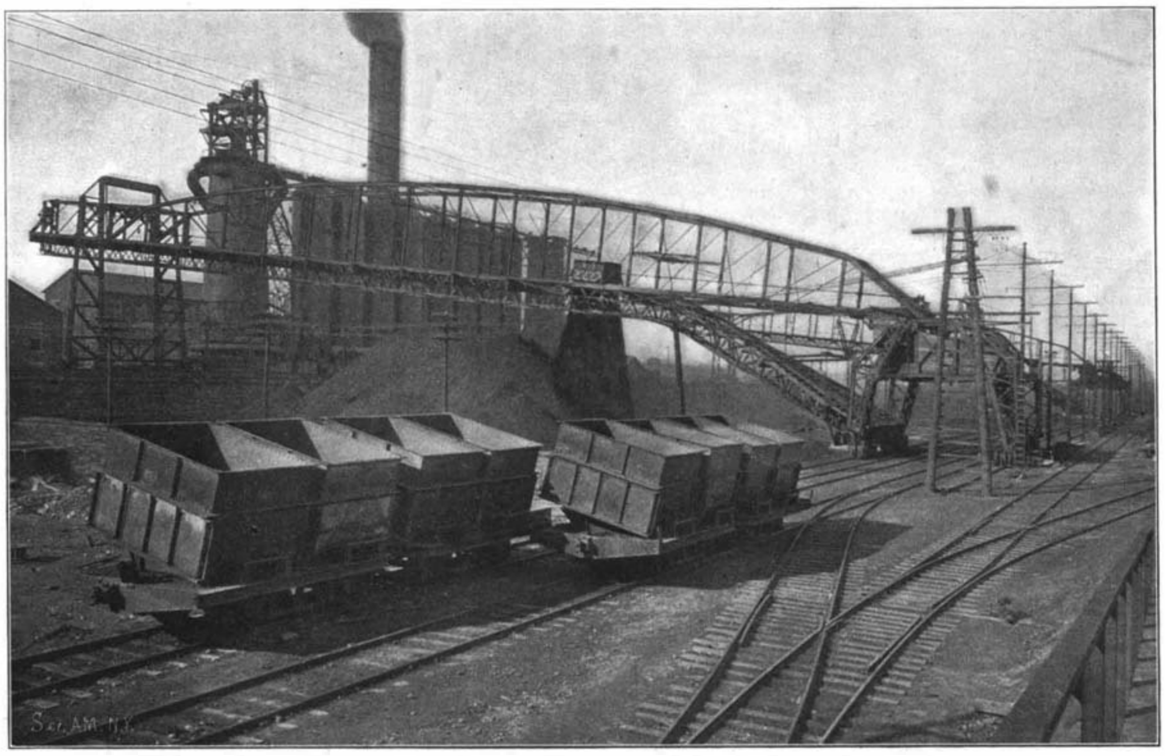
ORE HANDLING AT FURNACES.

BY WALDON FAWCETT.

In few sections of the industrial field has the past few years witnessed an advance which has been as revolutionary in its influence upon methods and equipment as in the handling of iron ore at the blast furnaces, where its conversion into pig iron constitutes the first step in iron and steel manufacture, according to the general interpretation of the term. A few years since it was the custom to transfer by hand the ore, coke, limestone and other ingredients of the furnace "charge" from the railroad cars to wheelbarrows, by which, supplemented by elevators of antiquated design, the raw material was conveyed slowly and laboriously to the top of the furnace. Under the new system mechanical devices perform automatically almost every function which was formerly dependent upon human labor.

The bridge tramways, equipped with hoisting and conveying apparatus for the movement at high speed of tubs or buckets of over a ton capacity, which have proven so successful in unloading ore from vessels on the Great Lakes, and the car-dumping machines which have come into extensive use for placing large consignments of coal on board vessels expeditiously, have both been utilized for handling ore at furnaces; and in some instances these two exceptionally interesting classes of machinery have been used in conjunction. This is the case at the plants of the National Steel Company at Youngstown, Ohio, and Mingo Junction, Ohio, and the Neville Island plant of the American Steel and Wire Company. It has been demonstrated at these institutions that under almost any conditions ore can be handled from railway car to ore-pit or from ore-pit to bins at an average of less than one cent a ton.

