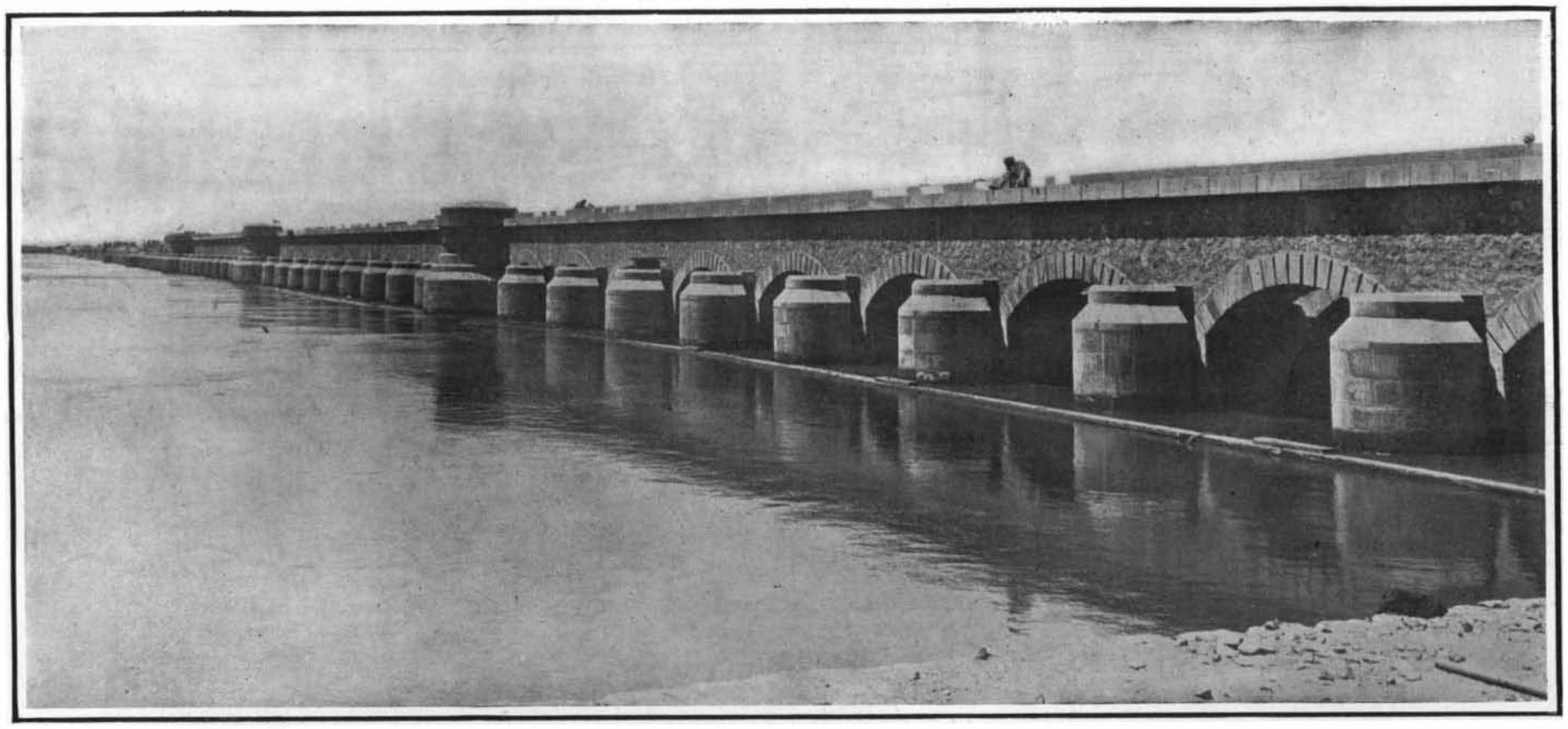
THE ISNA BARRAGE ACROSS THE NILE.

