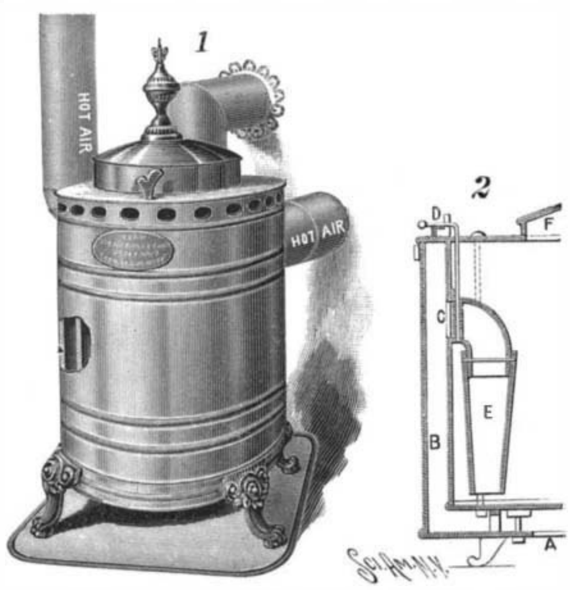
A COMBINED HEATING STOVE AND FURNACE.

The stove which we illustrate herewith is an improvement over ordinary stoves in so far as it serves the purpose of a furnace for distant rooms. In the construction of this furnace-stove only sheet metal is used, whereby the cost of manufacture is considerably reduced and the durability enhanced.

The stove consists of an oval outer casing, formed with a draft opening, *A*, in its bottom. Within this outer casing is a concentric, oval firepot separated from the outer casing so as to leave an air space, *B*, around the firepot. Legs pass through the casing, the inserted end portions of the legs engaging with sockets formed on the bottom of the firepot, to take load strain from the casing. Fuel is introduced through an aperture in a top plate having a cover, *F*, in the rear of which is a circular flange which receives a draft-pipe. The heat of the firepot is distributed to other rooms by hot-air pipes fitting on thimbles on the outer casing. Each of



A COMBINED HEATING STOVE AND FURNACE.

the thimbles is provided with a damper whereby the supply of hot air can be cut off. At the front end of the oval firepot an aperture is formed which receives a draft elbow, provided with a cast iron extension *E*, which can be removed when burnt out. The throat of the elbow is closed by a damper, *C*, controlled by a rod extending upwardly through the top plate.

Fire being made in the firepot, cold air is drawn through the opening, *A*, in the outer casing and is conducted by the draft elbow into the burning fuel. As the firepot is heated the air in the space, *B*, is also heated. This hot air arises and passes through the hot-air pipes into the rooms to be warmed. To permit the escape of the heated air directly into the room in which the stove is placed, the upper portion of the outer casing is provided with a series of openings, which can be closed by a rotatable metal band having similar openings designed to register with those of the casing. By moving the band the casing-openings can be partially or entirely opened and closed.

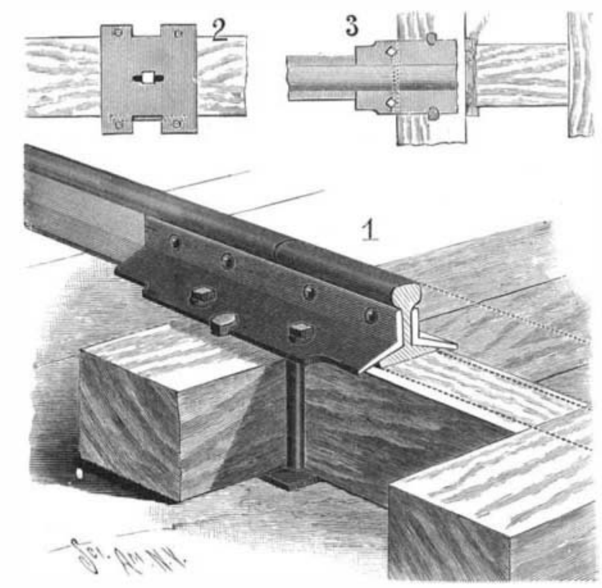
The inventors of this furnace, Wormald & Wormald, of Spokane, Wash., state that the stove has proven its efficiency on many an occasion. The saving in fuel effected by its use is said to be very marked; for one furnace stove is made to take the place of several ordinary stoves distributed in various rooms.

