the commutator which connects directly with this point on the armature is known as the neutral point on the commutator. In modern machines this point is either directly opposite the neutral point on the armature, as shown in Fig. 32, or directly opposite the poles, depending on the method of connecting the conductors to the commutator. These points on the commutator coincide with the position of the brushes.

Referring to Fig. 35, it will be noted that the neutral points on the armature divide the conductors into groups, the direction of the e.m.f. being the same for each conductor in a group, but opposite in each successive group. The direction of the e.m.f. generated in each conductor is indicated by an arrowhead. Starting from brush, $b_1$ or $b_3$, and following either circuit formed by the armature conductors—there are two circuits leading from each brush—it will be noted that the direction of the e.m.f. is positive until the brush $b_2$ or $b_4$ is reached. It will also be noted that there are an equal number of conductors included in each circuit from brush to brush, and that this number remains constant notwithstanding that the conductors are continually passing from one group to another as a result of the motion. The e.m.f. generated in each circuit will, therefore, be constant and unidirectional; and if the density of the magnetic field is the same opposite each pole, the average e.m.f. generated by each conductor in the several circuits will be the same, and consequently the total e.m.f. generated in the conductors forming the circuit between the brushes $b_1$ and $b_2$ will be equal to that generated in the circuit between $b_1$ and $b_4$. The potential of $b_2$ will, therefore, be equal to that of $b_4$, and if the two are connected no current will flow from one to the other. For the same reason $b_1$ and $b_3$ may be connected. The brushes $b_1$ and $b_3$ thus constitute the negative pole or terminal of the machine, while $b_2$ and $b_4$ form the positive terminal. Between these terminals the armature conductors form four circuits in parallel, in each of which the same e.m.f. is generated. The armature is thus equivalent to four batteries in parallel. In the actual machine the brushes are connected by a cable to suitable terminal blocks conveniently located on some part of the frame. (See Fig. 33.)

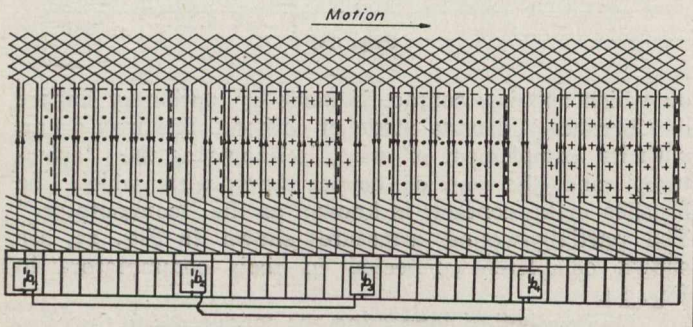


FIG. 35

Since the total e.m.f. which is generated in any one of the armature circuits, taken from brush to brush, is equal in absolute units to the number of lines of force cut per second by all the conductors in this circuit, as explained in Chapter III., the magnitude of this e.m.f. may be varied : (1) By varying the number of conductors included in each circuit; (2) by varying the density of the magnetic flux, or (3) by varying the velocity of the moving conductors. As the number of conductors cannot be changed after the machine is built, it follows that the e.m.f. of any particular machine can be varied only by varying the magnetic flux or the speed at which the armature revolves. In either case the e.m.f. changes proportionately; i.e., if the flux is doubled with constant speed, the e.m.f. is doubled, and if the speed is doubled with constant flux, the e.m.f. is doubled. This is true of all kinds of generators. In commercial work the speed of the generator can be varied only by varying the speed of the prime mover (engine or turbine), which is usually designed to run at constant speed. Variations of e.m.f. are, therefore, effected by varying the magnetic flux, which is done by increasing or decreasing the "exciting" current (the current which passes through the coils placed on the poles). This introduces the question as to the source of this current and the method of controlling it.

## WIDTH OF ROADS.*

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The unnecessary width of country roads and city and town streets would perhaps be a more appropriate and comprehensive title for the brief address contemplated in the preparation of our programme.

The subject should be considered under two distinct headings. First—The perhaps unnecessary width between boundaries; second, the unnecessary width of the roadway constructed and maintained for the use of wheel traffic.

In laying out country roads through undeveloped and perhaps useless land, the cost of acquiring a four-rod right-of-way may be little, if any, in excess of that for a two-rod road. After the road is opened and settlers or landowners develop the property on each side it increases in value, and consequently the cost of subsequent road-widening may be much greater than the original cost. Houses and other buildings may be built close to the road; fences, hedges, stone walls, ornamental and shade trees, wind-breaks, flowers and shrubs may occupy the land immediately adjoining the road. All these improvements, and even the proximity of houses which are not immediately on the road boundary increase the cost of road-widening.

Looking at the first cost of the right-of-way, and with a view to the future, it would seem to be the part of wisdom to acquire the four-rod width. The question may be asked here, however, if you are going to argue that four rods is an unnecessary width for a country road why should that width be acquired at all? Why not acquire only the width absolutely necessary?

That question has been answered partially in the preceding paragraphs. In the woods, in unsettled and uncultivated districts, one-half of the four-rod right-of-way is ample for all present requirements, but who can foretell the needs of the future? The wheel traffic of to-day cannot accommodate itself to the narrow lane of the past. The ox-teams of our forefathers could haul out into the bush to pass a traveller journeying in the opposite direction. Such treatment for a rubber-tired buggy or automobile is out of the question. This new and progressive style of transportation can be accommodated, however, on less than four rods. In fact, outside of the city, town and large village, a width of two rods is ample for traffic needs and for roadway construction. If there were no other consideration, we should have to decide only if it is probable that the natural features and facilities for reaching the outside world would justify the municipal authorities in deciding that the future settlement would grow into a village and the village to a town. Even after arriving at a favorable conclusion, it is a question whether the present generation should provide for the future or leave posterity

* Read before the Union of Nova Scotia Municipalities.