Upon the completion of the two barrages across the Nile at Aswan and Asyut, experience soon demonstrated the fact that in years of bad Nile flood, such as have prevailed since the completion of these undertakings, there was yet a very large district which was inadequately irrigated, accompanied by a marked deterioration of a considerable area of basin land. This was particularly the case in the Keneh province.

In order to remove the disadvantages affecting the above province, which were very marked, the government at once decided upon the execution of another noteworthy piece of work—the throwing of a third barrage across the river at Isna, about 100 miles above the great dam at Aswan. The population of Esneh is about 25,000; and as may be gathered, the erection of this work has restored the confidence of the natives in the affected area. This barrage is primarily intended to regulate the flood levels, and will insure in seasons of bad flood, such as have prevailed in Egypt for so many years past, the adequate irrigation of something like 250,000 acres.

Some time ago we described and illustrated in the SCIENTIFIC AMERICAN SUPPLEMENT the task of commencing this important work, which in character ranks with those already completed at Aswan and Asyut. The accompanying illustrations convey a further idea of its comprehensive character and completion, which was accomplished well within the stipulated contract time of three years by Sir John Aird & Co. of London, who carried out the previous works of this character, and to whom we are indebted for permission to reproduce these illustrations.

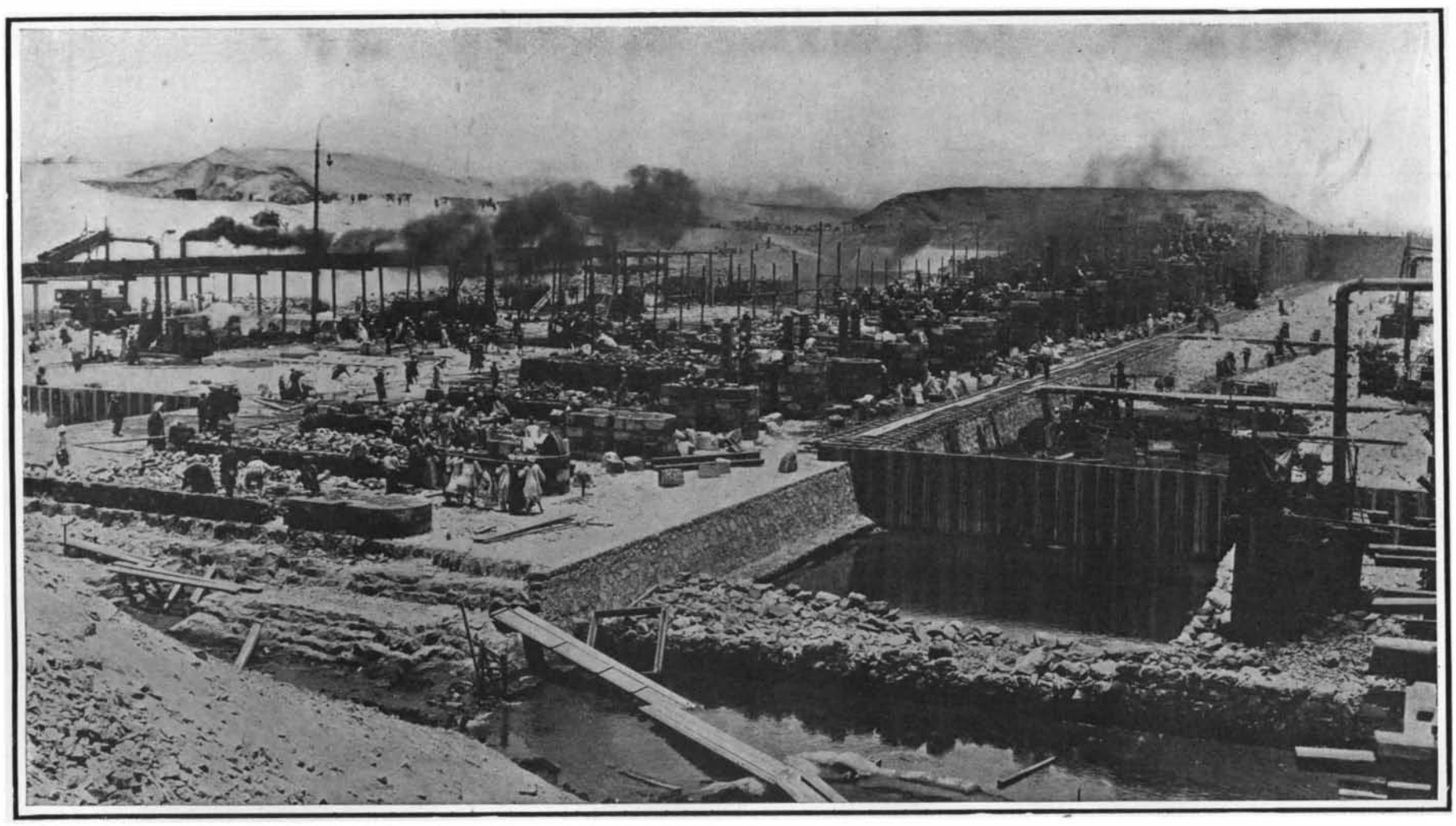


Isna Barrage; view from east abutment, upstream.

In addition to the barrage, the works carried out comprise two small canal-head regulators. The dam is erected about half a mile to the north of the town. Its total length from bank to bank is approximately 2,900 feet, and it is pierced by 120 openings or sluices, each being 16 feet 5 inches wide. The barrage is of sufficient width at top level to carry a roadway 19 feet 8 inches wide, with accommodation for a surface railroad of 2 feet gage. There are in all eleven large abutment piers, 37 feet 8¾ inches in height by 13 feet thick, and 108 smaller piers of 6 feet 6 inches thickness. The arches of the sluice openings are of concrete, 20 inches thick, faced with sandstone ashlar on both stream faces, while the piers are rounded to half their radius on the upstream side to form cutwaters, with battered square ends on the downstream side. On the deck level are three parapets, two on the upstream side, in the space between which are provided the facilities for opening and closing the sluice gates. Each opening has two gates of 9 feet 10 inches depth, working vertically in cast-iron grooves built in the piers.

