. The chief discovery so far has been a human fossil of a new type. The Grotto des Enfants, where the work has been carried on, yielded two skeletons in 1874-5 which are now at Paris, but less than 10 feet of depth was then explored. M. de Villeneuve has gone down to 30 feet before reaching the rock which constitutes the primitive soil. At 21 feet he found a complete skeleton, and 2 feet lower the last burial place, containing two bodies. Among the fauna are the eland, two deer, one of which is of large size (*Cervus canadensis*), bovidæ, equidæ, and others. The most interesting animal is no doubt the *Hyæna spelæa*, whose bones have been found below three human skeletons at about 20 feet depth. Implements and utensils have been found in considerable numbers. Quite at the bottom were rough implements of limestone and pebble, more rarely in flint. According to M. Cartailhac, who assisted in the work, the lower skeletons should be classed as palæolithic, and have a considerable value. The subject found at 21 feet is a man of great height, 6 feet 4 inches, stretched out on a layer of cinders, charcoal, bones, etc., more or less burned, which constituted the seventh habitation. His feet had been protected by stones and a large block, which, in falling, crushed the head, was no doubt destined to protect the latter. The skull has been reconstructed; the facial part is very low and well developed in length. This individual has the characteristics of the race known as Cro-Magnon. Two skeletons were found which present great interest, as they are of the negroid type. These were buried in the eighth habitation. A small ditch was dug to receive them and a kind of trilith formed of two vertical stones and one horizontal covered the two heads. One is an old woman who lies flatwise with the members strongly folded up, while the second is a young man approaching adult age, lying on the back, and his members are also folded. These skeletons are alike in characteristics and represent an ethnic type which has not as yet been encountered in the quaternary layers. They are of small size (the woman 5 feet 5 inches, the man 5 feet 2 inches) and not very robust. The most curious fact is that the facial part of the skull presents a strongly-marked negro type in the lower portions. The nose is somewhat wide and there exists a sub-nasal prognathism as well defined as in the present negroes of Senegal or other regions, and in consequence, a retreating chin. It is thus a striking fact that individuals of the negroid type have been encountered in this locality at a depth of 23 feet.

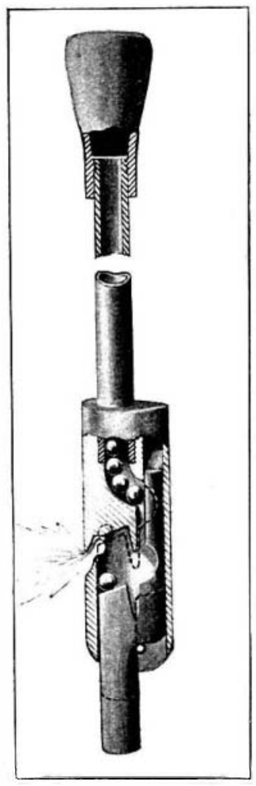
The Current Supplement.

The current SUPPLEMENT, No. 1434, contains a wide variety of instructive articles. Harold J. Shepstone gives an excellent description of the new harbor works at Dover, illustrating what he has to say by many clear pictures. George J. Burch tells something of a new capillary electrometer. Sir Oliver Lodge concludes his discussion on electrons. "Painting by the Acre" is the title of an entertaining article which tells how the great transatlantic liners are kept in trim, and gives one some idea of the difficulty of counteracting the effects of the sea water on ocean steamships. Ever since it was discovered how water could be electrically decomposed, inventors have sought to make use of the discovery for the purpose of utilizing the oxygen and hydrogen liberated. Emile Guarini describes the Garuti process for attaining this result. Prof. Arthur W. Goodspeed's remarkable discovery of new emanations from apparently inactive bodies is fully discussed in a paper from his own pen. Profs. Henri Moissan and James Dewar outline certain experiments on chemical affinity at low temperatures as determined by the reaction of liquid fluorine. Edmund Ledger reviews our present information of the much-discussed canals of Mars.

