tographs. M. Fournier arrived at Aix-la-Chapelle at two minutes past 12 o'clock, his time being 8 hours, 28 minutes and 3 seconds.

The day was marked by many accidents. On the way a child ran in front of one of the carriages and was instantly killed. The carriage of Foxhall Keene, the only American competitor, was overturned, but fortunately he was not injured. The next day the start was made from Hanover at 5 o'clock in the morning. Eighty carriages took part, starting in the same order that they arrived at Aix-la-Chapelle. M. Fournier arrived at Hanover at 2.13 P. M. in clouds of dust, having covered 276 miles in 9 hours, 7 minutes and 39 seconds. The correspondents who saw M. Fournier start from Hanover at 5.15 the next morning took a special train to Berlin, and when they arrived there they found the country roads lined with people. The enthusiasm at the West End race course, Berlin, at 11.46 A. M., when Fournier arrived, was almost beyond bounds. His friends broke through the line of troops, surrounded the car and cheered him loudly. The band played the "Marseillaise," and the Germans carried him on their shoulders to the judges' stand and thence to the prize platform, which, like the winning post, was decorated with both French and German flags. The other racers came in soon after, M. Girardot arriving second. Mme. du Gast came in at 4 o'clock. M. Fournier had eleven punctures in the tires of his vehicle, which prevented him from making a better record.

It may well be asked if the limit of speed in racing vehicles has been reached. It is not likely that it has, but the safe limit has been attained, and the higher the speed the more liable are the tires to destruction through excessive side strains in taking corners, in addition to the liability of puncture. Speed does not, therefore, depend entirely upon the motors; the tire is a factor of equal importance. It is almost impossible for even a trained chauffeur to carry on such sustained high speeds for days without physical collapse, the nervous strain being intense. Many of the French drivers in the recent race are still suffering from the results of the sport. The race, however, is intended to further the automobile movement all over the world by creating a great interest in it among the public, so that even though the technical lessons of the recent contest may not be very great, the net result must be gratifying.

THE CONQUEST OF THE AIR.

The navigation of the air has at last been achieved by a young Brazilian, M. Santos-Dumont, who has succeeded in driving his aerial ship a distance of ten miles in forty-one minutes, and performed evolutions which showed that he had the vessel under complete control during the trial, which was of course under favorable atmospheric conditions. His machine is by no means perfect, and there are some weak points to be strengthened, but within a month it is thought these defects will, to a great extent, be overcome. A number of inventors have been working along somewhat similar lines, so that M. Santos-Dumont has been very active, especially in view of the prize offered by M. Deutsch of 100,000 francs for a successful balloon trip from St. Cloud around the Eiffel Tower and return.

M. Santos-Dumont was born in Brazil in 1873 and early became interested in aeronautics. He soon abandoned spherical for cylindrical balloons, and the present is the fifth he has constructed. The balloon

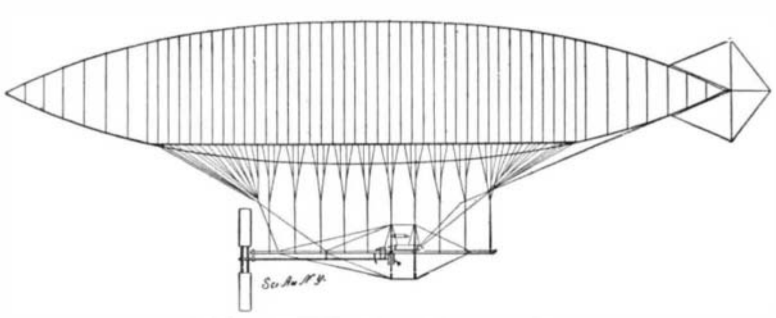
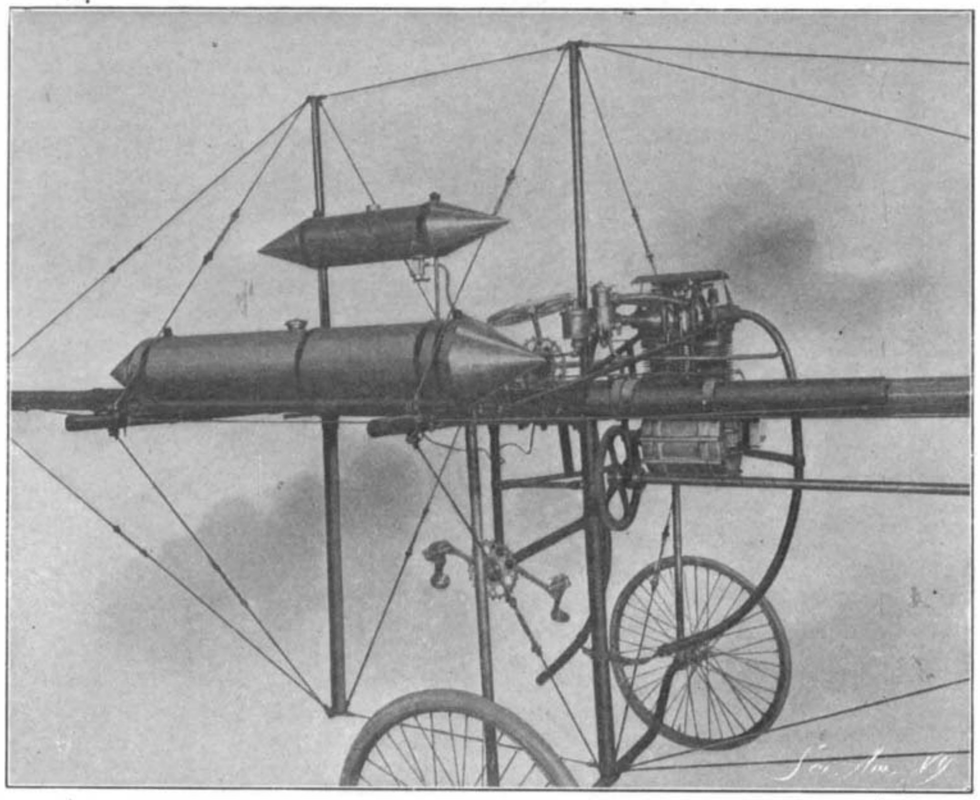