In order to convey an adequate idea of the scope of a representative installation of this character, it may be stated that the stock yard is from 700 to 1,000 feet in length with a width of 250 feet between opposite walls and has a capacity of from 750,000 to 1,000,000 tons of ore. The yard is spanned by two steel conveyor bridges which are the largest of their type ever constructed. Each bridge in addition to the span of 260 feet has a cantilever extension over the bins of 41 feet. Each bridge is mounted on a two-track machine tower at its outer or receiving end and on a one-track rear tower next to the furnaces. At their receiving ends the bottom chords of the bridges are approximately 54 feet above the bottom of the ore-pit and at the rear tower 80 feet, thus giving very large storage capacity.



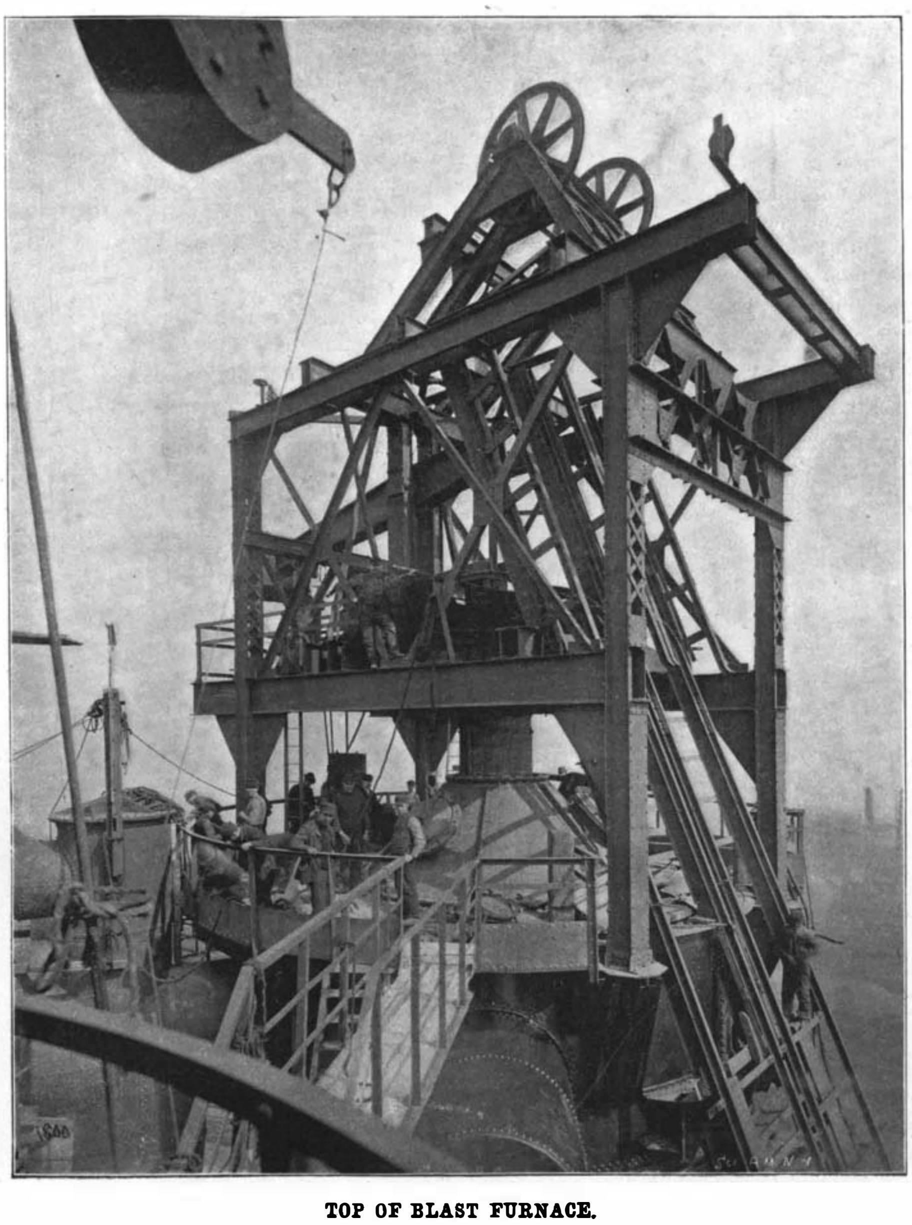
ELECTRICALLY-OPERATED BRIDGE TRAMWAY WITH HOISTING AND CONVEYING APPARATUS.