Mural Paintings Emblematic of Electricity.

Mr. W. B. Van Ingen, mural painter of New York, has opened an entirely new field by his large panels which decorate the offices of the Edison Illuminating Company in Duane Street, New York city. Instead of making his figures purely allegorical as does Puvis da Chavannes in the Boston Library, Mr. Van Ingen has taken some very workaday scenes like "Edison in his Laboratory," "Faraday and the Electric Motor," "Sir Humphrey Davy and his Electric Arc Light," and while utilizing them, has still clothed them in enough of the nineteenth century to make them interesting, for they tell the story admirably. There are many large concerns whose offices might be decorated in a similar manner emblematic of their manufactures. The idea is an attractive one and we would like to see it carried out on other industries in the same manner as has been done for electricity.

AN ANCHOR TO PREVENT THE CREEPING OF RAILS.

To prevent the creeping tendency of rails, and yet to allow the track to expand and contract is the object of an invention patented by Severin B. Anderson, of Hartford, Wash. This object is attained by means of the novel anchor represented in the accompanying illustrations. Fig. 1 is a perspective view of a rail with the anchor applied. Fig. 2 is an inverted plan view showing the anchor-plate. And Fig. 3 is a top plan view of a rail with the invention applied. The adjacent ends of rails are joined by angle-iron fish-plates spiked to the tie and bolted to the rails. The ends of the fish-plates project beyond the base of the rails; and through these projecting portions bolts are passed which rigidly connect the fish-plates with an anchor-plate on the under side of the tie. The plate, as shown in Fig 2, is provided with a longitudinal slot; and a bolt extends through the tie and slot to hold the anchor-plate to the tie and permit adjustment of the plate lengthwise of the tie. Between the tie at the joint of the rails and the next following tie, located in the direction of the creeping tendency, is a brace-block formed with a brace-plate which partially embraces the bolts connecting the fish and anchor plates and prevents the wearing of the bolts on the brace-block. On the opposite side of the tie a face plate is provided, upon which the bolts connecting the fish and anchor plates rest. The face-plate serves to prevent the embedding of the bolts in the tie. It will be seen that, although the fish-plates are so firmly locked in place, the rail can, nevertheless, expand and contract. The creeping of the rails is prevented by the means employed for securing the fish-plates. Dislocation of the tie by the creeping of the rails is prevented by the brace-block. The anchor-plate, being transversely adjustable, can be brought in position to insure the proper alinement of the rails. The track can be readily raised and surfaced without any interference from the device.



AN ANCHOR TO PREVENT THE CREEPING OF RAILS.

THE ALEXANDRE III. BRIDGE, PARIS.

BY J. GUENAIRE.

One of the most interesting features of the approaching Paris Exposition will be the handsome bridge which unites the different portions near the Champs d'Elysées, and forms part of the principal avenue, to be called the Esplanade des Invalides. This avenue commences at the Champs d'Elysées, having on either side the great and smaller palaces, and passes over the new bridge. On the left bank of the Seine it will be bordered by a succession of buildings of the Exposition, and will terminate at the imposing structure called the Hotel des Invalides, containing the tomb of Napoleon.

It was decided to give to the bridge the name of Alexander III., in honor of the father of the present Czar Nicolas II., whose visit to Paris, in 1896, consummated the alliance between France and Russia, begun by the late emperor, and it was in the midst of a series of splended fêtes that the Czar assisted at the laying of the corner-stone.

The construction of the bridge presents many points of interest. As will be seen in our illustrations, it consists of a series of metallic arches, whose thrust is received by the abutments on either bank. Accordingly the dimensions and construction of these abutments have been such as to assure great solidity. Each of the abutments forms a mass 44 meters (144·36 feet) wide and 30 meters (98·43 feet) in thickness, being formed of masonry and cement, with an outside covering of blue granite. The whole constitutes a block which offers as much resistance as if it were composed of a single stone.

