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PNEUMATIC TRANSMISSION.

FROM "ELECTRICITY AND THE ELECTRIC TELEGRAPH," BY GEORGE B. PRESCOTT.

The transmission of messages between the branch and central stations in the large cities, by means of pneumatic tubes, constitutes an important and valuable feature of the modern telegraphic establishment.

Messages are sent from the Central office of the Western Union Telegraph Company, New York city, by compressed air, and to the Central office by exhaust air, the engine, pumps, and valves being at the Central office. In our large illustration, Fig. 1, is represented the receiving and sending station in the operating room of the above named company's building. The tubes on the right are those in which messages are dispatched; from those on the left messages are received. The mode in which the missives are prepared for transmission is described in detail further on. It will suffice to say here that the paper is folded and inserted in a felt-covered case. A valve is opened and the latter inserted in the lower end of one of the tubes. The valve is then shut, and in thirty-two seconds the case travels through about 2,100 feet of tube and arrives at the Broad street station, the fact being announced by the sounding of an electric bell at the sender's table. To make the journey through the 3,308 feet of tube, between the Central office and the Cotton Exchange, occupies about 55 seconds: the compressed air which empties the case being under a pressure of about 9 lbs. Although by using greater pressures a higher velocity is easily attainable, the above is found to answer practical requirements best. To draw cases from the stations to the Central office a vacuum of some 12 inches is employed. The number of messages transmitted daily between the hours of 8 A.M. and 5:30 P.M. averages, we are informed, from two to three thousand. The arrangement of the apparatus is as follows: To the pumps are attached two large mains, one for pressure and the other for vacuum. These mains are carried from the engine room to the operating room, where the pneumatic tubes are situated, and are of such dimensions as to obviate the effect of the intermittent action of the air pumps. The valves are of two kinds, single and double sluice, and are so arranged that they can be employed for exclusively forwarding messages by compressed air, exclusively receiving messages by exhausting air, and for alternate forwarding and receiving through a single tube. The arrangement of the single sluice valves is shown in Figs. 2 and 3, on page 178. T is the tube which forms the prolongation of the underground conductor.

To receive a carrier at the Central office the lower end of this tube is closed by raising the hinge valve, C (which has a rubber packing); the stopcock, V, is then turned, which establishes a communication, through T and S, with the vacuum main. A vacuum is produced in T, and the valve is kept closed by atmospheric pressure. The carrier, on arrival, forces it open, but, as the shock which the carrier receives upon its arrival destroys its momentum, it is drawn up by atmospheric pressure and suspended against the opening, O, of tube, S. As soon as valve, C, falls, the operator shuts the stopcock, V, and the carrier, being no longer held by the outside pressure, falls out of the tube, T, by its own weight. To send a carrier from the Central office, it is placed in the tube, T, Fig. 3, and the operator, by means of the handle bar, *m*, pulls the sliding apparatus, formed by the rods, *g*, and the crossbar, *d*, which latter meets the ring, *b*, fixed on the rod, *f*, and carries this with it. The obturator, K, fixed to the end of *f*, is thus made to close the extremity of the tube, T. When this closure is complete, the inclined plane, *h*, fixed on one of the rods, *g*, meets and pushes back the roller, *j*, thus opening a valve within the cylinder, L, and establishing communication between the reservoir of compressed air and the tubes, M and T. The carrier is there forced forward in the tube, and whenever its arrival is announced by the electric bell, the slide is pushed back to its normal position.

If the rod, *f*, were connected rigidly with the crossbar, *d*, a certain effort would be required to push back the slider, owing to the friction due to the pressure on the surface of the obturator. This effect is avoided by making the rod, *f*, slide in the crossbar between the limits, *b* and *l*, for, in pushing it back, the inclined plane first leaves the roller, *j*, and the compressed air ceases to enter the tube; then the crossbar meets the ring, *l*, and the rod, *f*, removes the obturator without difficulty.

The greater portion of the parts which form the valves are made of brass. They are attached to strong boards, the one in a vertical and the other in a horizontal position. The latter forms the table, and receives the carriers to be sent, and those which are received from the corresponding offices.