Diagram of the Santos-Dumont Air Ship.

proper is 111 feet long and 20 feet in diameter. Beneath the balloon, suspended by steel wires, is a cradle 59 feet long, composed of pine poles secured together at the ends. This cradle contains a four-cylinder motor of 16 horse power. Suspended from the center section is a triangular cradle, which carries the screw. The aeronaut sits in a small basket at the opposite end and controls the valves and rudder. Our engravings show the method of propulsion used in a previous

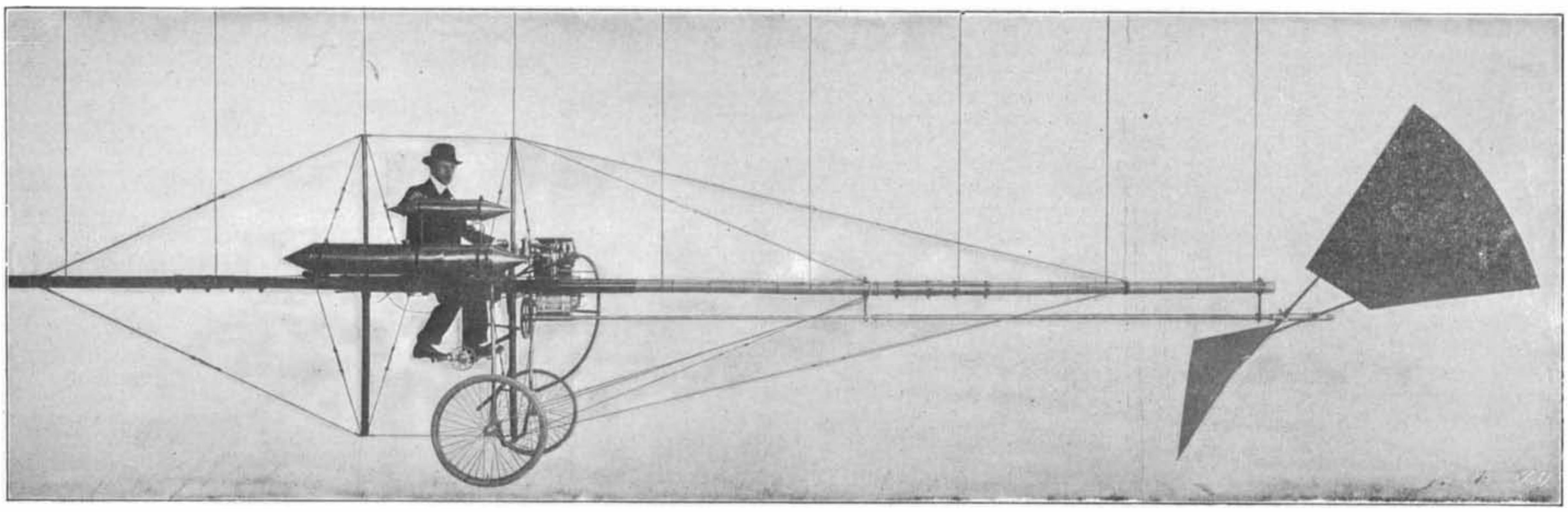


Detail View of Engines, Tanks and Controlling Gear.

