THE ZEROGRAPH.

It seems to be de rigueur that a fantastic name should be given to new instruments destined to be brought to the attention of the general public. The zerograph does not merely write ciphers, but is capable of transmitting the same number of letters and symbols as any other type-printing telegraph. However, a fancy name seems essential in this case, for to call the instrument the Kamm type printer, when one of its most important claims to attention is the absence of clockwork, would have been a comical error.

The general appearance of the instrument is shown in Fig. 1. Its overall dimensions are approximately 18 inches by 20 inches by 17 inches high. The keys, 36 in all, are not arranged in alphabetical order, but those most often required, i. e., those letters placed near the center of a typewriter keyboard, are put at the extreme left, the figures and stops which are less frequently used being at the right hand side. The reason for this will be explained presently. The most interesting part of the instrument is, as usual, the synchronizing device, and its action will be gathered from the following description and a reference to Fig. 2. The keys, A, of which one is shown in the diagram, are connected to vertical pins, B, arranged in the arc of a circle at right angles to the plane of the paper. The center of this circle is the axis of an arm, D, termed by Mr. Kamm the synchronizing arm. Normally this arm is held at a fixed starting position to the left of the arc of pins by a catch, and when the catch is released the arm is capable of swinging through the arc of a circle just above the pins already referred to until it is stopped by one of these rising. The impulse is given to the arm by a dropping weight connected to it by a cord passing over a pulley. The instruments at the two ends have exactly similar weights and synchronizing arms, a screw adjustment being provided; by this means the space through which the impulse-giving weight drops can be varied, so that the speed of rotation at either end of the arm can be slightly altered if it is not in exact agreement with the other end. The weight acts on the spindle through a pawl, so that it only acts during the forward swing of the synchronizing arm. Two current impulses are sent to line, the first releasing the catch and starting the synchronizing arm, and the second stopping the arm when the letter comes in a position for printing. The types are mounted on flat springs in the arc of a circle corresponding to that of the pins and fixed to the same spindle as the synchronizing arm, and the printing is effected by a plunger pushed forward by the printing magnet, which presses the type against the paper tape. An ink ribbon is employed in the usual manner, this being continuous and passing over two ink pads on the circumference of two rollers.

The arm, D, carries two projections, F and G, moved by the magnet marked "synchronizing magnet" in Fig. 2. The projection, G, is arranged to engage with any pin, B, as soon as this is raised by depressing the corresponding key, A. The other projection, F, engages with a hook, C, attached to the armature of the "starting magnet," and this catch holds the synchronizing arm in its initial position until the magnet is energized. On depressing any key, A, a contact at H is made as the key moves down, closing the circuit of the starting magnet and allowing the synchronizing arm to start on its journey. The lever attached to the key also makes a contact between K and L, and the starting magnet closes a contact at J; it will be seen that these two contacts connect the line battery to line. The line current passes through the synchronizing magnet at the other end, the armature, M, is attracted, F is released, and the synchronizing arm at that end also starts. When the synchronizing arm at the sending end reaches the pin, B, of the letter required, it is stopped by the pin, and closes another local circuit energizing the "second contact magnet" and the printing magnet. The former of these lifts its armature, making a contact at O, and sending another current impulse to line. This second current again energizes the synchronizing magnet at the other end, the armature of which moves the projecting fang, G, so as to stop the synchronizing arm at the nearest spring-pin. This pin must correspond to that at the sending end of the line, if the two arms move with equal velocity. The same local circuit at each end is therefore closed, and the printing magnets press the type against the paper. At the same time the paper is fed by the usual mechanism, and the circuit of the "zero magnet" is closed at N, this magnet returning the synchronizing arm to its initial position. We believe that an arrangement of condensers and resistances are connected across the contacts in the local circuits, to diminish sparking.