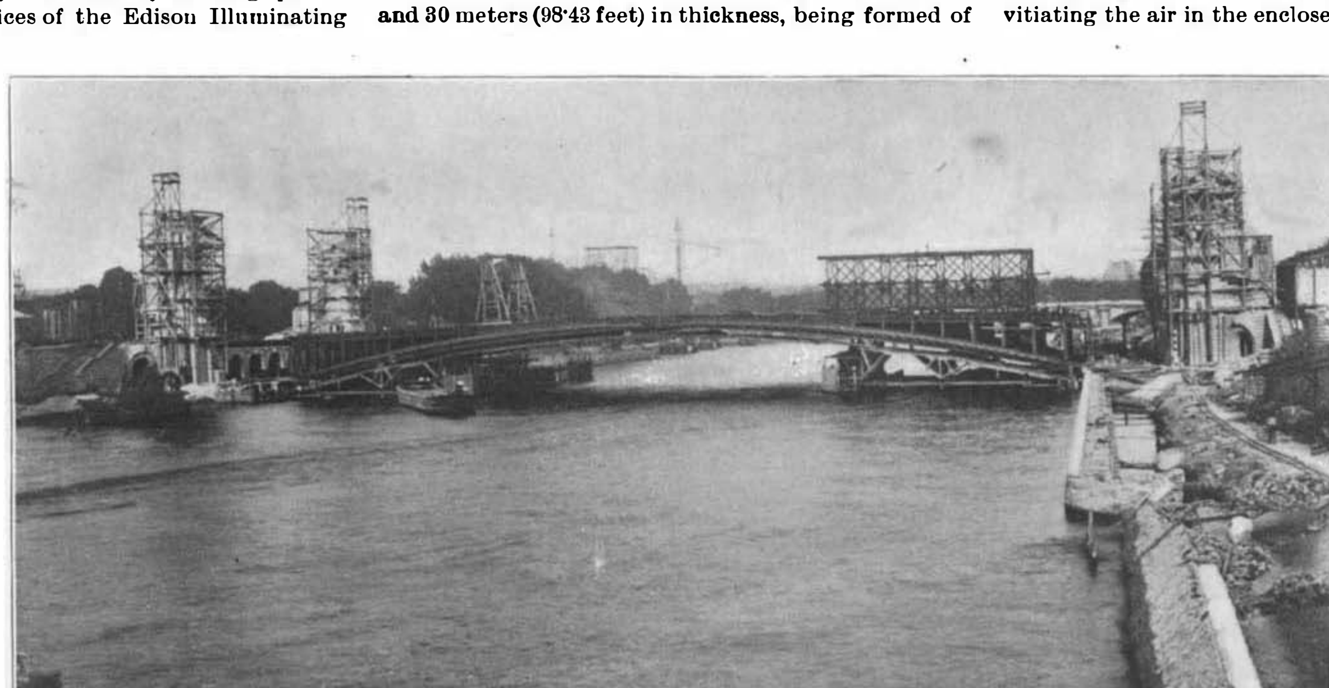
The foundations are separated from the clay stratum here existing in the bed of the river by a certain thickness of sand. As the horizontal thrust of the arches upon the abutments is considerable, the stability of these latter is secured by the effect of the friction of the abutment upon its bed, this being, in fact, greater than the maximum thrust of the arches. Experiments have been made with samples of sand extracted from the strata, and it is found that the coefficient of friction is more than 0·58, and on the other hand the relation between the horizontal thrust and the weight of the abutments is only 0·50. In this way the thrust of the arches will always be more than counterbalanced, and the perfect stability of the abutments assured.

In the construction of the abutments, metallic caissons were necessary; these were of more than ordinary dimensions, and were built upon the spot where they were to be sunk in the stream. The joints were carefully caulked with bitumen and felt, and thus perfect tightness was assured. These caissons, 44 by 36 meters in size, were divided into five compartments, each of these being provided with two shafts or chimneys for the descent of workmen and materials of construction. The material excavated from the bed of the river was taken out by the same shafts and emptied into the stream, from which it was removed by dredging machines. Some difficulty was encountered in the construction of the abutments by these caissons, as it was necessary that all parts of the caisson should sink the same distance as the work progressed. However, by establishing a series of water levels, connected by rubber tubing, a uniform rate of sinking was attained.

After the caissons had been sunk to the required depth in the bed of the river, they were filled with bêton, consisting of a mixture of cement and gravel; this was filled in commencing from the walls and working toward the shafts.