experimental air ship. The start was made from the huge shed at St. Cloud, near Paris. At five o'clock in the morning the sliding doors were opened and the huge aerostat with its strange appendages was wheeled out and the motor was given a turn; the ropes were cast off and the balloon began to rise. M. Santos-Dumont threw out handful after handful of sand and the balloon slowly rose higher and higher. It swung around and made directly for the Eiffel Tower. It had no difficulty in rounding the Tower within three hundred feet and the return was then begun. It could not, however, make the balloon-house, the motors not working well, and the entrance to the Parc d'Aerostation being obstructed by some other balloon-sheds where M. Deutsch, the donor of the prize, is having a balloon built. The attempt would probably have been successful if it had not been for the fact that the supply of liquid fuel gave out so that the balloon was left at the mercy of the wind. A quick descent was arranged for and the machine became entangled in a tree. Fortunately it was not injured and M. Santos-Dumont escaped unharmed. In a short time he will make another ascent, and there is little question that he can make the trip in the time required to gain the much-coveted prize—the blue ribbon of aerial navigation.

Experiments Upon the Liquid of the Internal Ear.

In a paper recently read before the Académie des Sciences, M. Marage describes a series of experiments made upon the crystals which are found in the liquid of the internal ear. This liquid contains more or less voluminous crystals which have been called "otoliths." The different hypotheses which have been advanced to explain the acoustic action of these solid bodies seem to be scarcely probable, and in any case are not founded upon experience. The author has undertaken a series of experiments using the liquid obtained from the frog's ear and draws some conclusions as to the character and composition of these crystals. In the case of the frog, the contents of the internal ear have a milky appearance, and it is possible to secure as much as one or two hundredths of a grain. He finds the density to be 2.18, which is a very high figure. As to its composition, it is a solution of carbonate of lime and of magnesia in a liquid charged with carbonic acid. In contact with the air the carbonic acid gas disengages very rapidly, and it is easy to detect its presence. The liquid itself is very volatile; under the microscope it is seen as an oily substance which condenses in drops. It has been impossible to collect a sufficient quantity to determine its composition. The crystals which remain are formed of carbonate of lime and very small quantities of carbonate of magnesia. The most voluminous of these crystals are about the same size as a blood corpuscle (32 μ); the others, representing about 98 per cent, are much smaller and there are a great number which are scarcely visible with a magnifying power of 450 diameters. These otoliths are soluble in water charged with carbonic acid gas and can be made to reappear upon evaporation. The contents of the internal ear are thus seen to be formed of a solution of bicarbonate of lime and of magnesia with crystals in excess of insoluble carbonates. The great density of this mixture makes it an admirable conductor of sound. The existence of the crystals may also be made manifest in the living animal; the author has made radiographs of a frog under suitable conditions, and the presence of the otoliths has been revealed by a small round spot on each side of the head. To sum up, M. Marage comes



General View of the Suspended Truss, Showing the Aluminium Propeller.

THE EXPERIMENTAL MACHINE OF M. SANTOS-DUMONT, WHO APPEARS TO HAVE SOLVED THE PROBLEM OF AERIAL NAVIGATION.

to the conclusion that the liquid consists of a solution, in a liquid of undetermined nature, of bicarbonate of lime and traces of bicarbonate of magnesia with crystals of carbonates in excess, and that one of the functions of the otoliths is to maintain as nearly constant as possible the acoustic conductibility of the medium. He intends to continue his researches upon the ear of mammiferes and the human ear.

Liquid Expansion Motors.