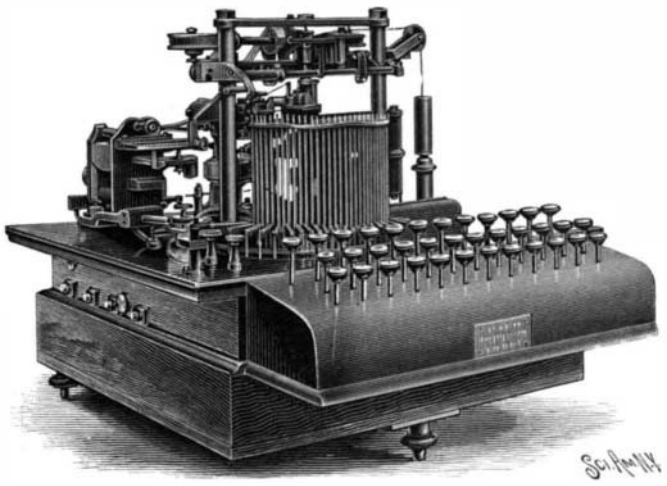


Fig. 1.—THE ZEROGRAPH.

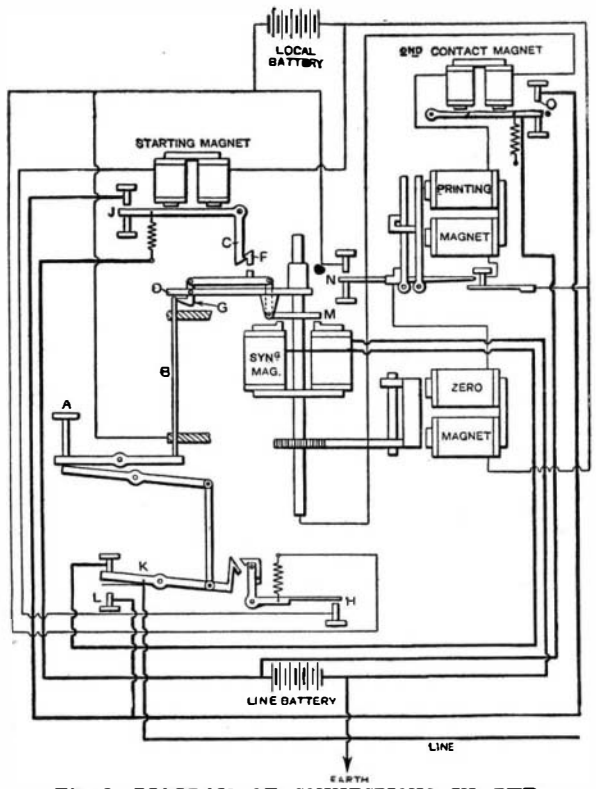


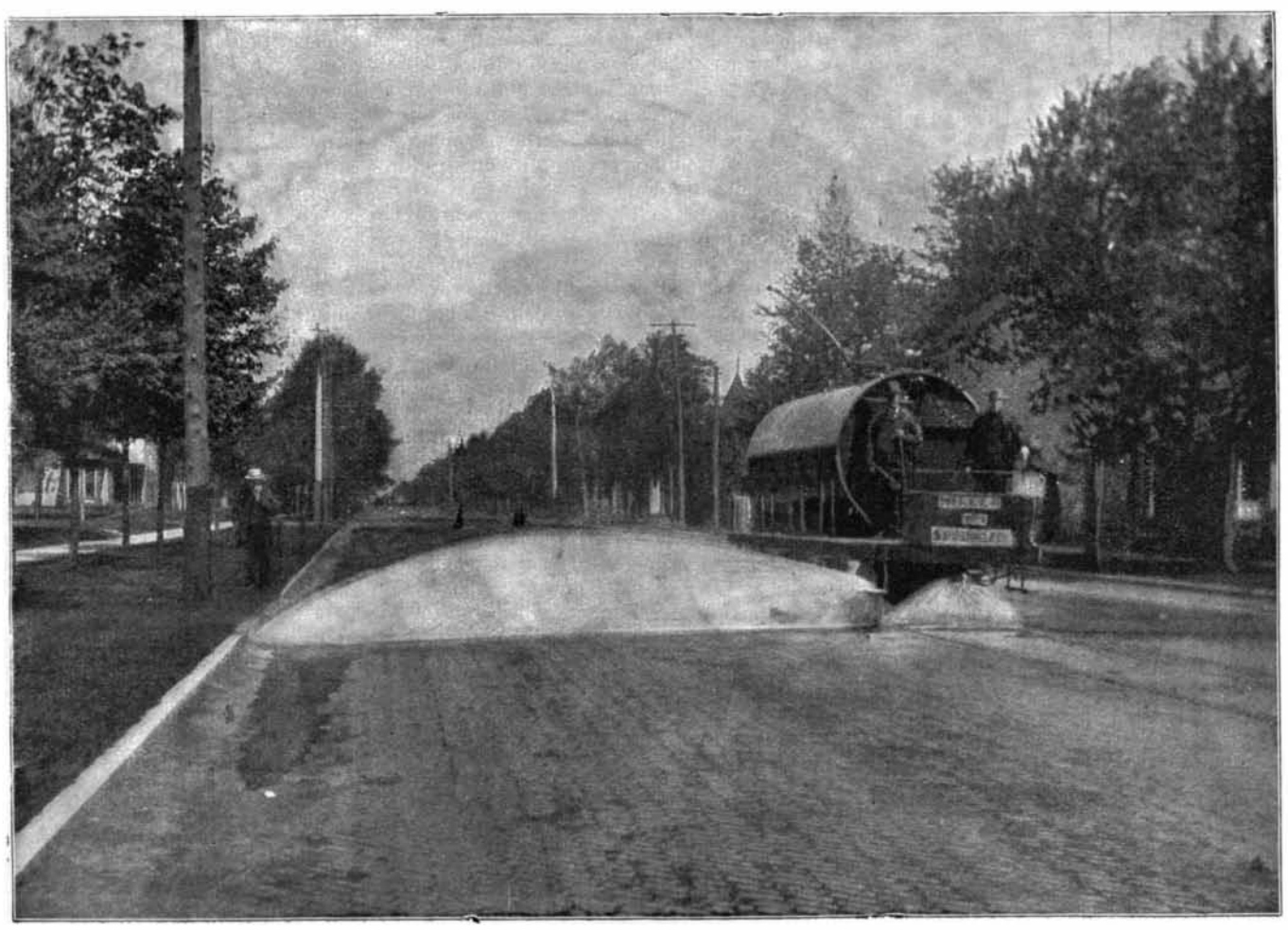
Fig. 2.—DIAGRAM OF CONNECTIONS IN THE ZEROGRAPH.

In point of speed the zerograph, although not competing with the Hughes type printer, is, it is seen, far beyond instruments of the step-by-step type, of which latter the "telescriptor," described in the SCIENTIFIC AMERICAN of January 1, is an example. The synchronizing arm takes but half a second to swing to the limit of its travel and back, and as the letters most frequently used are placed to the left, at the first part of the range of the synchronizing arm the average time per letter is but a very small fraction of a second; in fact, it is claimed that the instrument can transmit 25 words a minute. As evident from the description, however, everything depends on the accuracy with which the speed of the two synchronizing arms agree; and although the spindles are mounted on jewels, and the instrument shows most careful and workmanlike finish, time only can decide whether in this important respect no trouble is likely to be experienced. We understand that experiments have been made on long artificial lines, but no actual trials on long telegraph lines. The synchronizing magnet is very sensitive, and a 12 milliampere current suffices to work it, but we should expect that on long lines with considerable distributed capacity some method of curbing will be found necessary to insure the first current impulse being completely wiped out before the second occurs. It is essential that each impulse should take the same time to reach the other end, but the time elapsing between successive impulses varies with each letter.

Mr. Kamm has also devised a "column printer," in which paper of a certain width is used instead of tape. To commence a new line a key is pressed which is not connected to any of the circle of pins, and the synchronizing arm swings right to the end of its travel, closing a contact there which completes the local circuit of an extra electromagnet. This magnet moves the paper forward, and at the same time brings it back to the commencement of the line. This type of instrument is, however, not beyond the experimental stage, so that a detailed description of it would be out of place now. For our engravings and the description we are indebted to The London Electrician.

AN ELECTRIC STREET RAILWAY SPRINKLER.