When the work was commenced, the preliminary operations proved a huge task. Owing to the enormous demands for masonry, quarries had to be opened by the contractors, and an extensive fleet of vessels secured for its transportation in sufficient quantities and in such a manner that work once commenced should not be arrested for lack of material. The sandstone had to be quarried at a point 57 miles up the river toward Aswan, while on the other hand the limestone was brought from a point 15 miles distant in the opposite direction. Temporary roads and railroads had to be laid down, the length of the latter aggregating at one time 24 miles, and every type of craft was pressed into service for the transportation of the constructional material.

These preliminary operations occupied several months, but work on the site of the dam was com-



The east bank, looking east.

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menced in November, 1906. Actual foundation work was first commenced on the east bank, but at the same time the necessary excavations and sudding of the river on the opposite bank were commenced. The conditions were fortunately such that the bank sections could be carried out in such a manner that upon the arrival of the ensuing flood season work was not stopped, since it had been carried to a point to enable it to be continued during the period of high Nile. A large sandbank had formed adjacent to the east bank, and this facilitated considerably the requisite excavation for the erection of nearly forty piers, while on the opposite side of the river it was arranged to sudd sufficiently to enable foundation work to be carried out in regard to the navigation lock and twenty-six piers, the river traffic being maintained meanwhile in midstream.

In this work the experience gained by the contractors in the carrying out of the former works served them to conspicuous advantage. They were able to calculate very closely the time that would be occupied in accomplishing certain sections of the work, and this factor appreciably assisted them in the rapid execution of the undertaking. The result was that both sides were carried out to adequate height before the arrival of the flood season, to enable them to continue operations thereon without any delay. The sudding works were built up of hard black soil cored with bags of sand. As the presence of the sandbank naturally gave rise to the conclusion that water would percolate through to the dam foundations, a battery of 12-inch pumps was erected on the river bank, to keep the foundations dry between the piles. The entire foundations of the barrage are inclosed by two lines of cast-iron sheet piling placed 69 feet 9 inches apart, and stretching in two parallel lines right across the river.