The accompanying diagrams show, Fig. 4 a back view, Fig. 5 a section, and Fig. 6 a top view of the double sluice pneumatic valve. The following is a description of the method of using it and of its action: To send a carrier by the forwarding or outward tube, the mode of working is as follows: The carrier containing the message is inserted up the mouth of the pneumatic valve, P, Fig. 5, into the message chamber, M, until its buffer is held by the contraction at C, which is the true diameter of the message tube. (The illustrations show the valve in its normal position.) The handle, H, is then drawn forward, carrying with it the sluice valve, S, until the mouth of the message pipe, P, is closed. By this time the stop, S^1, strikes against the tail of the quadrant, Q, pressing it into the slot, *s*, of the steel slide bar, B; and by the continuation of the motion necessary to bring the sluice valve, S, to the end of the sluice box, *b*, bringing with it the tail of the quadrant, which is centered at O, gives an opposite motion to its other extremity, which, fitting into the rack, R, opens the top sluice, T. During this motion an inclined plane, I, Fig. 6, which is fixed upon one of the side rods carrying the lower sluice, passes between the fixed roller, F, and the roller fitted upon the pressure valve, V, establishing communication between the pressure main and the message pipe; the air thus admit-

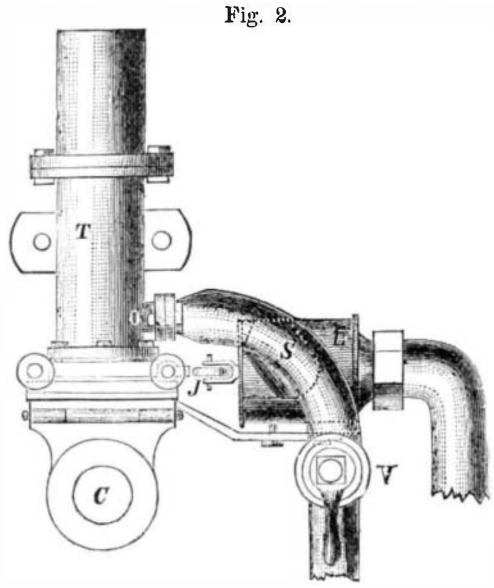
[*Continued on page* 178.]

PNEUMATIC TRANSMISSION IN NEW YORK CITY.

[*Continued from first page.*]

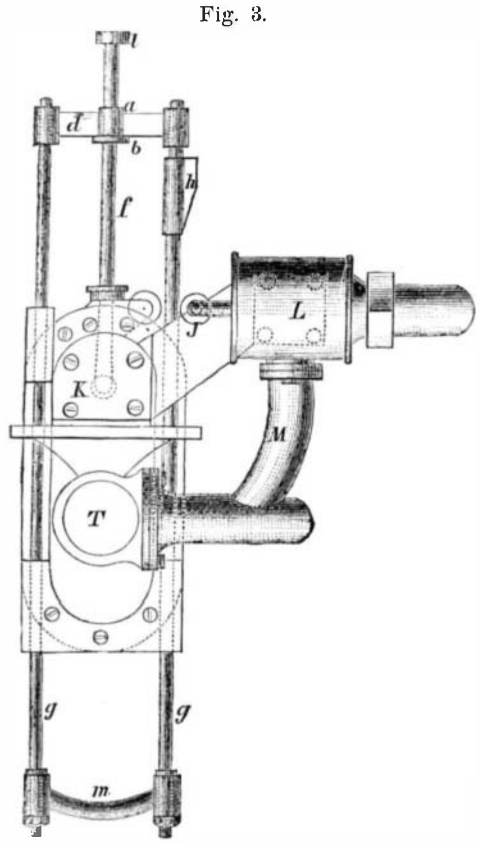
ted immediately acts upon the lower part of the carrier (which portion it expands, so as to make it fit the pipe with

Fig. 2.



as little friction as possible) and forces it onward to its destination. If it be necessary to send a second carrier while the first is in transit (a process which is undesirable), the