We present an engraving of an interesting trolley sprinkling car which is designed to sprinkle the streets from curb to curb. It is very essential in many of our wide streets and boulevards to sprinkle the entire width of the street at one operation, and the car which we illustrate does it very effectually. The sprinkling wagon of to-day is a great improvement over those formerly in use, on account of the ability of the driver to judge and determine instantly how much water to put on the pavement to sprinkle it properly and not flood it; but sprinkling with an ordinary horse tank wagon is expensive, owing to the fact that its capacity is small, requiring frequent fillings, and the cost of maintaining horses is very heavy. Many of our modern trolley lines are miles in length, and, with a car like that shown in the illustration, many miles of streets or roads may be sprinkled with economy and dispatch. The trolley sprinkler



THE MILLER ELECTRIC WIDE SPRAY SPRINKLING CAR.

has a capacity of 25,000 gallons of water, and by means of rotary electrically-driven ejectors the water is thrown out from the car to a distance of fifty feet if desired. The width of spray can instantly be reduced and at the same time the mechanism permits the varying of the quantity of the water discharged, so as to give the operator complete control of the spray and quantity of water discharged, so as to meet instantly any changes in the width of the road or the speed of the car, and the spray can be entirely shut off if desired. Both sides of the car are equipped so that it can move either end forward. The ejector consists of a four-roller gun metal rotary pump, with adjustable casing for regulating the flow of the water. The ejector is operated by an independent differential gear electric motor, and there is no connection between the movement of the car and the operation of the ejector. Two separate sprinklers of the ordinary kind are placed below the front and rear of the car for watering the space between the tracks. These are controlled by lock stops separate from those of the side sprays.

The car is fitted with two 25 horse power propulsion motors, the same as an ordinary electric passenger car, and can be run at any speed without interfering with the sprinkling device, which, on account of its adjustability, can discharge the same amount of water on the roadway irrespective of the speed at which the car is traveling. It will be seen that this sprinkling car is a radical departure from other devices for sprinkling streets. That it can be successfully operated in the largest cities and result in better service at a smaller cost per front foot will be easily seen.

We are indebted to the Miller-Knoblock Company, of South Bend, Indiana, for the foregoing particulars. This device is patented by William H. Miller.

Bessemer Steel and its Effect on the World.

The wonderful economic changes wrought by the introduction of Sir Henry Bessemer's inventions have never been more ably set forth in a few words than by the Hon. Abram S. Hewitt, in an address delivered before the Iron and Steel Institute, when the Bessemer Medal was conferred on him in 1890, for distinguished services to the iron and steel trade. We quote Mr. Hewitt's words in full:

"I do not propose to enlarge upon the practical application of the Bessemer process to the manufacture of steel: but, if you will bear with me, I think it would be well to direct attention to the effects of this invention on the economic, social and political condition of the world. A very few considerations will serve to show that the Bessemer invention takes its rank with the great events which have changed the face of society since the time of the middle ages. The invention of printing, the construction of the magnetic compass, the discovery of America, and the introduction of the steam engine are the only capital events in modern history which belong to the same category as the Bessemer process. They are all examples of the law of progress which evolves moral and social results from material development. The face of society has been transformed by these discoveries and inventions. It is inconceivable to us how the world even existed without these appliances of modern civilization; and it is quite certain that if we were deprived of the results of these inventions, the greater portion of the human race would perish by starvation, and the remainder would relapse into barbarism. I know it is very high praise to class the invention of Bessemer with these great achievements, but I think a candid survey of the situation will lead us to the conclusion that no one of them has been more potent in preparing the way for the higher civilization which awaits the coming century than the pneumatic process for the manufacture of steel. Its influence can now be traced, although the future results are still beyond the reach of the imagination.