The work of construction of the abutments was commenced on April 19, 1897, and the operation of filling the caissons was finished March 26, 1898. The mean rate of descent of the caissons was about 12 centimeters (4·72 inches) per day. Two important questions were those of furnishing air and light to the workmen. For the lighting, incandescent lamps were used, to avoid vitiating the air in the enclosed space. Two groups of engines and dynamos were installed for the purpose, one of these acting as a reserve in case of accident; each group included a Radsworth engine driving a continuous-current dynamo at 140 volts. Three lines of wiring were used for the interior and exterior lighting, each caisson requiring about 130 lamps.

The essential portion of the abutments having been constructed, the work of mounting the metallic part of the bridge was next in order. In view of the existing conditions of traffic upon the Seine, the arch could not be con



THE ALEXANDRE III. BRIDGE FROM THE RIVER, SHOWING PYLONS.

structed in the ordinary manner, which consists in sinking piles into the river bed, upon which a long scaffolding is built reaching from one bank to the other, leaving only a narrow opening in the center for the passage of boats. According to the terms of agreement, the constructors were required to leave a passage of at least fifty meters (164 feet) in width in the center of the river, as on account of the curvature of the Seine at this point, the trains of merchant boats, which sometimes have a length of 150 meters (500 feet) could not pass without difficulty in a narrower space, and the agreement stipulated that there should be no interruption of navigation during the work of erecting the bridge.

For this reason, the construction of the arches was carried out entirely from above, by means of a temporary bridge called the "Passarelle," extending from one bank to the other. It was supported on rollers at each end, as shown at the right-hand end of our larger view, and could thus be moved from side to side as the work required; upon it were established the steam engines, hoists, and cranes for the transport and putting in place of mater'als. Its length was about 130 meters (420·5 feet); its width, (6 meters 19·68 feet); and height, 7½ meters (24·6 feet), and it was the largest construction of this kind yet made. It was built on the right bank of the river on a high scaffolding, the other end being upheld by a floating scaffolding in the river; when one-third of the passarelle was finished, it was drawn forward by means of ropes attached to drums, thus permitting the second part to be constructed in the rear. This was drawn forward in turn, and thus the whole construction was extended across the river between the abutments.

The supports on which it rolled back and forth over the arches were formed at the base by a strong iron frame upon which a pyramidal construction was built to sustain the inward end of the passarelle. These pyramids were about 6 meters (19·68 feet) in height; the base rested upon ten rollers arranged in two series of five each, rolling on rails 4 meters (13·12 feet) apart. To give additional stability to the passarelle, a series of piles wasdriven in the stream near the bank, upholding an iron structure which supported the passarelle at that point.

The bridge proper is composed of fifteen great metallic arches placed side by side and connected one to the other by intermediate pieces, as will be seen in the end-view of these arches. Upon the arches are secured vertical steel frames supporting the horizontal I beams above. Upon these will be laid the iron planking and wood pavement of the bridge. The arches are built up of sixty-four short sections or voussoirs, which are bolted together end to end. These sections are massive steel pieces having a length of 3 meters (9·84 feet) and weighing 7,000 kilogrammes each (15,432 pounds). Their section resembles that of a T, having 6 centimeters (2.36 inches) thickness in the web.

Two arches at a time are constructed for a given position of the passarelle; traveling cranes take up the voussoirs from the end of the passarelle and bring them into the proper places on the arch. The method of construction of this bridge somewhat resembles that used in the case of stone bridges. The piece constituting the origin of the arch is solidly fixed into grooves made in the granite blocks of the abutment, and upon this piece is fixed the first voussoir, it being held by a cylindrical key of special construction, thus forming a movable joint at the beginning of the arch. The piece corresponding to the keystone of the arch carries a similar articulation, the rest of the voussoirs being solidly bolted together. Before bolting, however, their position must be regulated with care. To this end the voussoir is first brought into its approximate position by the movable carriage on the passarelle above, it being upheld by timber supports. For the final regulation, thin metal plates are inserted between the two voussoirs, until the required form is obtained as determined by the template of the arch, after which the voussoir is solidly bolted in place. The regulation of the arch as a whole then remains to be made. This is accomplished by means of the joint arranged for the purpose in the keystone. Here thin metal plates are added or taken out until the desired form is obtained. This is determined by surveying instruments placed at different positions on either bank.