The bridges travel along their tracks at a speed of fifty feet a minute by means of gearing driven by two 130 horse power electric motors on each bridge. These motors also furnish the power for handling the ore on the bridges, as well as in rehandling it from the stock pile, suitable drums and gearing being connected with the motors. The motors take their current from an overhead trolley above the machinery tower. The operating machinery is located overhead in the main tower, and an operator's house is placed next to the bridge in a position giving the operator an unobstructed view of the ore cars as they move on the bridge, for this apparatus, it should be explained, delivers ore to the stock piles in small cars instead of buckets.

The car-dumping machine, which constitutes an important feature of the installation, is located at a point easily reached from the storage yard in which the regular railroad cars loaded with ore are received. The car-dumper is located on the summit of a slight incline, and in a pit below the loaded car as it reaches the foot of the incline is a disappearing car. This is drawn up out of the pit, moving the loaded car by winding drums located on the car-dumper. A push-bar on the disappearing car engages the drawhead of the ore car, pushing it up grade into the car-dumper.

The car-dumper consists of a substantial steel structure on which is a platform to receive the loaded car. This platform is pivoted at one side, and when the platform with the car load of ore is rotated around this axis, the car is raised sufficiently high to discharge the ore over an apron into four small steel cars of seventeen tons capacity each, mounted on a transfer car alongside the car-dumper. To insure the equal distribution of the ore in the four smaller cars, movable deflectors are pivoted to the apron of the car dumper. These are moved by a steam cylinder with cataract locking cylinder, both being under the control of the operator. By means of this machine gondola, wood or steel hopper bottom cars of twenty to sixty tons capacity can be handled. The car dumper may be operated either by steam engines or electric motors. After the loaded car is run into the car-dumper the operator sets the deflector for either a short hopper car with ore loaded nearly uniform throughout the car or for a long gondola with ore loaded at either end over the trucks, as the case may be.

The 17-ton cars which receive the ore from the car-dumper are of the side-dump pattern. The transfer



TOP OF BLAST FURNACE.

FURNACE HOIST FOR AUTOMATIC CHARGING OF BLAST FURNACES.

car on which they stand side by side is pushed by a locomotive under the front or machinery tower of the bridge in alignment with the tracks on the incline underneath the bridge. These tracks converge into one main track on the bridge, the switches being automatically operated by the car as it passes over them. One by one the cars are drawn up through the incline tracks and down through the bottom chords of the bridge and dumped automatically at any point desired. This is accomplished by a lever underneath the car engaging a knuckle, causing the two hinged side plates to be thrown outward.

For rehandling the ore from stock pile to bins a second or supplementary track is suspended below the chords of the bridge with a trolley running thereon, which carries an automatic bucket of ten tons capacity that is filled by dragging it up the stock pile. A two-part, clamshell bucket, or a four-part, grapple bucket may be used with equal advantage. When the stock pile from which ore is being drawn is not opposite the bins into which it is desired to put the ore, the 10-ton bucket will empty into the motor cars, which move to the proper bin with their contents. It is possible to bring a train of drop-bottom ore cars directly to the tracks over the bins; but the usual method is by way of the stock yard and conveyor apparatus. The capacity of the car-dumper is thirty railway cars an hour. Each of the bridges is capable of handling fifty of the 17-ton cars per hour, or an equivalent of twelve and one-half railway cars per hour. Three men are required for the operation of the car-dumper, two on each conveyor-bridge and three on the locomotive for moving the transfer cars.

Another important adjunct of the present-day equipment for handling ore at furnaces is found in the furnace hoist for the automatic charging of blast furnaces, which dispenses with the employment of top-fillers, all operations being conducted by one man at the engine at the base of the hoist. The hoist consists, in the main, of an inclined, steel-trussed bridge, starting from a pit in the stock house and reaching to the top of the shell of the furnace, to which it is secured by abutment-lugs and pins. From this point there is an extension of the frame, continuing upward and over the top of the bell and hopper. Secured to the chords of this bridge are cross-ties, supporting a track of T-rails. Running on this track is a skip-car of from one to three tons capacity, the hoist-rope to which it is connected passing over the top sheave and back to the drum of the hoisting engine, near the foot of the incline. When the load has been hoisted to the proper height unwinding is prevented by a special safety throttle-valve.

