ment—a great inconvenience that can be remedied only by gears or ratchets; but this is hardly worth while, in view of the great advantage to be gained by using an eight-day clock, which, in addition to its ability for long running, usually has the winding stem on its face. The proper speed of the driving disk is that which will cause the moving band to complete the circuit through the tube in about two minutes.

Aerial and ground are connected to the terminals of the primary coil, and the telephone to those of the secondary. An almost inaudible hissing sound, in the telephone, as the band slowly threads its way through the tube and around the pulleys, shows the detector to be in working order.

A CONTINUOUS VARIABLE-SPEED SYSTEM OF RAPID TRANSIT.

Most of the transit evils from which every crowded city suffers are due to the periodic character of the train service. The steady current of people that pours into the station must be periodically checked to await the arrival of the trains. It is this intermittent damming of the human stream that produces the rush-hour crush, and retards, as well, the unloading and loading of the cars. The only remedy possible under the periodic transit systems is to reduce the headway of the trains so as to carry off the crowds at more frequent intervals. But the headway cannot be cut down below a certain minimum determined by the length of time required to load and unload the cars, plus a constant allowed for starting and stopping. This minimum has already been reached by the New York Subway express service where, at certain hours, three and four trains are sometimes stalled waiting their turn to enter a station.

Realizing that we have reached the limit of possibilities of an intermittent or periodic service, the next logical step would seem to be in the direction of a continuous transit system. Several such systems have been proposed. The moving platform, consisting of three endless platforms traveling side by side at rates of three, six, and nine miles per hour respectively, is familiar to our readers. Another, and a most unique plan which was recently described in these columns, consists in an endless chain of cars traveling at a speed of, say, 20 miles an hour, and to which access is had by means of a large whirling platform with a peripheral speed equal to that of the chain of cars, but with a speed so reduced near the center where the station entrance is placed that the platform can be here readily boarded.

Still another continuous scheme has just been brought to our attention which is decidedly novel in many respects. It is the invention of two engineers of this city, Messrs. B. R. Adkins and W. Y. Lewis. In this system a series of short cars are used, which travel at high speed between stations, but slow up while passing a station platform to permit the passengers to alight or step aboard. In this respect the system resembles that of separate trains. However, the cars do not stop at the station, but come together to form a continuous train or moving platform traveling at a rate of three miles per hour. Once the station is passed the speed is uniformly accelerated up to say 21 miles per hour, hence the cars successively break away from the close formation and are strung out all along the line until the next station is approached, when they again draw together and pass the station as a continuous train. In other words, the cars run under a headway much smaller than the present minimum because they do not stop at stations, but merely slow up. Furthermore, this retardation is of known duration, whereas in the ordinary periodic system it is a very uncertain quantity depending upon the size and compactness of the crowd which desires to get on and off.

The method of driving the cars at this variable rate is very simple. On each side of the track, extending along the entire length of the line, is a pair of screws, or rather shafts, in each of which a spiral groove is cut. One of these is formed with a right-hand spiral and the other with a left-hand spiral. These opposed spiral grooves receive the opposite ends of the forward axle of each car, so that when the shafts are turned in opposite directions they feed or "screw" the cars forward. The desired acceleration or retardation of the cars is produced by varying the pitch of the grooves.

We are accustomed to think of screw and nut gear as adapted only for very powerful but slow motion, and it may at first sight seem to be impracticable to obtain a high speed without considerable friction, also impossible to obtain such a variation in feed as between three and twenty-one miles per hour on the same screw. However, this detail has been quite carefully worked out. The inventors propose to use a shaft 18 inches in diameter. At the slow-speed points the groove would have a pitch of 7.5 inches, while at high-speed points the distance between threads would be 52.5 inches, and the maximum speed of travel stated could then be obtained by driving the shafts at 422 revolutions per minute. The angle of the groove with the axis of the screw at maximum and minimum pitch is 45 deg. 20 min. and 8 deg. 15 min., respectively, while the screw efficiency is 96 per cent and 86 per cent, respectively, because the friction is almost entirely eliminated by using ball-bearing rollers on the axles to engage the spiral groove, and the shafts are carried in the well-known "anti-friction" roller bearings.