Dr. O. Zimmermann, of Ludwigshafen, on the Rhine, proposes to construct motors on a principle which, if not novel, has at any rate not been applied with success so far, namely, on the dilatation of heated liquids, says Engineering. Between the temperature limits of its freezing and boiling points, water expands by 4.3 per cent. Considerably larger expansions result when we raise the temperature further, or when we apply other liquids like ether or sulphurous acid. The direct utilization of this expansion is, however, unprofitable on account of the high specific heat of water. Dr. Zimmermann overcomes this difficulty by arranging his caloric engine on the counter-current plan. Imagine two cylinders in tandem, the one heated, the other cooled; we call the cylinders *W* and *C*. They are connected on the sides, facing one another, by a system of pipes; their pistons *p w* and *p c* are perforated, and also connected by tubes, these latter passing through the first-mentioned tubes. If we call the space confined between the two pistons, the inner space, and that on their external surfaces the outer space, then, at a certain position of the two pistons, which are balanced and move in unison, the liquid in the inner space will be warm, and that in the outer space will be cold. If we shift the pistons, warm water will pass from *W* to *C*, and cold from *C* to *W;* the inner volume will be cooled, and the outer be heated. If we fit on *W* a kind of steam chest containing a piston *a* and communicating by ports with the inner and outer space of *W*, then the expansion of the outer volume and the contraction of the inner volume, consequent upon the heating and cooling respectively, must be equalized by a motion of the piston *a*. This piston can hence do work. In practice, the pistons *p c* and *p w* are whole and only connected by their common rod, the concentric tube system lying outside in a special cylinder which communicates by two ports with the outer and inner spaces. If we make the area of piston *p w* larger than that of *p c*, we can dispense with the special pressure cylinder, and can attach the continued piston-rods *p w c*, direct to the crank to be driven. In any case, it will be advisable to transform the rigid pressure of the liquid into an elastic pressure, and thus to combine the engine with one or more air chambers. When we heat *W* to the desired degree, and admit a certain quantity of air into the air chamber, the engine can work under any constant desired pressure. High pressures will be advantageous, because the higher the temperature, the greater the expansion coefficients, and for such motors the pistons will suitably be replaced by plungers. Dr. Zimmermann explains his views in a pamphlet which the firm of R. Oldenbourg, of Munich, has published; and he points out how hydraulic lifts, pumping engines, and even marine engines, might be constructed on this plan, for which he has secured a German patent. The heat-exchanger vessels—several may be wanted—with their two systems of tubes, would not require any awkward dimensions. But how a caloric motor of this novel type would really work between temperature limits of 20 deg. and 100 deg. or 200 deg. C., can only be ascertained by experiments, conducted on a large scale.

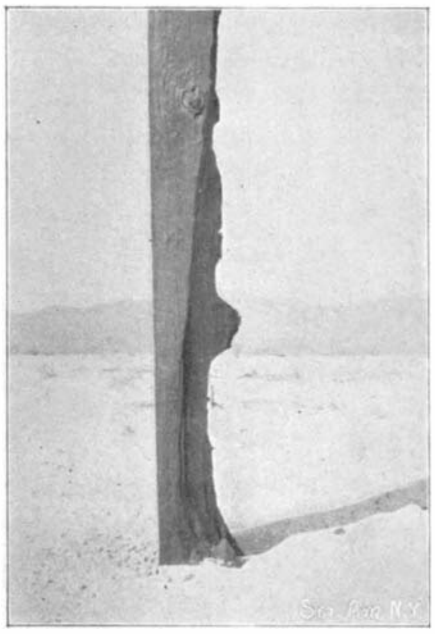
Big Rush for Automobile Patents.

By all odds the automobile section is the busiest of all the divisions of the Patent Office these days. Since all the fashionable world has taken to automobiling, and this sport is no longer a fad, the inventors of the country seem to have turned their attention to bringing out improvements in motors, carriages and other parts. The number of applications that are being received for patents on devices for automobiles is so great that it has been found necessary to have five special examiners on this work. Four separate divisions have been organized to which are referred patent papers, according to the specific kind of patent that is demanded. One division handles electric motors, another steam motors, another gas and acetylene motors and another looks out for the compressed-air motors. It is very seldom that the rush of business for a certain division is so great as to cause an increase in the number of special examiners or to bring about the establishment of additional divisions. One special examiner is ordinarily able to take care of all applications relating to one branch of work. The only record there is of a greater volume of work coming to one division than now falls to the lot of the automobile bureau, occurred some years ago at the time the bicycling craze was at its height. There was such a deluge of claims for patents on wheels, chains, bearings, handles and the other parts of a bicycle, that ten special examiners were detailed to help out the chief of the division. These cases have dwindled down since, until now only two men are required in the bicycle division. The electrical division is pushing the automobile section for first honors in the matter of work. There has been a marked increase in the development of the electrical science in the past five years, and this is shown in the Patent Office to a greater degree than anywhere else.—The American Automobile.

A NATURAL SAND BLAST.

BY JAMES M'ILHENNY.

The writer made a prospecting trip of two months on the Mojave and California deserts in southern California, and returned to Redlands from the latter desert by way of the San Gorgonia Pass. The small railroad town of Beaumont is at the summit of the pass at an elevation of 2,560 feet, from which in each direction the Southern Pacific Railroad descends heavy grades—on the west to Colton and southeasterly to Salton, the latter being 263 feet below sea level. North



ERODED TELEGRAPH POLE.