The largest ferryboat in the world was launched May 23 at the Schichau Shipbuilding Works, at Stettin. The boat is designed to carry whole trains over the Baltic Sea between Warnemuende and Gjedser, providing direct communication with Copenhagen.

A SAFETY MAGAZINE TORPEDO CANE.

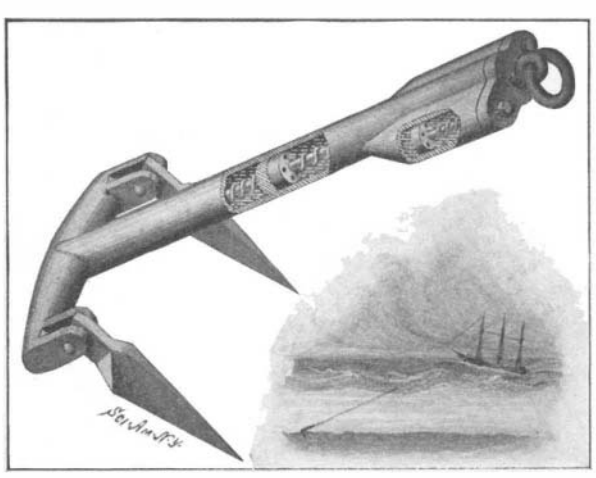
With our national holiday only a week off, the patent just granted to Mr. John H. Rese, of Alleghany, Pa., is of timely interest. The patent covers the invention of a magazine torpedo cane arranged to positively feed the torpedoes out of the magazine and safely explode them in a casing which is so arranged that the flames or burnt products of the exploded charge will be prevented from returning to the magazine and exploding its contents. As shown in our illustration, the main rod of the cane is hollow, and serves as a magazine in which the torpedoes may be stored. At the lower end of the cane a casing is secured, in which a plunger is adapted to slide. The plunger is provided with a recess, which registers with the lower end of the magazine when the plunger is forced up to the position illustrated in dotted lines. The recess is of such size as to receive only one torpedo at a time, which is carried down with the plunger when the latter drops to the normal position, and is permitted to roll out into the explosion chamber. Now, on striking the end of the cane on the ground, the plunger is forced upward into the casing, exploding the torpedo by crushing it against the upper wall of the chamber. The fumes and burnt products of the explosion are blown out through the opening at the side of the chamber, being prevented from passing up to the magazine by a tongue which projects down into a slot in the plunger. At the same time the recess in the plunger is brought into position to receive another torpedo from the magazine. On lifting up the cane, the plunger drops by gravity, carrying this torpedo down to the explosion chamber, where it is exploded on the next blow. The process may be repeated as often as desired, or until the magazine is entirely exhausted.



A SAFETY TORPEDO CANE.

ANCHOR WITH YIELDING CHAIN CONNECTION.

In order to prevent the breaking of anchor chains by sudden shocks or pulls due to the motion of vessels while at anchor, Mr. William A. Duncanson, of Falmouth, Nova Scotia, has invented an anchor having a yielding connection with the chain. The shank of the anchor is tubular, and movable within the shank is a rod to the outer end of which the anchor chain is secured. The hollow shank is divided into two chambers by a center partition. Through this the rod passes and is provided with two perforated pistons, one above the partition and the other at the lower end of the rod. The chambers are filled with oil or similar material not subject to freezing. A crosshead secured to the rod at its outer end is provided with two auxiliary pistons, which operate in cylinders at opposite sides of the main tube. The pistons are normally



ANCHOR WITH YIELDING CHAIN CONNECTION.

held in the positions illustrated by coil springs on the piston rods. In operation the pistons are drawn out by any abnormal pull on the anchor chains. The shock of a sudden pull, however, is absorbed by the cushion of oil against which the pistons are drawn. By perforating the pistons the bearings thereon will be relieved to some extent, for the liquid will pass through these perforations as the pistons move upward. The auxiliary pistons and springs serve to check the continuous draft on the main pistons and springs, that is, when the auxiliary devices are completely compressed, the main devices will not be fully compressed, so that a complete elastic cushion is obtained. The springs on the piston rods serve to restore the pistons to their normal positions upon the slackening of the anchor chain.