The screws or driving shafts are supported at frequent intervals on rollers, as shown in one of the figures of our front-page illustration. They are driven by electric motors at various points along the line, say one-fourth of a mile apart. Each motor drives a short power shaft which passes under the track at right angles thereto. By means of bevel gears the power is transmitted to a pair of short drive shafts parallel with the screw shafts. The drive shafts are fitted with broad-faced spur gears which mesh with toothed collars secured on the screw shafts. As is clearly shown in our illustration, the spiral groove passes right through the gear collars. The shaft is made in short lengths of, say, 25 feet, which are spliced together with a lap joint. An axial play of one-sixteenth of an inch is allowed at each joint for expansion and contraction. At suitable points along the line thrust collars are secured to the shaft and these are engaged by rollers which take up the end thrust.

It is the plan of the inventors to inclose the screws on each side throughout the length of the lines, providing a platform level with the car floors, so that in case of stoppage the passengers can leave the cars and walk along the platform to the nearest station. The rails are supported on a concrete bed, which is molded to form a deep trough or open conduit in which workmen can walk while cars pass over them. Should a passenger fall between the cars the latter would pass over him without doing him any injury; also, if a parcel should be dropped from the cars it would fall into the conduit without obstructing the track.

The cars are short, four-wheeled vehicles with two seats placed back to back. They are open at the sides and closed at the front and rear by means of wire screens. At stations a platform may be built on both sides of the track, so that passengers may enter or alight from either side of the car.

A system of this sort is, of course, unsuitable for any but a straight track because the shafts cannot be bent around curves. Yet the inventors propose to negotiate slight curves by laying straight lengths of shafting on chords of the curve and gearing these chords together. The cars may be carried past joints in the chords by their momentum, or by a clutch device which will act automatically. Some such scheme would also be necessary on a straight line to pass over a rise or a dip in the track.

Very evidently, as this is a continuous system, the track must be endless; that is, at the ends of the course the "down" and the "up" tracks must be connected by a curve. A number of schemes have been devised for carrying the cars around the connecting curve. The best plan seems to be the use of a wheel with an automatic clutch which seizes each car just as it leaves the screws and carries it around to the return screws.

The following are some of the advantages of this continuous variable-speed system: It does away with motormen, conductors, and guards, hence greatly reducing operating expenses. The entire line is operated from a single power station. As the shafts run continuously at constant speed, the load is almost constant, varying slightly with the number of passengers carried. The retardation of a car on approaching a station contributes energy to the shafts which, farther on, is used in accelerating a car that is leaving the station, there being no brakes with resulting wear of wheel tires. Owing to the constant speed, no more suitable prime mover could be desired than the simple alternating-current motor. This motor requires practically no attention. It will operate with high-tension current, thereby minimizing copper in cables and entirely saving costly sub-stations and other complicated accessories to the present subway system. Transmission losses, such as are common to the ordinary third-rail systems with the sliding shoe contacts and consequent destructive earth currents, are done away with, as well as all danger of injury to the workmen or by fire in time of accident from an exposed third rail. The entire system may be mechanically considered as one vast machine under control of a single engineer at the power-house switchboard. No signal system is required, as there is absolutely no possibility of a collision except in the event of a breakdown. But the chance of a breakdown of any of the cars is exceedingly remote, owing to the fact that there are no complicated parts to become disordered, and that the axles and engaging projections can be made enormously strong. To be sure, this system is hardly adaptable to a long line, but the inventors believe that it might be applied to short crosstown lines or, by arranging the driving shafts in chords, on bridges.

In addition to this horizontal system, the Messrs. Adkins & Lewis have devised a continuous variable-speed elevator system which moves very slowly past floors, but travels swiftly between floors. A modification of this system has been devised for use at elevated and subway stations for carrying passengers to and from the street level. In this arrangement the cars move horizontally at the top and bottom of the shaft, long enough to permit passengers to step aboard or alight, and then they assume the vertical course and travel at high speed between levels.