When the skip-car arrives at the top of the furnace the narrow-tread wheels in front continue on a portion of the track bent in toward the hopper, whereas the broad-tread wheels in the rear pass to outer rails and by continuing thereon, tip the car and dump the load. One of the great advantages of this device is that it obviates the necessity for exposing workmen to the dangers of the noxious gases at the furnace-top. For use in conjunction with the hoist there is a stock-distributor, which absolutely insures any desired predetermined order of distribution of stock in the furnace. The distributor itself consists of a cone-shaped steel structure with an oval spout leading out at one side underneath it, the whole being supported on rollers, which are in turn supported by a built-up structure resting upon the top ring of the furnace. As each trip of the skip is made, this distributing-cone is revolved a certain portion of a revolution by means of gearing connected with the hoisting mechanism and engaging with the ring on the cone. Thus a perfectly uniform distribution is insured.

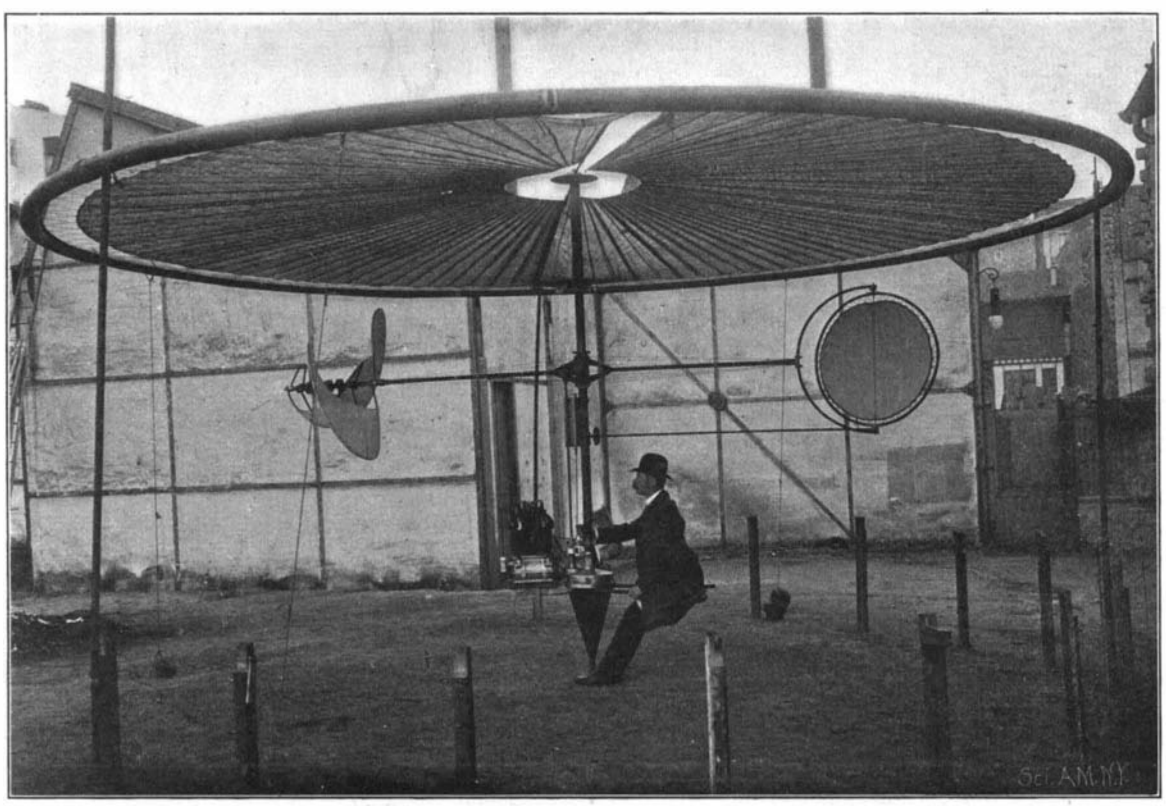
Other notable devices consist of automatic stock-registers for indicating every time the bell is lowered the exact height of the stock in the furnace and skip-registers for indicating the number of skip-cars charged into the hopper, thus preventing over—or under—filling. All the work of hoisting stock and filling the largest furnaces is easily performed by one man.

THE VILLARD FLYING MACHINE.

BY OUR PARIS CORRESPONDENT.