The first two arches being thus finished, the passarelle was moved into position over the second pair. This was done by means of capstans acting upon its rollers. In this manner eight different positions were successively taken in order to complete the fifteen parallel arches of the bridge. Since the photograph was taken the passarelle has been taken down as it has served its purpose in the construction and the assembling of the metallic parts of the bridge proper is practically finished. The finished bridge presents a curve having 7 meters (22·96 feet) distance from height to base. Its total length is 110 meters (360·91 feet) between the abutments and its width 40 meters (131·24 feet). It is to have two sidewalks of 10 meters (32·81 feet) wide, leaving a central space of 20 meters (65·62 feet) for vehicles.

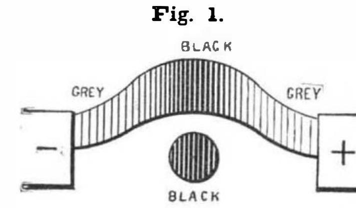
The approaches to the bridge are upheld by a series of stone arches, of which the outside series is shown in one of the upper illustrations on front page, and is built of blue granite; behind this are a second and third series of arches; these arches, being concealed from view, are of inferior materials. Upon these arches will be laid the I beams and flooring constituting the approaches. In another illustration on the extreme left will be seen the iron footing of the bridge resting against the stone abutment.

As the bridge has been constructed in view of the Exposition, its decorative effect has been made prominent, and it will harmonize with the buildings now being erected on either side of it. There will be two large and handsome pylons at either end, one of these being shown surrounded with scaffolding and the sculptors' temporary house. These pylons resemble in their material and architectural motifs the construction used in the great and smaller palaces. Each of the pylons will have an allegorical figure and will be surmounted by a bronze group, designed by Fremiet and other sculptors. At either side of the pylons is a large carved figure of a lion led by a child. The bridge is to have a handsome stone balustrade upon which will be mounted a series of decorative bronze lamp posts.

RADIO-ACTIVE MATTER IN MAGNETIC FIELD.

M. Becquerel has given an account to the Academie des Sciences of a remarkable phenomenon which he has observed in the course of his experiments upon radio-active matter. He finds that a magnetic field has a marked effect upon the action of these bodies, and when placed between the poles of a powerful electro-magnet, the radiation which they emit is changed in direction and becomes concentrated upon the poles. In the first experiment, the effect was observed with the radiation parallel to the magnetic lines of force. Between the pole pieces of the electro-magnet were placed two circular soft iron disks, fourteen millimeters in diameter, so arranged that their distance could be varied from a few millimeters to several centimeters. Upon exciting the magnet, a powerful field is established between the disks. Near the center of one of the disks was disposed the radio-active matter, containing the supposed new element, radium, whose action is very powerful; this was placed upon paper and covered with a thin leaf of aluminium. Against the other pole was placed a fluorescent screen, such as platinocyanide of barium, double sulphate of uranium and potassium, etc. When the electro-magnet was unexcited, the phosphorescence excited in the screen by the radio-active matter appeared as a large luminous spot extending beyond the polar surface containing the screen; at a distance of one centimeter between the disks, the screen is but feebly phosphorescent. Upon exciting the electro-magnet, the luminous spot is seen to contract and become more intense; the illuminated area scarcely reaches beyond the limits of the pole-piece, upon which all the rays of the active matter seem to be concentrated, with a resulting increase of brilliancy. Upon reversing the magnetization, no appreciable difference is observed. The interposition of screens, such as black paper, glass, etc., cause only a diminution of intensity. If a photographic plate is substituted for the phosphorescent screen, one may obtain, with exposures of a few instants, an interesting series of negatives. Among others, M. Becquerel shows a plate which he obtained at a distance of fifteen millimeters; upon this may be seen first the feeble impression when the magnet is not excited, then the more strongly marked and concentrated effect caused by the magnetic field.

Fig. 1.



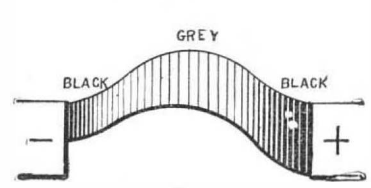


Fig. 2.