Another application of the system is in the nature of the well-known escalator, which is becoming popular at department stores. The new design provides a series of seated cars moving slowly and horizontally in a semicircle at each floor and passing at relatively higher speed up or down an incline between all the floors.

This system is extremely flexible and can be applied in many useful ways for the transportation of passengers or merchandise.

Industrial Alcohol.*

The value and significance of a tax-free alcohol have been so widely discussed in the press and periodical literature of the entire country, that it is hardly necessary to emphasize the great importance of this subject, especially to our agricultural and industrial interests, since the new alcohol law became operative on the first of the year. For years we have been far behind the nations of Europe in this regard, and in consequence, our literature has been sadly lacking in authoritative works covering this phase of industrial activity. "Industrial Alcohol, Its Manufacture and Uses," recently issued by the publishers of the SCIENTIFIC AMERICAN, was designed with the especial purpose of supplying this want; it is the latest and most comprehensive work of its kind which has been published in this country. The book is a practical treatise, and will be found especially valuable by the layman and the student, notwithstanding that it is well adapted for use as a handbook by the expert. It comprises the researches and writings of the most eminent of Germany's specialists in the science of fermentation and distillation, being based upon Dr. Max Maercker's "Introduction to Distillation," as revised by Drs. Delbrück and Lange. The book covers the manufacture of alcohol from the raw materials to the final rectified and purified product. An introductory section deals with the importance of the new law, what it means to the farmer and the manufacturer, and the possible conditions arising under the law. In additional sections the methods of denaturing, the domestic utilization of alcohol for heating and lighting purposes, its use as a fuel for power production, and a statistical review are given. The discussion of the use of denatured alcohol for heating and lighting and for power productions is supplemented by numerous well-chosen illustrations; the entire text is fully illustrated throughout. In an Appendix is given the complete United States law. Few in number are those to whom this book would not prove of interest and value. The farmer, the manufacturer, the power producer, the householder, will all find that denatured alcohol is of importance to them, that its use and introduction will render feasible savings and economies which were hitherto impossible of accomplishment.

The Death of Prof. Ernst von Bergmann.

Prof. von Bergmann, the famous surgeon, died in Wiesbaden on March 25. He was operated on for intestinal disorder without an anæsthetic, and bore the prolonged cutting with the greatest fortitude, although he did not direct the surgery, as he did in the case of a previous operation some months ago.

Ernst von Bergmann, the celebrated German surgeon, was born in the Baltic province of Livonia on December 16, 1836. He studied at the universities of Dorpat, Vienna, and Berlin, and was graduated from the medical department of Dorpat in 1864. During the Austro-Prussian war of 1866 he was placed in charge of the military hospital at Königinhof, in Bohemia, and during the Franco-Prussian war he was at the head of the military hospitals of Mannheim and Carlsruhe. In 1875 he was appointed to the chair of surgery in the University of Dorpat, remaining there until the breaking out of the Turco-Russian war, when he became attached to the Russian army of the Danube as consulting physician. Returning to Germany, Dr. von Bergmann was made surgeon in chief of the hospital at Würzburg and professor of surgery at the university. In 1882 he was called to the chair of surgery at the University of Berlin, to succeed Prof. von Langenbeck, and also had charge of the surgical clinic of that city.

* Industrial Alcohol, Its Manufacture and Uses. A practical treatise based on Dr. Max Maercker's "Introduction to Distillation" as revised by Drs. Delbrück and Lange. Comprising Raw Materials, Malting, Mashing and Yeast Preparation, Fermentation, Distillation, Rectification and Purification of Alcohol, Alcoholometry, the Value and Significance of a Tax-Free Alcohol, Methods of Denaturing, Its Utilization for Light, Heat and Power Production, a Statistical Review, and the United States Law. By John K. Brachvogel, M. E. 528 pages, 107 engravings. Price, $4.