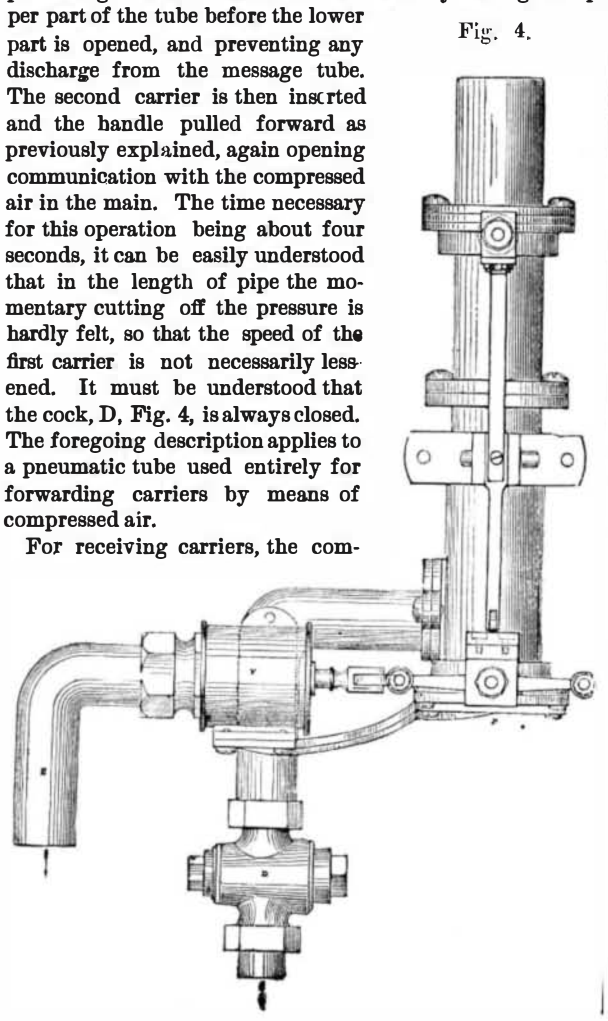
Fig. 3.



handle, H, Fig. 5, is pushed back to its normal position, thus producing a reverse motion of the valves by closing the upper part of the tube before the lower part is opened, and preventing any discharge from the message tube. The second carrier is then inserted and the handle pulled forward as previously explained, again opening communication with the compressed air in the main. The time necessary for this operation being about four seconds, it can be easily understood that in the length of pipe the momentary cutting off the pressure is hardly felt, so that the speed of the first carrier is not necessarily lessened. It must be understood that the cock, D, Fig. 4, is always closed. The foregoing description applies to a pneumatic tube used entirely for forwarding carriers by means of compressed air.

For receiving carriers, the communication between the pressure main and the pressure valve, V, is first cut off by means of a stopcock fitted upon the tube, E, but lower than is shown in the diagram. The handle, H, is then drawn forward, and the stopcock, D, opened, thereby establishing communication between the message pipe and the vacuum main. The carrier inserted at the distant end is then pushed forward by atmospheric pressure, until it arrives in the message box, M, and signals its arrival by the sharp noise caused by its striking the sluice valve, S. The handle, H, is then pushed back, the stopcock, D, having been previously closed; and, by the arrangement already described, the message pipe is closed by means of the sluice valve, T, Fig. 4, and the bottom of the tube being open the carrier falls out of the message chamber, M. It will be remembered that before the admission of compressed air the forwarded carriers are held at C. The buffers of the received carriers, however, having passed this point, the carriers rest free in the chamber, M, and drop out.

Fig. 4.