To observe the effect when the direction of the screen is parallel to the magnetic flux, the radio-active matter, covered as before with aluminium, was placed in the center of a glass tube arranged in the axis of the field; the interior walls of this tube being covered with fluorescent matter, forming a cylindrical screen. Upon exciting the magnet, the phosphorescence is seen to diminish considerably, even to a point where it is scarcely perceptible. In another experiment, the active matter is placed between the pole-pieces, somewhat below the center, and a flat screen is placed at an equal distance above and parallel to the lines of force. Under these conditions, the effect changes with the direction of magnetization; in one case the luminous spot becomes more brilliant, in the other it diminishes. This may be very well observed by using a photographic plate. In one experiment, the plate, wrapped with black paper, is placed between the poles and parallel to the field, the distance between the poles being forty-five millimeters; the magnet is first excited, and upon the plate, midway between the poles, is placed a small quantity of radio-active matter. After a few minutes' exposure under these conditions, the plate was developed, and it was found that the impression, which was very intense, was not uniformly distributed around the source, but was entirely thrown over to one side of the field, this being to the positive pole of the magnet. Outside of the black spot marking the position of the active matter, the maximum impression is distributed over a relatively limited region, giving somewhat the effect shown in Fig. 1, which shows the direction of the curve and the relative values, but not the actual appearance of the plate. The maximum of luminous effect as well as of curvature is in the center of the field; on either side the curve bends in and joins the polar surfaces somewhat above their centers. The experiment was then tried with the active matter placed near one of the poles, with the plate in the same position. The effect differs from the former, as shown in Fig. 2. The action is strong in the vicinity of the active matter near the + pole, and from this the intensity diminishes, reaching a minimum in the center of the field, from which it augments in approaching the other pole. Near the pole it becomes again very intense, but less so than on the other side. By varying the position of the active matter between the poles, a series of curves may be obtained whose maxima are opposite the point occupied by the source, the maximum has, however, a tendency to approach the neighboring pole. When the active matter is but a short distance from the pole, a second maximum appears near the opposite pole, the effect being analogous to that of Fig. 2.

Commerce of the Great Lakes.

A suggestion of the extent of the commerce of the great inland sea extending from Buffalo to Chicago and Duluth, known as the "Great Lakes" is supplied by some figures which have been issued by the Treasury Bureau of Statistics, showing the details of the commerce passing through the Sault Ste. Marie Canal, which connects Lake Superior with Lakes Michigan, Huron, Erie and Ontario. This necessarily registers only the traffic between the single lake, Superior, with Duluth, as its great concentrating and distributing point, and the chain, Michigan, Huron, Erie and Ontario with Chicago, Detroit, Toledo, Cleveland and Buffalo, the great points of concentration and distribution. The commerce passing through the canal thus registers accurately the movement between the single lake penetrating the wheat and iron producing regions and the chain tributary to the corn, provision and coal producing and iron manufacturing regions. It is the great gateway through which wheat, oats, flour, iron ore, copper and lumber of Montana, the Dakotas, Minnesota and Northern Wisconsin move to the consuming and manufacturing sections, while through the same gateway moves in the reverse direction the coal manufactures and miscellaneous merchandise from Lake Erie and Eastern points.

All of the traffic moving between Lake Superior and the chain of Lakes from Chicago to Buffalo must pass through either the American or Canadian Canal which lie side by side. Of the total business through the two canals in 1899, 88 per cent was carried by the American Canal, while of the passenger business 68 per cent passed through the same canal. It is only by a comparison of figures of 1899 with those of earlier years that the importance of this commerce can be realized, especially as regards its rapid growth. The actual number of passages through the canal, counting each vessel as it passed through it, was 20,055, during 1899, against 9,579 in 1889, having thus more than doubled during a period of ten years. The total freight business passing through the canal in 1899 was 25,255,810 tons against 7,516,022 tons in 1889, showing that the freight tonnage has increased much more rapidly than the number of vessels, thus indicating in some degree the rapid increase in the size and capacity of freight-carrying vessels of the Great Lakes. The development of grain production of the extreme Northwest during the decade is indicated by the fact that the wheat carried through the canal in 1899 was 58,297,335 bushels, while in 1889 16,231,854 bushels were carried, while grain other than wheat in 1899 amounted to 30,900,935 bushels, while in 1889 it was but 2,133,245 bushels.