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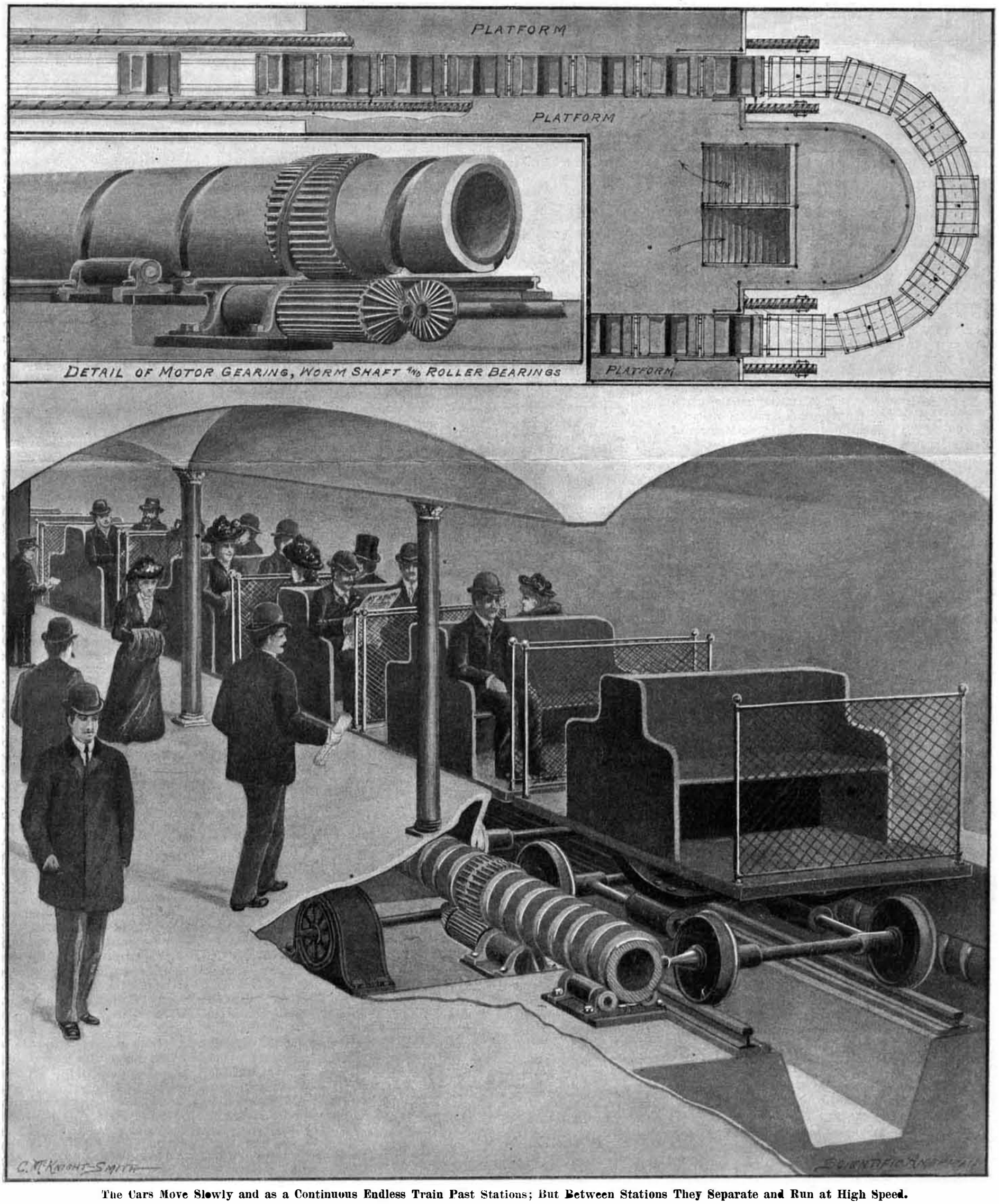

The Cars Move Slowly and as a Continuous Endless Train Past Stations; But Between Stations They Separate and Run at High Speed.

NOVEL RAPID TRANSIT SYSTEM OPERATED BY A CONTINUOUS SCREW WITHOUT MOTORS OR TRANSMISSION AND WITH NO RISK OF COLLISION.—[See page 291.]