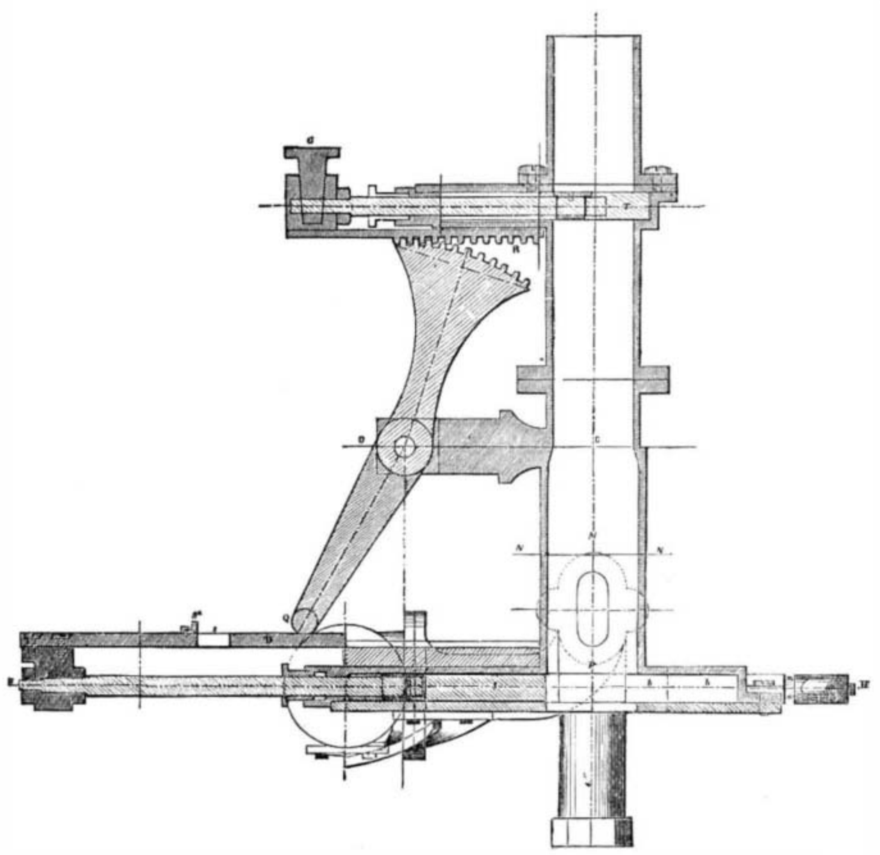


Fig. 5.—THE PNEUMATIC VALVE.

When the tube is used for a constant succession of carriers from the out station, it is necessary to pull forward the handle, H, immediately after the taking out of any carrier. The short space of time occupied in this operation will not have any appreciable effect upon lessening the speed of the succeeding carrier. It will be seen, therefore, that a number of carriers may be continuously passing in succession through the tube. It is, however, undesirable to permit more than one carrier to be in transit at the same time. Where the traffic is not sufficient to warrant the expense of an up and down tube, one tube only is worked in both directions in the following manner: The top sluice, T, is entirely thrown out of use. This is done by removing the plug, G. The rack, R, is then removed, and the sluice valve, T, drawn back, and held in that position by a small clamp made for the purpose. The tube is then in its normal state for alternate traffic, and entirely open to the atmosphere.

To forward a carrier, it is inserted in the message chamber as previously described, and the handle, H, drawn forward. The sluice valve, S, first closes the orifice, P, after which the continuation of the motion opens the pressure valve, by means of the inclined plane on the slide rod, and the carrier is forced to its destination. The handle, H, is, immediately on the arrival of the carrier being signalled, pushed back sufficiently far to remove the inclined plane from between the rollers, so as to close communication between the message pipe and the pressure main, but not far enough to remove the sluice valve from over the mouth of the message chamber By this means the compressed air which remains in the pipe expands to the atmospheric pressure through the distant end of the pipe only. To receive a carrier, the cock, D, Fig. 5, is opened, and a communication is thus established between the vacuum main and the message pipe. The carrier is pushed forward from the distant end, as in the case of the continuous working, and signals its arrival by striking the sluice. The vacuum is then cut off by closing the cock, D. On pushing back the handle the carrier falls out.

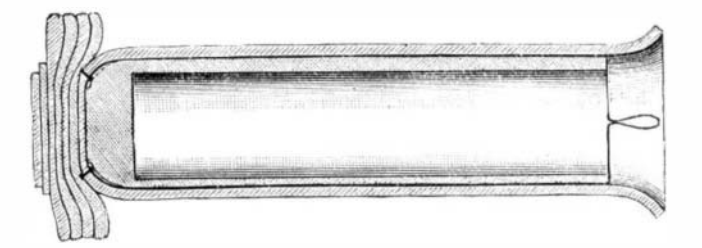


Fig. 7.—CARRIER FOR PNEUMATIC TRANSMISSION.

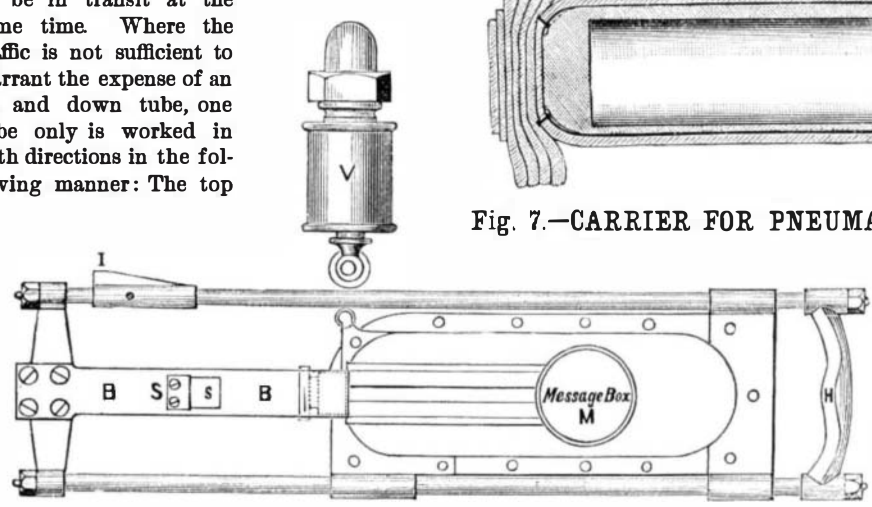


Fig. 6.—PNEUMATIC TRANSMISSION SLUICE.

