would give trouble, and, therefore, he thought it wise to restrict himself to a single one. No doubt he was right; motors have been immensely improved of late years, and in no respect more than by the use of the carbon brush. Without that it would have been a difficult matter to have brought the electric tramcar to the point of commercial success which it now enjoys, and other forms of motive power transmission would have failed, in a greater or less degree, to attain their present established position.

The success of the electric tramway upsets every possible objection which can be raised against the reliability of the electric motor for other purposes. On a car it runs among slush and mud, is stopped and started every two or three minutes, and has often to get into motion under loads many times the normal. It may safely be said that if an electric motor succeeds in such work—and it certainly does succeed—it may be employed with the fullest confidence in every position in an engineer's shop, for there it meets with skilled care, and the greatest demands that can be made upon it are uniformly easier than those found in a tramway. It may be a moot point how far the subdivision of electric power should be carried in the driving of tools, but its applicability and economy of power when used in traveling cranes has passed beyond the stage of discussion. The question of economy in the driving of a crane is, however, of little moment. What does matter is that no time shall be lost at the tools. Lathes, planing machines, and other appliances now represent such an immense capital outlay that it is most imperative that they shall work every available minute, and this can only be done if the work can be lifted in and out with expedition and with certainty. For this work there is nothing on the market equal to the electric crane.

The most advanced practice in overhead travelers is to use a separate motor for each motion. It is not many years that Messrs. Adamson have been making cranes, their original business being that of boilermakers, and it will be interesting if we trace their connection with the new industry, as their experience reflects in a general way the history of the electric crane in this country, says Engineering, London, Eng., in a recent issue. In the early nineties the firm were in want of two additional overhead cranes, and after considerable enquiries they determined that they should be electrically driven, and that they would build them themselves, because at that time the established makers did not recommend this application of electric power. The makers of motors also cast very considerable doubt on the advisability of using reversing motors, while at the same time the cost of the motors was very high. In 1893 one of the firm went to the United States, and soon found that there did not exist the same hesitancy about using reversing motors on the other side of the Atlantic as here, and he returned with the conviction that they might proceed with confidence. On November 5, 1894, they set to work their first three-motor crane, and during the next two years they constructed cranes for their own shop, proceeding tentatively and experimenting at their own cost rather than at that of their customers. In that period they built five or six cranes, not only as regards the ironwork, but also the motors and the electrical equipment. In 1897 they began working for the public, and have since turned out cranes of various sizes.

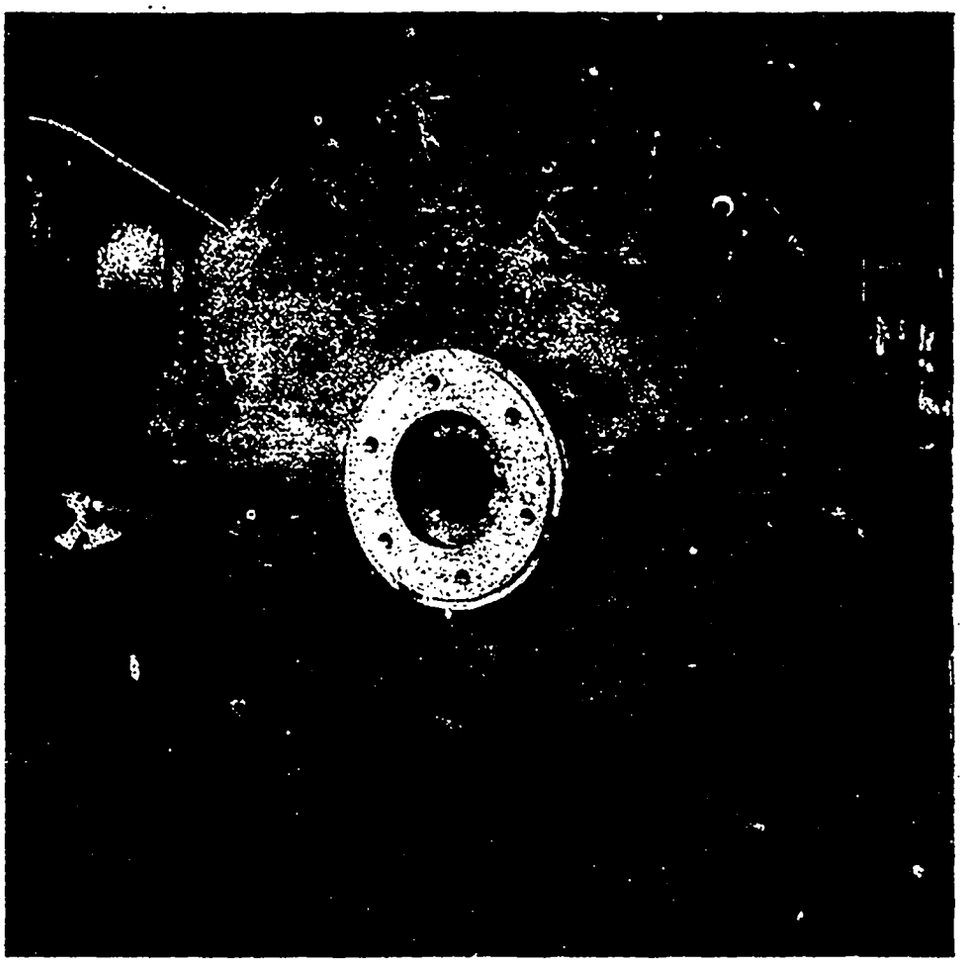

FIG. 2 ARNOLD MAGNETIC CLUTCH.

The latest crane has four motors. Their purposes are respectively to drive (1) the main barrel, (2) the light barrel, (3) the longitudinal motion, and (4) the traverse motion, and all are supplied with current at 220 volts. The main lifting speed is 4 feet per minute, the corresponding motor running at 400 revolutions per minute, and the barrel being 2 ft. 6 in. in diameter, there being three intermediate shafts between the motor and the barrel. All these spur gears are machine cut out of the solid, except the last two, which are of the double helical type, all being of steel. The first motion wheel has a bronze rim bolted on it. The use of keys is avoided wherever possible, the pinions are forged solid on their shafts, and the wheels are keyed on prolonged bosses formed on the pinions to receive them. The load is carried by a steel wire rope 5 inches in circumference, passing in two bights round two sheaves on the hook block. The two ends of the rope are fixed to the drum, and the centre bight is led round an equalizing pulley, thus