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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

MUNICIPAL ARCHITECTURE AND THE ELEVATED RAILWAY.

The series of articles on the Berlin underground and elevated railway, of which the last is published in the current issue of the SUPPLEMENT, teach a forceful lesson in good taste in engineering work, by which Americans may well profit. Probably in the whole world there is no engineering structure that so admirably harmonizes with its architectural environments as this newly-opened Berlin road. Each section of the line was carefully planned to correspond in style with the particular quarter of the city through which it passed; every precaution was taken to relieve the coldness and rigidity that are necessarily found in every trussed iron structure. Artistically designed masonry piers have been introduced wherever possible; arches and towers have been employed, notably at the Oberbaumbruecke, with a singularly happy effect. Here and there, as at the Schlesisches Thor, a station has been built, the formal charm of which immediately arrests attention.

It must be conceded that the Germans and French have a finer sense of architectural fitness than we. Perhaps not in all Europe, assuredly not in Germany and France, would a Manhattan Elevated Railway, obtrusively hideous, with machine-made stations, built with no pretense to beauty, be allowed to disfigure a beautiful public park and to mar street after street with its commonplace iron pillars and frames. In Europe good taste is never forgotten—or rather the municipal authorities will not allow it to be forgotten. Not how cheaply, but how artistically, can a public work be carried out seems there to be the official criterion.

From its very inception the Berlin road was the object of municipal care. It was stipulated that no station should be a blemish to the city; that the traffic of the streets should be interfered with in no way. As a result of this rigid control, the builders of the road were prevented from resorting to many a structural convenience, which, commendable enough from the engineer's standpoint, would have been an architectural blot on a beautiful city. As an example of this fine municipal vigilance, we have but to cite a single example. The western branch of the Berlin line passes through a series of wide, handsome boulevards in the newest and finest residential portion of the city. Between the driveways of the broad central esplanade, it would have been a most convenient makeshift to build a viaduct, and thus to have saved millions of marks. Such an overhead structure would have ruined that quarter of the city architecturally. The company was, therefore, compelled to lower the grade from the Nollendorfer Platz westward, to run beneath the boulevard, and to conceal its road until the terminus at Charlottenburg was reached. The construction of this subway entailed an enormous outlay. Quicksands were encountered which rendered it necessary to drive piles —a work which involved months of delay. How beneficial to the city this authoritative rigor has been is shown tellingly enough by the present condition of that section of the road. The excavated channel is walled in, roofed with earth resting on steel girders and arches of masonry, and surfaced with graceful walks on which shade trees have been planted.

In a city which is growing more beautiful as its old buildings are torn down and better designed structures erected in their place, the architectural enormity of a Manhattan Elevated Railway becomes all the more glaring. Bad from the very begining, it apparently grows worse as finer structures are erected along its line. And yet American engineers seem slow to profit by the lessons which have been taught. The new East River Bridge, stupendous though it be, can surely not be considered an architectural adornment. Artistically it is distinctly inferior to the old Brooklyn Bridge with its noble masonry piers. Here again Germans have shown us what can be done. The traveler who steams up the Rhine must feel how vastly superior are the handsome bridges that span Europe's most beautiful stream. Time and time again we have commented upon the excellence of the design which characterizes these Rhine bridges. At Düsseldorf and at Worms, structures span the river, which have been executed so as to harmonize architecturally with the towns on either bank. Mediæval towers and battlements have been used wherever the cities themselves were mediæval in character. The harsh discord of an intensely modern structure and a mellowed old town has thereby been avoided.

The architectural fate of New York city is in the hands of the Municipal Art Society, which has undertaken to correct, so far as it possibly can, the mistakes made two decades ago. A total rebuilding of existing elevated structures can hardly be asked in reason; but surely the Society might see to it that the overhead structure which is to form a part of the new Rapid Transit line, and the proposed bridges which are to span the East and Hudson Rivers, shall be commensurate in dignity and beauty with the metropolis of the greatest industrial country in the world.

THE ARNOLD SYSTEM OF ELECTRICAL TRACTION.

The question of the employment of high-tension alternating currents for long distance or heavy traction has not received the attention that the subject deserves from the American engineering fraternity at large. As a result, the German and other Continental engineers, who have been continually striving to reconcile the demands of the traffic problem with the limitations of the alternating current motor, have, until recently, made much more progress toward a satisfactory solution of the problem than has been made in this country.

It has, however, gradually come to be generally conceded even here, that the direct current, embodying though it does tremendous advantages along the line of speed regulation of the motors, is hardly to be looked to as presenting in the present state of our knowledge a satisfactory solution of the traction question. The difficulties in the way of an economical distribution of the current have thus far proved an insuperable obstacle. In the attempt to conquer this difficulty various expedients have been resorted to, but expedients they have remained. Even the combination of high-tension alternating currents converted to direct low-tension working currents by rotary transformers has proven unsatisfactory to the man who pays the bills, since the loss of energy at conversion, the first cost of substation installation, with the subsequent cost of substation maintenance, together with the cost of the copper wire which it was even then necessary to string between substations if the traffic were at all heavy, almost entirely neutralized the advantages obtained by the initial employment of the alternating current.