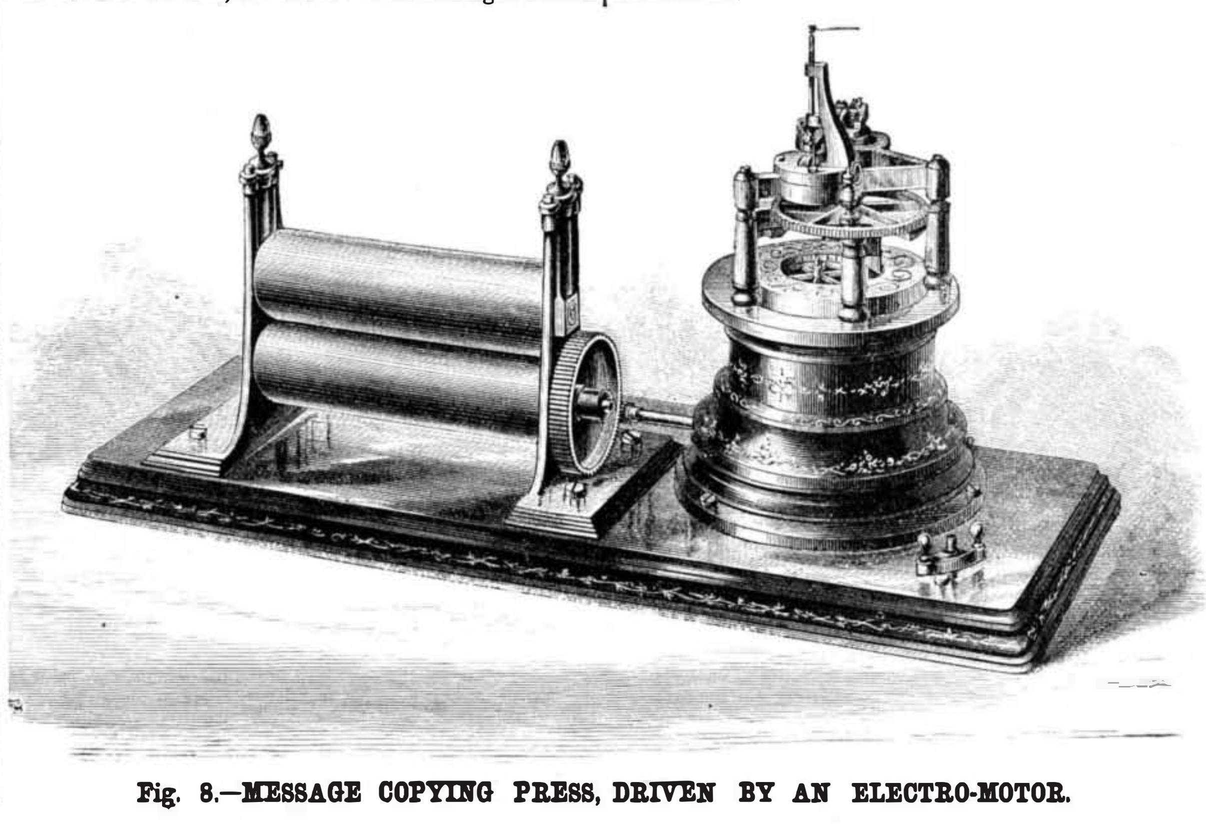


Fig. 8.—MESSAGE COPYING PRESS, DRIVEN BY AN ELECTRO-MOTOR.

A system of electric signals is used between the central station and the outlying stations, consisting of a single stroke bell with indicator, to signal the departure and arrival of carriers, and for answering the necessary questions required in the working.

The carriers or pistons in which the messages are placed are made of a cylindrical box of gutta percha, one sixth of an inch thick and six inches in length. A section of one of these carriers is shown in Fig. 7. The gutta percha is covered with felt or drugget, which projects beyond the open end of the carrier. This part expands by the pressure behind, causing it to fit the pipe exactly. The front of the carrier is provided with a buffer or piston, which just fits the brass tube. This buffer is formed of several pieces of felt. To prevent the messages getting out of the carrier, its end is closed by an elastic band, which can be stretched sufficiently to allow the message to be put in. At the branch stations, where no apparatus is required, the message tube terminates with the end downwards, above the counter or table, so that nothing can fall into it by accident.