Its principal characteristic is to be found in its cheapness. Steel is now produced at a cost less than that of common iron. This has led to an enormous extension in its use and to a great reduction in the cost of the machinery which carries on the operations of society. The effect has been most marked in three particulars: First. The cost of constructing railways has been so greatly lessened as to permit of their extension into sparsely inhabited regions, and the consequent occupation of distant territory otherwise beyond the reach of settlement. Second. The cost of transportation has been reduced to so low a point as to bring into the markets of the world crude products which formerly would not bear removal, and were thus excluded from the exchanges of commerce. The practical result of these two causes has been to reduce the value of food products throughout the civilized world; and inasmuch as cheap food is the basis of all industrial development and the necessary condition for the amelioration of humanity, the present generation has witnessed a general rise in the wages of labor, accompanied by a fall in the price of the food which it consumes. I think it would be a very modest estimate of the improvement in the condition of the working classes as a whole to say that in the essential elements of comfort the working classes of our day are enabled to earn and to expend at least double the amount which was at their command in any previous age of the world. This result appears to me to be due very largely, if not altogether, to the economy in the agencies of production made by the cheap steel of the Bessemer process and of the other inventions which have followed in its wake. These are material results, but they are accompanied with the slow but sure elevation of the great mass of society to a higher plane of intelligence and aspiration. No better evidence of this can be afforded than the association of workingmen together for the advancement of their moral and social condition. Troublesome as the trade unions may have been, they indicate a step in advance which should be the subject of congratulation among all the well-wishers of the race. I see nothing but good to come out of the modern tendency to association, and I hold it to be one of the chief glories of Sir Henry Bessemer that he has contributed more than any other living man to that condition of industry which compels all who are engaged in its conduct to combine on a scale unknown before his time in the work of economic production and equitable distribution.

The first striking result in the cheapening in the cost of the production and transportation of food products was felt in Great Britain, which is now compelled to import at least two-thirds of its consumption. The competition of our western wheat regions with the products of India in the English market altered the whole condition of agriculture in the British Isles. The profitable raising of wheat practically became impossible, and the farmers who had depended upon it could no longer pay the rents stipulated in their leases. A general reduction of rent, therefore, became necessary, which of course reduced the income of the landlords. The aristocracy of Great Britain is a survival of previous conditions, depending for its existence upon the ownership of the land and the revenue derived from it. Hence a serious if not fatal blow at the domination of what may be termed the privileged class of Great Britain was struck, unintentionally, doubtless, by the invention of Bessemer. We have not seen the final result of the competition it has introduced, but enough is apparent to show that the structure of the British government will necessarily undergo very serious changes, all tending to the transfer of power from those who own the land to the commercial, manufacturing and working classes of the people. I think it is doubtful whether any event in modern times, of equal significance, has occurred. Sir Henry Bessemer has certainly been the great apostle of democracy, and although he may be inclined to disavow the claim, history will record the fact that he has been the most potent factor in the reconstruction of the British Constitution upon the basis, ultimately to be reached, of universal suffrage.

Turning from Great Britain to this country, the effects of the Bessemer invention have been even more pronounced and striking. The cheapening in the cost of transportation enabled us to increase enormously the sales of food products in foreign markets. In accordance with the well-known law of commerce that a nation cannot sell without buying, our imports of foreign merchandise have been increased in a corresponding degree. Under our fiscal system, made necessary by the war for the Union, a revenue has been derived enabling us to reduce our national debt in twenty-five years from about four thousand millions of dollars to less than nine hundred millions of dollars at the present time, notwithstanding the payment of a pension roll which now amounts to fully one hundred and twenty millions of dollars per annum. We can trace, therefore, directly to the Bessemer invention the ability to reduce our national debt, and finally to pay off the outstanding bonds at maturity. This proposition can easily be verified by examining the results of the operation of our railroads, by which it will appear that since 1870, when Bessemer rails began to be largely used, the rate of transportation has been reduced about two-thirds, and an eminent authority has recently stated that the difference in a single year would now amount to one thousand millions of dollars, a very large portion of which is directly traceable to the greater durability of the track, due to steel rails and the capacity to haul increased loads, not only in the cars but in the train. I doubt whether it ever occurred to Sir Henry Bessemer to consider the effect of his invention in furnishing us the means of paying off our national debt, but it certainly ought to secure for him the gratitude of every American citizen; and I am glad to have the opportunity, on this occasion, to bring this obligation to the notice of my countrymen.