Engineering Notes.

The first British use of the Hall signaling apparatus is to be carried out upon the North-Eastern Railroad of Great Britain. Hitherto this system has been tested experimentally only in this country. The section of track upon which the apparatus is to be installed is between Alne and Thirsk, a distance of about 11 miles. In the Hall signaling system the normal position of the semaphore is horizontal, indicating "danger." By means of an electrical appliance fixed to the track the train as it approaches the semaphore lowers the arm of the latter, provided the section in front be clear; but should there still be any wheels on the rails of the section, this operation is automatically rendered impossible. It is proposed to equip the installation with Raven's patent fog-signaling apparatus, and to work the semaphore arms by compressed carbonic acid gas. Each signal post will have a cylinder of gas stored at its base, and the gas is to be conveyed to the semaphore arms by means of an electric device. Should this installation prove reliable and efficient upon this section, it is to be extended throughout the whole system.

The work of towing off the large floating dock for Durban, which was wrecked on the rocks at Mossel Bay, South Africa, during a storm, while on the way out, has proved more difficult than was anticipated, owing to the difficulty in obtaining hawsers sufficiently strong to stand the tremendous strains that have to be exerted. The authorities engaged in salving the structure also found that there was no large vessel sufficiently powerful to accomplish this work, and the battleship "Monarch" was requisitioned for the purpose. By this means the dock was hauled 100 feet seaward, but at this critical point the hawser parted. A fresh hawser specially for the purpose has now been ordered from England. It is to be 3,120 feet in length, consisting of 720 feet of 18-inch Manila cable, with 1,200 feet of 7½-inch steel wire at each end. The dock only requires power and an unbreakable hawser to refloat her, and it is considered that the damage will not be so severe as was at first supposed.

In a recent number of Cassier's Magazine may be found an interesting discussion of the modern use of suspension bridges. From time to time the statement is made that suspension bridges are things of the past, and that cantilever and other structures have superseded them. As an instance a correspondent of one of the New York daily papers recently maintained that "when the problem of really consolidating the city of New York with its great neighboring cities, to the east and west, is really taken in hand, it will not be solved by suspension bridges, typical of the engineering of the early years of the last century, but rather by tunnels or by great steel tubular and girder structures, which will link the railroad systems, as well as the thoroughfares of the cities." As to this, however, it is proper to point out that the old form of suspension bridge is an antiquated, superseded structure in only the same way that all old designs are antiquated and superseded. It is not the principle that is wrong; it is that the details are behind the modern methods of construction. To eliminate the suspension bridge from modern work would be to deprive engineers of a form of construction which has special adaptations and which modern science cannot afford to give up.

A contemporary remarks that a recent computation has placed the total aggregate power of steam turbines in use or under construction or ordered in different parts of the world at over 500,000 horse power. Of this total the major portion is used or to be used for the driving of dynamos, alternators or other electrical machinery, while the next in point of power consumption is marine engines. An item in point is the contract recently given to the British Westinghouse Electric and Manufacturing Company, Ltd., by the Metropolitan District Railway Company, of London, England, for four turbo-alternators. Each of these machines is designed for a normal capacity of 5,500 kilowatts, but will be capable of carrying an overload of 50 per cent, giving for each unit a maximum output of 8,250 kilowatts, or about 11,000 E. horse power. These turbines will be not only the largest steam turbines ever made, but also the most powerful single cylinder engines of any type whatever in the world. Very few multiple cylinder engines existent have greater power. Notwithstanding the enormous power they will develop, the dimensions of these engines are only 29 feet in length by 14 feet wide, by 12 feet high, the overall length of turbine and alternator being 51 feet 9 inches. The steam pressure will be 165 pounds per square inch, and the speed 1,000 r. p. m.