By pushing the work at full speed—the number of men engaged fluctuated between 8,000 and 10,000—it was found possible to get the works well advanced in height by the time that the water pressure upon the sudds gave warning that the flood season was approaching; and the haste which was exercised in this connection, and the fineness with which the work was gaged, may be realized from the fact that when the sudd was cut, the water was allowed to flow over the flooring, which had only been completed a few days previously.

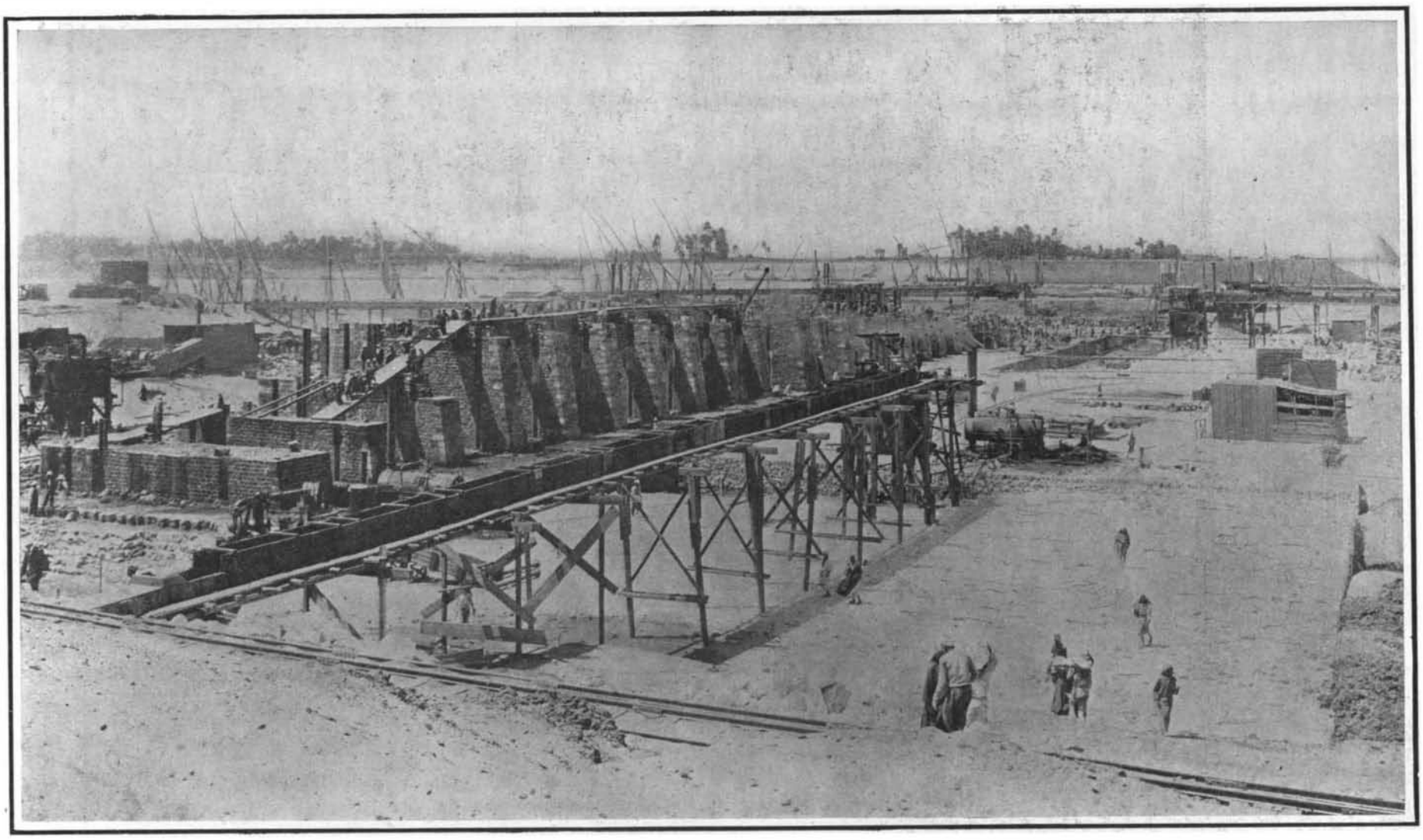
As the foundations were found to be on wet running sand, extreme care was observed in connection with the protective iron piling. The piles are so driven as to inclose completely the area within, with joints grouted, thereby forming a complete cutoff. They were driven to over 14 feet into the river bed, about 20 inches of the heads projecting above the latter, and tied into the superimposed concrete with bolts 3 feet long on the downstream side. Before grouting the joints a ¾-inch pipe was placed in the latter, and all sand blown out under a water jet having a pressure of 40 pounds per square inch, the cement grouting being run down these same pipes after cleaning had been completed to the base of the piles, the pipe being slowly withdrawn while grouting was in progress, so as to secure a perfect joint. Above foundation level the joint was calked with oakum and made completely water-tight from top to bottom. Each pile, it may be mentioned, weighed 2,184 pounds. To prevent possibility of scouring under the foundations of the first season's work, piles were driven across the scar ends to serve as a cutoff, followed by a pitching on both stream faces to a point about 80 feet back from the extremities of the foundations.