The third point to which I would call attention is the vast extension and new direction of commerce which has resulted from the construction of steel vessels. The size of these vessels has enormously increased, and the cost of operating them has been reduced in a corresponding degree, comparing very favorably with the reduction of cost upon land, which is about one-third of what it was ten years ago. The characteristic of modern commerce is the rapidity with which exchanges are made, and in the fact that all portions of the habitable globe are quickly reached. The commercial world has been converted into a vast clearing house for the exchange of products. One country may sell more than it buys, or buy more than it sells, to a particular country, but the difference is counterbalanced by a corresponding sale and purchase from some other country. The balances are not paid in money, but are passed to the credit of each country in the general settlement which takes place in the banking centers of the commercial world. Thus the function of the precious metals is reduced simply to the payment of final balances, which in the course of any one year are small in amount. The economy in exchange thus effected is largely due to the improvement in transportation, made possible by the general use of steel, aided by the telegraph and particularly by the submarine cables which now reach every part of the civilized world. The interdependence of the human race has thus been increased, and the possibilities of hostile action by war diminished in a corresponding degree. The name of Bessemer will, therefore, be added to the honorable roll of men who have succeeded in spreading the gospel of 'Peace on earth and good will toward men,' which our divine Master came on earth to teach and to encourage."

When Mr. Hewitt was seen after the death of Sir Henry Bessemer, he stated by way of corollary that in 1897 the United States was the largest producer of iron and steel in the world, and that she would remain so. This will make her mistress of the export trade, of which we are now only on the threshold. We need not fear losing the primacy when once obtained, for it has been found that the Lake Superior ores are specially adapted for the Bessemer process, as they are low in phosphorus; this puts us ahead of all competition.

Psychic Development of Cats and Dogs.

Prof. Wesley Mills' experiments on the psychic development of young animals continue to be very interesting, says The Popular Science Monthly. In the kitten, while the first stages are very slow and obscure, the author finds that in the progress of all the senses to full development the course, while marked by definite steps, is often so rapid that distinct advances may be marked in a single day. Apart from the senses, etc., there seems to be a definite order in which all the features of feline nature appear, as, for instance, purring, crouching, stalking, etc. Certain physical changes are correlated in time with certain psychic developments, the significance of which is in some cases clear, in others obscure. Comparing the two animals, the cat, on the whole, develops more rapidly than the dog, the greatest difference between them appearing in the social and gregarious nature of the dog and the independent and solitary traits of the cat. The dog is docile in the highest degree: the cat to a slight degree, compared with its intelligence. The play instinct is early and highly developed in both, and the peculiar qualities of each are well exhibited in the manifestation of it. In will power and ability to maintain a separate existence the cat is superior to the dog. In the higher grades of intelligence the wisest dogs are much in advance of the most knowing cats; and this is foreshadowed, if not exemplified, in the early months of existence. The nature of the dog as compared with the cat tends to beget prejudices in his favor with the mass of persons, so that in general the dog is overestimated and the cat underestimated with the great majority; at the same time the dog's nature is much nearer that of man than the cat's. "The kitten may amuse, but even a puppy dog touches chords of sympathy in the heart of man that the cat can never reach."

The Current Supplement.

The current SUPPLEMENT, No. 1160, contains a number of articles of unusual interest. The complication of the United States, Cuba and Spain is touched upon in three articles: The 'Naval War Game," "The United States Buys the 'Mayflower,'" and "Alphonso XIII., King of Spain." All these articles are illustrated. The "War Game" is of particular interest, in view of the fact that the question of a naval fight between Spain and the United States is taken up, and models of the vessels of the two navies are pitted against each other. "Prehistoric Bronze" is the subject of an interesting paper by R. L. Packard, of Washington, D. C. The "Reduction in Cost of Steam Power from 1870 to 1897," by F. W. Dean, gives important figures showing the cost of steam power to-day and twenty-seven years ago, and demonstrates the remarkable changes which have been introduced by improved methods of generating and consuming steam. "An Electrolytic Process for the Manufacture of Parabolic Reflectors" describes an ingenious electrical process for coating mirrors for reflectors for search lights and similar purposes. The "Phonendoscope," an instrument for ascertaining the state of the organs in the human anatomy by means of the ear, is described more fully than heretofore. The "Report of the Commissioner of Patents for 1897" deals with the condition of the Patent Office to-day, and the first installment of this report is published in this week's SUPPLEMENT.