Tubes are made of lead, iron, and brass. In London lead tubes are preferred. In Berlin iron only are used. In Paris both iron and brass are employed. In New York brass tubes are exclusively used.

All messages received at the offices of the Western Union Company for delivery, either by the tubes or by messenger, are written by the operator on the proper blank forms with copying ink, and a duplicate is taken, for filing, by laying a sheet of dampened unsized paper upon the message, and passing the two through a copying press. The latter consists of a pair of rollers, which are turned by steam power, an electromotor, or by hand, according to circumstances. Fig. 8 shows one of these presses driven by a Phelps electro-motor. This method of taking duplicate copies is much neater, and is in many other respects preferable to the manifold process employed in Europe, which is only used in this country when a large number of copies are to be taken of the same despatch, as in the case of press news.

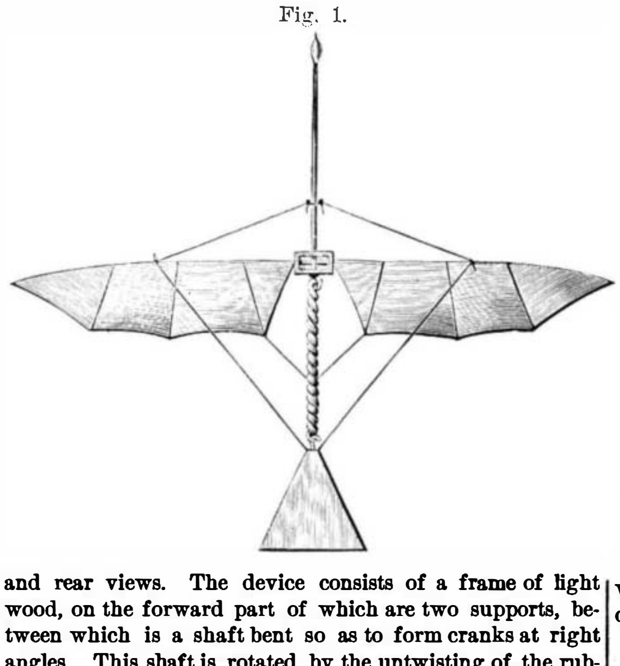
NEW EXPERIMENTS ON MECHANICAL FLIGHT.

M. V. Tatin has recently published a report of results of experiments conducted during the past year, the object of which has been the reproduction of the flight of birds by mechanical contrivances. He has studied, by the aid of small models set in motion by rubber springs, the best form of wing, in order to determine the nature of the large wings most suitable for use on a machine actuated by compressed air. After many trials, M. Tatin finds the larger proportion of advantage to be with long and narrow wings. Other investigators have already shown that a wing may be as effective when narrow as when broad, and Professor Marey has pointed out the fact that those birds which have small amplitude of wing movement always have very long and narrow pinions. With this form (Fig. 1) M. Tatin has rendered as short as possible the period during which his artificial wing takes the proper position to act on the air during its down stroke.

As a bird flies the more easily as his wings act upon large masses of air in shorter periods of time, it will be evident that the velocity of maximum translation will be the most advantageous pace in point of reduction of expenditure of power. M. Tatin, not being able to prevent his mechanical birds expending considerable power in order to obtain a useful velocity, seeks to remedy this difficulty by moving their centers of gravity forward. A bird in full flight then keeps the same equilibrium as one that soars, and its velocity is in one sense passive, new bodies of air, as it were, placing themselves under the wings. All the expenditure of power may then be utilized for suspension. In this way M. Tatin has been able to augment the weight of his apparatus without increasing the motive power.