When the river fell the following season, it was found that the sandbank still existed on the eastern side, and operations were soon resumed. At this point there remained 1,280 feet of space between the two projecting ends of the work. But the strength of flow of the river rendered extreme caution to be observed in the progress from the eastern sections. An area 830 feet in length of the line of the barrage toward mid-river was successfully sudded off and pumped dry. This construction of the river imposed a heavy water strain upon the farthest sudd, but by throwing down many thousand sacks to protect the toe of the outside slopes the difficulty was overcome. Work then on the foundations proceeded so rapidly that the distance between the ends of the two outwardly-reaching sections from either bank was reduced to 450 feet by the time the river began to rise again, and foundation work had to cease.

This was the critical point of the whole task. It was realized that as the river had been so narrowed, if the sudds on either arm could be joined up, the work could be considerably facilitated. Mr. Webb, the Secretary of State for Irrigation and who had designed the barrage, visited the works at this juncture, and it was decided to make the attempt. It was a difficult operation, since it entailed diverting the river from its normal midstream path, and this procedure naturally increased the velocity of river flow. The lock being by this time completed, it was opened to allow the passage of the water. It was an anxious task. Bundles of sacks roped together had to be thrown overboard from boats at those points in mid-river where the stream ran strongest, from a point 150 feet upstream, where temporary piles were driven for the purpose. Finally success attended the efforts, and the river was diverted, leaving the remaining central space sudded off. The sudds were then strengthened by boatloads of earth being brought down and dumped on their outer surface, and a substantial temporary embankment thus erected. This accomplished, pumping had to be hurried forward, but it was a task that had to be accomplished with extreme care. When the sudds were finished time was pressing, and only twelve weeks were left in which to carry out the remainder of the foundation work and proceed with the superstructure to a height above flood level to enable work to be continued without cessation. It was anticipated that as the area within was cleared of water, the outward pressure upon the sudds might cause some slipping; but, as this developed, boatloads of sacks standing by for such emergencies were cast overboard, and in this manner the task was successfully achieved.

The area clear, it was imperative that all possible labor should be crowded upon the works. At one time over 4,000 men were at work upon the narrow stretch of 450 feet linking up the two progressive arms. To the contractors it was the most anxious period of the whole work. There was a pressure of 17 feet depth of water upon the sudds outside, while the diverting of the river had developed a flow of six miles per hour velocity. "Blows" occurred frequently in the sudds, but the arrangements provided for dealing with them were such that no floodings of the workings arose.

At last the foundations of the two sections were connected, and the masonry was pushed forward so as to get above water level by the arrival of the flood. As the superstructure proceeded, the pumping operations were gradually suspended, so as to allow the water within the sudded area to rise slowly. Thus by the time the river rose the superstructure was well advanced, and carried to completion without any delay.