A novel form of flying machine has been devised by M. Henri Villard, a prominent engineer and aeronaut of Paris, who has carried on experiments in this direction for some time. His apparatus was exhibited at the last concourse of aviators, but as it was not entirely completed it could not be given a practical trial. The Villard aerostat embodies several different principles in the same apparatus, those of the kite, the parachute and the aeroplane, and part of it is given a gyroscopic motion, such as is exemplified in the well-known toy flier, the rapid revolution of which tends to keep it in the same plane so that is is almost impossible to overturn it. These principles are not contradictory, and may therefore be combined in an apparatus which will possess the advantages of the different forms. The principle of the flying machine may be best explained by imagining a parachute of considerable size and supposing that it is made rigid by an exterior steel rim and wire spokes. Again, if this parachute were attached by a cord, it would act like an ordinary kite. To propel the parachute in the horizontal direction a screw is added, operated by a suitable motor. In this case the apparatus, if started from an elevated point, will fall very slowly and will be enabled to cover a considerable distance from its starting point. One of the most original ideas is to add to the above combination the gyroscopic principle. This is brought about by causing the whole upper part of the parachute to turn rapidly, and as the rim is somewhat heavy this action becomes quite effective, and tends to keep the machine in one plane. In this way the apparatus acquires a great rigidity and it becomes difficult to overturn it. Another point is that the fall of the parachute may be almost or even quite overcome by arranging the upper part so as to give the surface the form of a very flat screw, just enough to compensate for the fall. In this way when the parachute revolves rapidly the descent becomes very slow, and it would no doubt be possible to overcome it entirely if desired. To complete the flying-machine it is only necessary to add a rudder and a seat for the aeronaut. One advantage it will have is that the aeronaut runs but little risk, for should the motor fail to work he will descend as in an ordinary parachute. The inventor has calculated the dimensions as well as the force which should be given to such an apparatus. As the whole machine, with the aeronaut, weighs from 650 to 750 pounds, he finds that according to a bird's proportions he should have about 52 square yards of surface. The form to be given to the screw is that which will overcome the air resistance, which in this case is very small, allowing a speed of 40 feet per second, and not more than ½ horse power would be needed; the inventor allows 4 horse power for the screw. To give a rapid revolution to the parachute requires also but a very small power; this, calculated on the proportions of a flywheel, is found to be about 2 horse power. As the parachute is also built on the plan of a helice, this will absorb, for the lifting, about 4 horse power. For these three different operations he considers that 12 or 14 horse power will be quite sufficient.

DEMOUVEAUX AVIATOR.



VILLARD'S AVIATOR.

M. Villard has already constructed an experimental form of the apparatus, which is shown in the engraving, but expects to modify it considerably before carrying out the practical trials which he is to make next spring. The parachute, which embodies the gyroscope principle, is a large flat wheel, somewhat resembling a bicycle wheel, whose rim is made of a circular steel tube half an inch in diameter and very light. The wheel has an exterior diameter of 22 feet. It is attached to the upper and lower ends of a long hub by two sets of double steel piano-wire spokes, with 100 pairs of wires in each set. The length of the hub is about 3 feet. The parachute covering is stretched upon the top surface; it is made of stout cotton balloon-canvas and offers a resistance of 1,400 pounds per square yard. Below are placed the horizontal shafts of the screw and rudder, at a point calculated according to the resistance which the parachute offers to the air when in movement. The screw, made of canvas stretched upon wire frames, is composed of two similar halves; in front it has a small surface, but increases toward the rear until the whole has a complete half-turn of thread. It is driven by a horizontal shaft which passes to the center and there engages with the vertical shaft of the motor by a worm-gearing. The rudder, mounted in line with the screw, works in a forked support which allows it to turn in the vertical sense. It is directed by a horizontal shaft which engages with it below by a worm gearing. The shaft passes to the center and is there controlled by the aeronaut. To operate the gyroscopic portion and the screw a Buchet motor of the two-cylinder type is used, operated by gasoline which is fed from the reservoir above. The motor gives normally 12 horse power and has 4-inch cylinder-bore and 4-inch stroke; it weighs about 130 pounds and works at 1,920 revolutions per minute. The motor, which is seen on the left, is attached to a circular aluminium box surrounding the main shaft and containing the gearing and transmission devices for operating the whole apparatus. The box is mounted upon a cone-shaped piece whose point rests on the ground. The aeronaut sits upon a small movable seat, mounted upon two horizontal rods, and has at hand the various steering and controlling levers and the hand-wheel of the rudder.