THE current through the iron gate of the Danube is still far too rapid owing to the sharp incline and the work of excavation does not suffice to secure the expected depth. The navigable channel created by blasting under water is not quite regular. Ridges have been discovered and through additional lines of buoys have been fixed, further work will be required.

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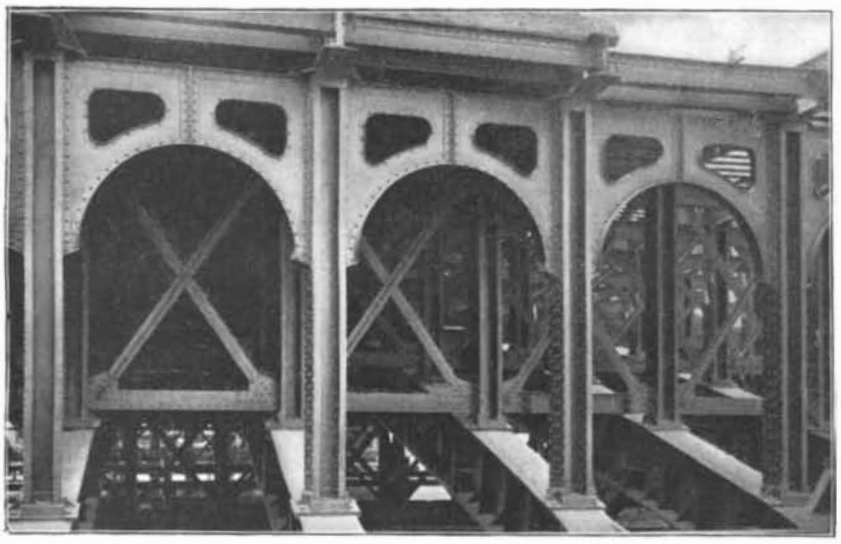
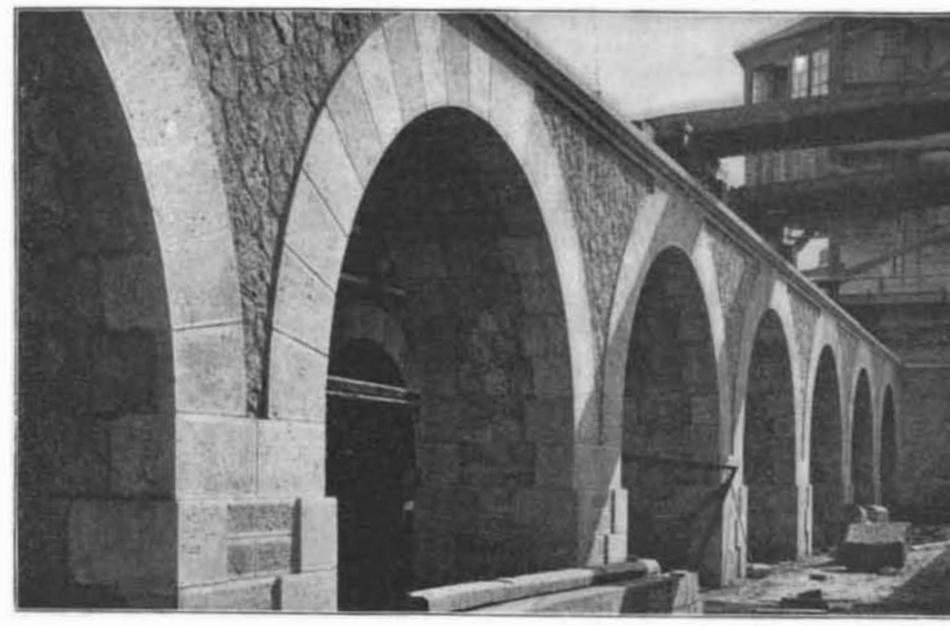


View Along Axis of Bridge, Showing Vertical Posts and Bracing.



Interior Line of Arches—Masonry Approach.

Masonry Approach—Footing of Metallic Arch Shown at Left.

Pylon with Housing for Use of Sculptors.

View from Right Bank of Seine During Construction.

THE ALEXANDRE III. BRIDGE—THE NEW MONUMENTAL BRIDGE CONNECTING TWO SECTIONS OF THE PARIS EXPOSITION.—[See page 149.]