View looking west from downstream.

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It is noteworthy to record that owing to the energy displayed by the contractors the work, despite its magnitude, was completed no less than eighteen months within the contracted time, so that the inhabitants of the province will be reaping the benefits of irrigation a year in advance of the date promised. The whole task was finished within twenty-two months from the commencement of the foundation work, which is a record in an undertaking of this caliber.

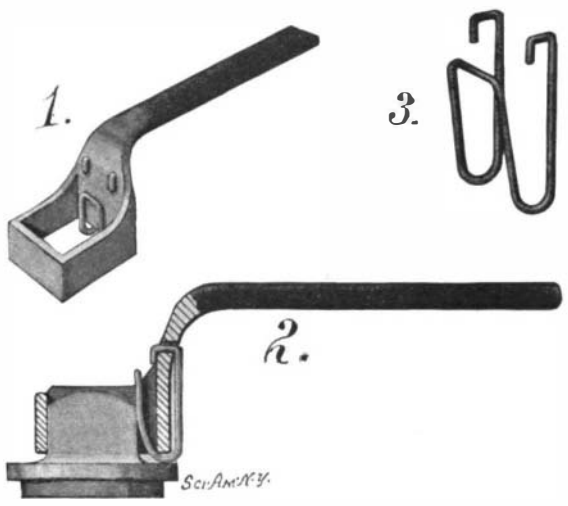
To gather some idea of the extent of the task, it may be pointed out that the excavations entailed the removal of 1,200,000 cubic yards of material; the erection of the temporary sudds required the use of 550,000 cubic yards of earth and sand, while 1,000,000 sacks were used in their construction. There were 3,950 tons of piling used, 42,000 cubic yards of concrete, 80,000 cubic yards of sandstone rubble in the superstructure, 400,000 cubic yards of ashlar, and 166,000 cubic yards of limestone pitching in the diversion.

The whole of the ironwork was supplied by the Ipswich engineering firm of Ransomes & Rapier, who carried out all the similar work in connection with the other barrages. The navigation lock on the west-

ern bank is 262½ feet long between sills by 52½ feet wide, fitted with gates 40 feet deep and a swing bridge. On the upstream side the foundations comprise puddle clay topped with limestone pitching 65 feet 7 inches wide; while on the downstream side, to avoid the severe socuring of the water pouring through the sluices, there is a protective apron composed of limestone pitching carried to a distance of 131¼ feet from the toe of the dam. The floor is built up of concrete, 3 feet 3 inches thick, with a superimposed layer of granite rubble masonry 6 feet 6 inches thick. The total cost of the barrage has been approximately $5,000,000 and it was formally opened by the Khedive on February 9th. The provision of this dam will insure a plentiful supply of water for irrigation through a great tract of fertile land, even in the lowest floods, and will remove all apprehensions regarding the safety of the crops within its area for all time. The chief engineer responsible for the works was Mr. Murdoch Macdonald, the Director General of Reservoirs for the Egyptian government.

IMPROVED VEHICLE WRENCH.

Pictured in the accompanying engraving is a wrench particularly adapted for unscrewing the nuts of carriage and wagon axles. The wrench differs from the ordinary in that it securely holds the nut

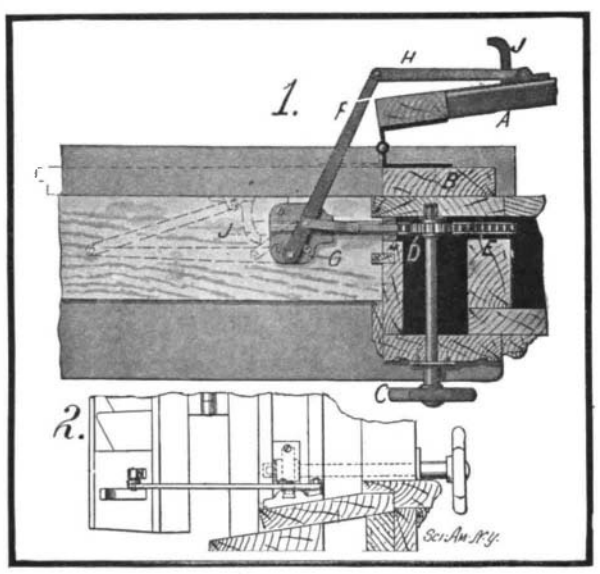


IMPROVED VEHICLE WRENCH.