SAND DRIFTS AT RIMLON, CAL.

and south of Beaumont are the peaks of San Gorgonia and San Jacinto, averaging about 12,000 feet above sea level, and between these giant portals there blow at certain seasons of the year violent winds which pick up the sandy soil of the desert and use it as a sand blast to erode anything of a softer nature than itself.

The first illustration shows the lower six feet of a redwood telegraph pole, which has been cut half in two by the sand. The projection part way up is a knot which resisted the sand by reason of its tougher grain. Broken bottles or crockery which have been thrown from passing trains have the part which projects from the sand ground perfectly smooth. Where a bush or other object offers any resistance to the wind, there is piled behind it a drift of pure white sand in the same manner a drift of snow is formed behind a fence or haystack. The second cut shows the sand drifts behind the section house at Rimlon, near which the photograph of the telegraph pole was obtained. It was in the early part of June that these pictures were taken, and the maximum temperature for that day, in the shade, was 114 deg.

It is supposed that these winds are caused by the difference in radiation between the sand of the desert and the more fertile soil of the valleys that slope to the Pacific Ocean. The almost total lack of humidity in the desert air favors a free radiation each night of the heat that has been accumulated by the sand the previous day, and the same dryness causes a rapid rise of the thermometer as soon as the sun is up. The expansion of the air from contact with the hot sand causes it to rise and draw from the cooler valleys that lie to the west a supply to take its place. San Gorgonia and San Jacinto peaks being separated only by a narrow valley, form a funnel for concentrating the wind and make what might be called the largest sand blast in the world, as the dust and sand-filled air frequently covers a stretch of territory five miles wide by twenty long.

Caspian-Black Sea Canal.

Consul Hughes, of Coburg, informs the Department of State that a canal to unite the Caspian and Black seas is under consideration. The projected waterway will be 22 feet deep and about 150 feet broad; will begin at Astrakhan, on the Caspian, and end at the harbor of Taganrog, on the Sea of Azof. It is estimated that the cost will be about 40,000,000 rubles ($20,600,000). The center of Russian trade and manufacture, adds the consul, is gradually shifting southward, where the production of iron, coal, and petroleum is rapidly increasing. The metallurgical industries and the trade in cotton from middle Asia are also being largely developed. The railroads at times prove insufficient carriers, and the construction of other roads and the digging of this canal will be necessary in the near future to meet the growing demands of commerce.

The Fate of Von Zeppelin's Balloon.

On several occasions we have given an account of Count von Zeppelin's balloon and the experiments which he made with it. We regret to note that the machine has been badly injured. Violent storms which swept over central Europe in January nearly demolished the balloon house and ripped open the aerostat for about a third of its length. The inner framing, which was constructed of aluminium, was also badly twisted, and a large part of it was torn away. The cross pieces were so twisted and bent that some of them were actually broken. Count von Zeppelin intends to carry on his experiments and is repairing the balloon, and has ordered two more Daimler motors of a more powerful and lighter type than before.

Motor Trucks.

Motors for carrying merchandise to various parts of cities are attracting a good deal of attention at the hands of engineers. Recently extended trials of various types were held in Liverpool, and the conditions of competition were exacting. The vehicles were required to have a platform area for goods of from 45 to 75 square feet, according to class, and carry from 1½ to 5 tons load. The wagons varied from 18 to 22 feet in length, had wheel tires from 4 inches to 6 inches in width and made speeds of about five miles per hour loaded. They were driven by steam chiefly, though there were some oil motors. The boilers were mostly of the vertical type, both fire and water-tube systems, and carried 225 to 250 pounds per square inch gage pressure. The engines were beneath the truck platform, and of the horizontal type, having cylinders 3½ inches diameter by 6 inches stroke, compounded to 6¼ inches, and making about 350 to 420 revolutions per minute, geared to various ratios of wheel speed, direct and by chains. The total distance run was about 50 miles, and the several types came through with credit, accidents being very few.

The Current Supplement.

The current SUPPLEMENT, No. 1334, is one of the best numbers ever published. The first page engraving shows Fournier in his racing car during the Paris-Berlin motor carriage race. There are a number of other interesting illustrations showing scenes along the route of the race, and there is also a full list of the vehicles which covered the entire distance. "Abstract of the Statistics of the Railways of the United States for the Year Ending June 30, 1900," gives most valuable and interesting information. It is compiled by the Interstate Commerce Commission. "The Fire Hazard of the More Important Chemicals," by Ernest H. Cook, is continued. "Submarine Mines" is an illustrated article showing various types. In the Selected Formulæ column will be found a number of formulas for tooth-powders and pastes.

Contents.

(Illustrated articles are marked with an asterisk.)