At the same time the single-phase alternating current motor has presented, until recently, even less hope of a final solution of this problem than the direct current motor. Practically unalterable as regards speed, low starting torque, and an inability to adapt itself to an overload have rendered it almost impossible as a railway motor, and while the three-phase machine removed many of the difficulties enumerated above, the complexity of conductors presented so many difficulties in the way of transferring the current to the motors that the last state of affairs was but little better than the first.

With traction engineering affairs in this condition the importance of the announcement of Mr. Bion J. Arnold at a recent meeting of the American Institute of Electrical Engineers can hardly be overestimated.

The simplicity of his basic idea illustrates how easily mankind, by continued contemplation of almost any given series of conditions, becomes convinced that the conditions are necessities.

The proposition, somewhat in detail, is as follows: Each motor car is to be equipped with a single-phase alternating current motor of which *both* the armature and field are capable of revolution about the common shaft, either separately or together. Attached to armature and field are two engines, one to each, which are so constructed that they may be used either for compressing air which is stored in a reservoir carried on the car or for driving by means of the compressed air the portion of the motor to which they are fastened. The motor, which is designed to fulfill the average propulsion requirements of the car, is intended to be maintained at a constant speed (synchronous with the driving dynamo) and at a constant load.

Let us now consider the behavior of the device under normal running conditions with the field magnet at rest (with respect to the car) and the armature, to which is attached the car wheels, rotating at its constant speed. (A constant speed is, of course, undestood to mean that a given point in the armature passes a given point in the field a given number of times per second; whether this relative motion is obtained by the rotation of the field or of the armature is of no consequence.) If it be now desirable to slow down the motion of the car the field is released from the clutch which holds it motionless (with respect to the car) upon its shaft and the reaction of the force which until now has been driving the armature causes the field to rotate in the opposite direction. The engine attached to the armature is, at the same instant that the clutch is removed from the field, started compressing air; this increase of the load would tend to decrease the speed of the armature in an ordinary type motor with fixed field, but as the field is here free to revolve, the effect of the increased load on the armature is simply to accelerate the backward motion of the field, and thus the synchronism or relative speed of motion of the parts is maintained. By gradually applying the brakes the actual rotation of the armature is gradually diminished while a proportional increase in the velocity of the field is taking place until such time as the car comes to rest, when the armature has ceased to rotate and the field is revolving at the constant speed necessary to maintain synchronism with the driving dynamo, and incidentally, during all this time the field has been actuating the air-compressing engine attached to it and consequently has largely succeeded in storing the kinetic energy which the moving car possessed. During the whole time of car stoppage the field continues to revolve, and the field engine to compress air in the reservoir.

To start the car again in motion the brakes are released and the field engine gradually throttled, and as this latter, of course, has a tendency to slow down the rotation of the field, the armature in order to maintain synchronism is compelled to revolve, thus starting the car. In addition the connection between the armature engine and the reservoir is changed so that the engine is actuated by the compressed air and this of course assists in rotating the armature. By gradually throttling the field engine, the field revolution is eventually entirely stopped, at which time the speed of synchronism is that of the armature. Speeds greater than this may be secured by changing the connection of the field engine and the reservoir in such way as to actuate the engine by the stored air, so that, as the engine is made to drive the field in the same direction as the armature is rotating, and as the armature is compelled to maintain a given speed with respect to the field, the resulting speed of the armature will be the sum of the synchronism speed of the motor and the actual speed of the field.

In this way an infinite number of speeds may be secured while the relative motion of the parts of the motor remains constant. In ascending a grade the natural capacity of the motor is augmented by the engine of the armature, which, connected with the reservoir as in starting, assists the armature rotation. While in descending a grade the energy of the motor may be entirely converted into energy of compressed air by the proper connection of the engines.

Another tremendous advantage which this system offers is that each car, after having been run for a given time, is independent, by virtue of the energy stored in the air tanks, of the main line, and being an independent unit can be shunted and switched across tracks not electrically connected with the main line for a time dependent upon the capacity and contents of the reservoir. In passing through communities where it is undesirable, for any reason, to have the high-tension wire or contact-rail, the car can proceed under its stored energy without any electrical connection whatever; or if the district to be traversed is so extensive as to introduce the possible danger of the air reservoir being emptied it would be possible to provide a static stepdown transformer at the territorial limits which would supply a working current of such potential—say 200 volts—as to be well within the danger limit. The motor would then work directly from the line.

Requiring, as the system does, only a single-phase motor, the ordinary third-rail or overhead construction can be used, always provided that the high potential required be met by proportionately high insulation. In fact, this latter condition seems to be the one weak point in the scheme; a 15,000-volt potential hardly being a desirable accompaniment for any third-rail system now in vogue, and even an overhead naked conductor will present difficulties in the way of insulation, particularly in wet or winter weather, that will make a most careful consideration of this subject absolutely necessary.

It is the present intention to take the current direct from the high potential conductor at 15,000 volts and transform it through a static transformer situated on each car to a working voltage of 200 volts. Under conditions which did not necessitate the use of the high potential conductor the transformer might be done away with, but even under such conditions which would eliminate the saving occasioned by the transfer of energy, at high potential, the system would still show a greater efficiency than any now in use.