in place, permitting of conveniently starting the nut when screwing it on the axle, and preventing it from falling and being lost when it is removed from the axle. The general form of the wrench is similar to the ordinary, consisting of the usual square socket with an extension at one side which serves as a handle. Fitted in the socket is a spring, the general form of which is indicated in Fig. 3. It will be observed that the spring is bent at its center, and then doubled, so as to provide a portion which extends into the socket and another portion which passes along the outside. The outer portion terminates in a pair of hooks which pass through openings in the wrench just below the handle, and serve to hold the spring firmly in place. When using a wrench of this sort the operator may keep his hands clean, for he does not have to touch the nut. The wrench clings to the nut after it has been removed, and there is no danger of its becoming soiled by falling to the ground. The inventor of this improved vehicle wrench is Mr. Carroll J. Atkins, Cando, N. D.

DEVICE FOR OPERATING WINDOW SHUTTER.

In cold weather, or when a rain storm suddenly comes up and it is desirable to close the window shutters, it is rather unpleasant to have to expose oneself to the elements by opening the window and reaching out for the shutter arm or catch. The accompanying illustration shows one method of overcoming this ob-

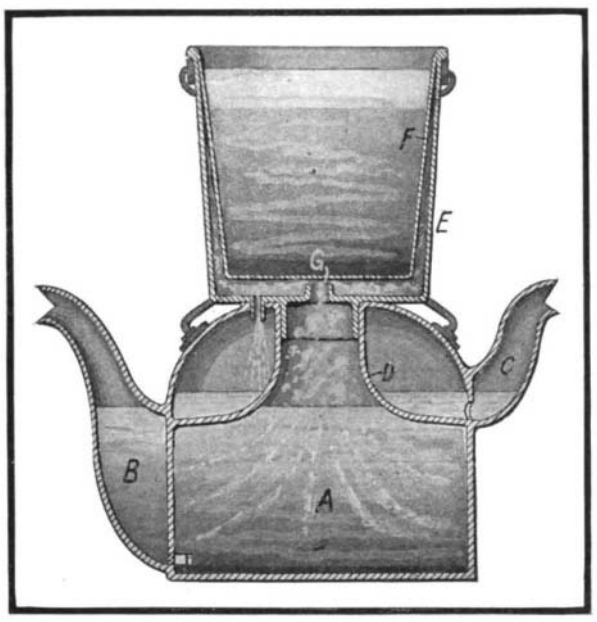


DEVICE FOR OPERATING WINDOW SHUTTER.

jectionable task by operating the shutter from within the room. A sectional view, in plan, of the mechanism used is shown in Fig. 1. The shutter *A* is hinged to the outer frame *B* of the window. Projecting through the inner side of the frame is a hand wheel *C*, mounted on a shaft which carries a pinion *D*. The latter engages a rack *E*, adapted to slide through the stile of the window frame. At its outer end this rack bar is connected by a link to a lever arm *F*. The lever arm is pivoted at one end to a plate *G* secured to the window sill, while at its opposite end it is connected by a link *H* to the shutter *A*. When the hand wheel *C* is turned in clockwise direction, the rack bar *E* is fed toward the left, causing the lever arm *F* to swing on its pivot, closing the shutter *A*. The end of the rack bar which slides in a track formed in the plate *G* engages a hook *J*, carried by the shutter *A* when the latter is closed, as shown by dotted lines in Fig. 1. This serves to lock the shutter in closed position. The inventor of this shutter-operating mechanism is Mr. August Weber, of Long Branch, N. J.