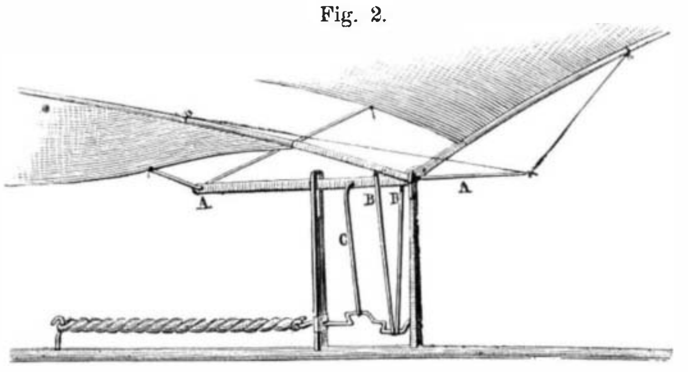
The movement which the wing makes around a longitudinal axis, and which allows it to present always its lower face forward during the up stroke, is obtained by the apparatus illustrated in Figs. 2 and 3, which are respectively side

Fig. 1.



and rear views. The device consists of a frame of light wood, on the forward part of which are two supports, between which is a shaft bent so as to form cranks at right angles. This shaft is rotated by the untwisting of the rubber spring shown. The forward crank, B, produces the up and down movement of the wings, which are movable around a common axis, A. The latter is inclined downward and rearward by the second crank, C, when the first is passing its dead point, and when the wings are at the lowest position during their stroke.

Fig. 2.



But the wing should not only change position in its entirety; each point on its area should have, especially during the up stroke, an inclination as much more marked as it is nearer the extremity. The portion nearest the body alone should keep a uniform obliquity. M. Tatin therefore concluded that it would be necessary to produce this torsional movement by the wrist; and he therefore substituted, for the wings of silk hitherto used, wings of strong feathers,

Fig. 3.

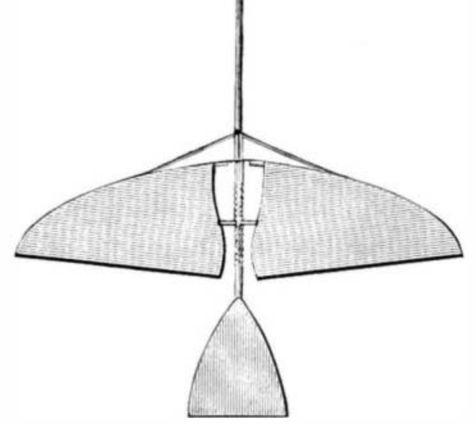
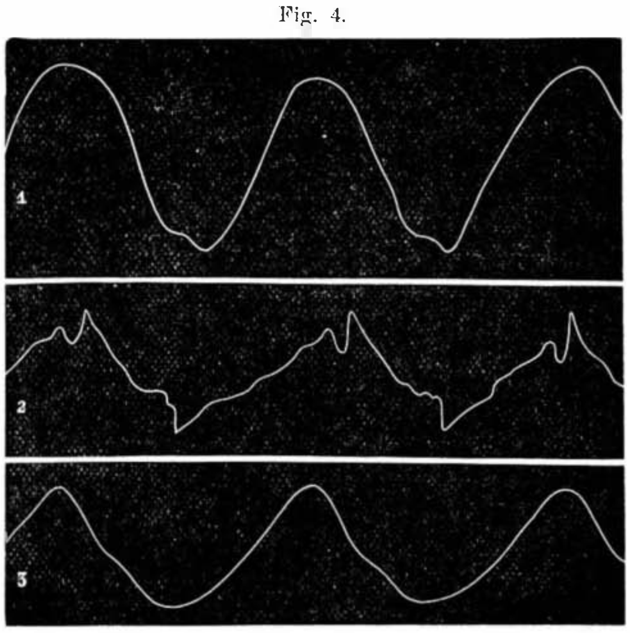


Fig. 4.



which would not bend like the former, but which would slide one on the other during the torsion. This apparatus worked admirably in the model; but when tested on a larger scale the results were inferior, and led the author to return to the silk wings, which he now definitely adopts.

By means of many slight modifications in the shape of the wings, extent of their amplitude, etc., M. Tatin has finally brought his compressed air bird to a remarkable degree of perfection. He had previously made the apparatus lift a load corresponding to three quarters its own weight; now it lifts one equalling its weight. The only difficulty seems to be to cause the device to follow a horizontal course; but this can doubtless be adjusted by a suitable disposition of the tail. The value of M. Tatin's results is shown by a comparison of the curves, graphically produced on Professor Marey's registering apparatus by the motion of the wings of birds, and that of the flying machine. No. 1 in Fig. 4 is the curve produced by the up and down movement of a pigeon's wing; No. 2 is that of the mechanical wing actuated by a rubber spring; and No. 3 is that of the mechanical wing driven by compressed air. The analogy between Nos. 1 and 3 is striking. M. Tatin believes that he will soon reach a formula which will show definitely how many foot lbs. per second are necessary to cause the flight of a given weight.

FRENCH journals state that M. Henri Giffard is building a steamboat that will make 45 miles per hour.

A New Compressed Air Railway.

Some interesting experiments have lately been made in Geneva, Switzerland, on a new system of compulsion by compressed air, the invention of M. Gonin. The road upon which the invention is to be practically employed connects Ouchy, on Lake Geneva, with Lausanne, the line following a grade of 12 in 150. For two thirds of the distance, which is but 4,800 feet, traction is accomplished by metallic cables driven by hydraulic motors; over the remaining third, the vehicles are moved by a piston traveling in a long air tube and impelled by compressed air.

In the recent experiments, a section of the tube, 128 feet in length, was used. The interior diameter was 9·75 inches, and the thickness 0·46 inch. The total weight was 880 lbs. On the upper side a slit was made, with its edges flaring inwards, in which an angular valve fitted. The lateral faces of the valve were covered with leather; and it was pressed against its seat by coiled springs fastened on the outside of the tube. The piston inside the tube was composed of six cast iron disks, with leather washers between them, the latter being cut a little large so as to pack the tube tightly. The piston rod supported three rollers, which served as guides to keep the piston in the axis of the tube. Between rollers and piston, the propelling bar was attached. This was made of such a form as, when the valve in the slit above was lowered, to extend up between said valve and one edge of the slit. Its upper end then came in contact with the vehicle; and thus the motion of the piston was transmitted to the latter. In order to cause the lowering of the valve just in advance of the bar, the car carried a roller which pressed upon a band of metal which rested on the valve rods, the latter being extended up through the springs.

A small compressing engine supplied air to a reservoir, whence it was drawn at a pressure of about 12 atmospheres. The object of the experiments was principally to determine the staunchness of the valve, and in this respect, the *Revue Industrielle* states, they were entirely successful.

A NEW KEELY MOTOR DECEPTION.

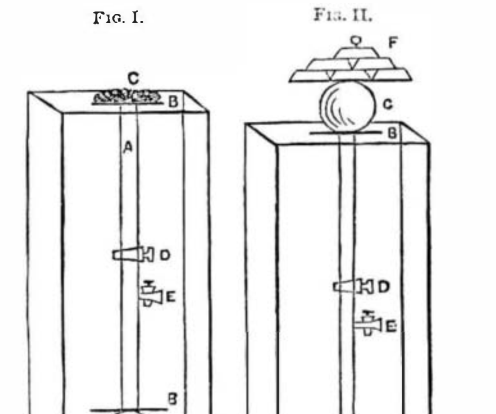
Professor E. Stebbing writes from Paris to the Philadelphia *Photographer* as follows:

"For the last few days all the *élite* of Parisian science have been deep in thought, as an engineer has given the news to the world that he had discovered a new power which would revolutionize the art of the engineer. The inventor, M. Charles Boutet, is well known; he is the author of the project of a bridge over the Straits of Dover, which would probably have been finished but for the overthrow of the French Imperial Government. Since the war he has directed his attention to hydraulic machines, and upon the following experiment he has based his idea of a new engine: He takes an apparatus composed of a two-inch bore iron tube, of a yard and a quarter long; to each end is brazed an iron disk, intended to support two india rubber balls in communication, the one with the other, by means of the iron tube. This communication can be cut off at will by means of a tap (see Fig. I.); a small tap is also placed in the tube to inflate the india rubber ball. When this is done the apparatus is pressed down into a large tank of water (Fig. I.). This requires a force which can be calculated at about 10 lbs.

"A charge of 160 lbs. can be placed upon the upper ball; and when the communication cock is opened, the 120 lbs. will be raised up (see Fig. II.). By this simple experiment it is clearly proved that a gain of 120 lbs. of force can be obtained. The author intends to avail himself of this force, and to make a 20 horse power engine for the next Exposition of Paris in 1878.

"Such is the invention of which every one speaks —a constant force obtained without expense. A machine of unlimited power, which feeds itself. No

FIG. I. FIG. II.



A is an iron tube; B B are iron disks; C C are india rubber balls; D is the communication tap; E is the air cock; F is 160 lbs. weight.

smoke, no dust, no noise, no danger of explosion. Another crown to the glory of the nineteenth century.

TO PROLONG the duration of ropes, steep them in a solution of sulphate of copper, 1 oz. to 1 quart of water, and then tar them.