KETTLE STILL.

A simple apparatus for distilling water is illustrated herewith, which should prove quite valuable in districts where the water is so impure that it must be filtered and boiled before it can be used. The apparatus is in the form of a kettle, and, in fact, may be used as a kettle when it is not desired to use it as a still. The body of the kettle, which is indicated by the letter *A* in the engraving, is provided with a main spout *B* at one side, and a smaller spout *C* at the opposite side. The interior of the kettle is divided into two compartments by means of a partition *D*, and the spout *C* communicates with the upper compartment. The partition *D* is formed with a central tubular por-

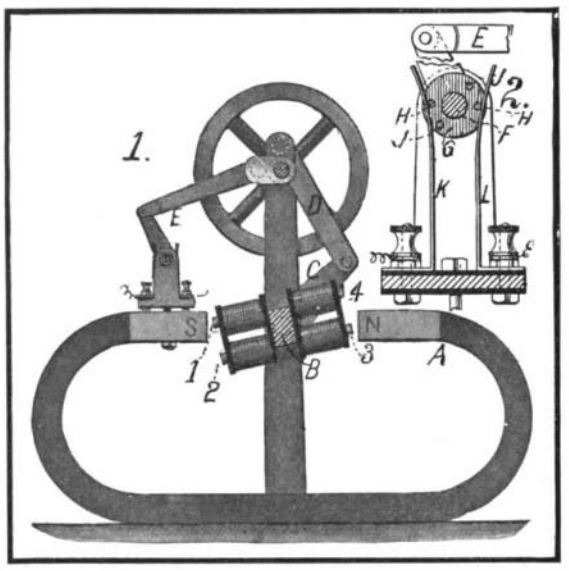


KETTLE STILL.

tion, opening through the top of the kettle to permit of pouring water into the lower compartment. A bucket *E* is used with the kettle and is provided with a flanged portion at the bottom adapted to fit into the tubular portion of the partition *D*. Communication between the interior of the bucket *E* and the lower compartment of the kettle is had through an opening *G* surrounded by an upwardly-extending flange. Adapted to fit into the bucket *E*, or formed integrally therewith, is a second bucket *F* which is of such dimensions as to provide a narrow chamber between the two buckets. In use, the lower compartment of the kettle is filled with the water to be distilled, and as this water is brought to a boiling point over a fire, the steam generated passes into the bucket *E* and is condensed by coming into contact with the bucket *F*. The latter is filled with cold water so as to keep it cool and insure proper condensation of the steam. The condensed steam cannot flow back into the chamber *A*, owing to the flange surrounding the opening *G*, but it flows through a small pipe into the upper chamber of the kettle. Thence it may be poured out through the spout *C* when desired. It will be observed that the spout *B* is almost entirely cut off from communication with the body of the kettle *A*, except for a small aperture at the bottom, the object of this being to prevent the steam from escaping through the spout *B*. Mr. A. W. Blunden, of Sebastopol, Cal., has rerently secured a patent on this kettle still.

A NOVEL ELECTRIC MOTOR.

Pictured in the accompanying engraving is an electric motor which is operated by an oscillating armature. The motor is formed with a C-shaped permanent magnet *A*. The oscillating armature is supported on a shaft *B* between the poles of the permanent magnet. The armature consists of four electromagnets numbered 1 to 4 in the illustration, and the polarity of magnets 1 and 3 is of the same sign, but opposite to that of the magnets 2 and 4. By alternately changing the polarity of these electromagnets, a rocking motion of the armature is produced, owing to the action of its poles on those of the permanent magnet. The armature shaft *B* is formed with an arm *C*, connected by a pitman *D* to the revolving power shaft of the motor. The latter carries a flywheel at each end. Connected to the power shaft by means of a crank and link *E*, is a crank arm formed on the rock shaft *F*. The latter carries four disks *G* of insulating material, which are connected by means of rods *H* and *J*. Bearing against these rods are the contact springs *K* and *L*, and the

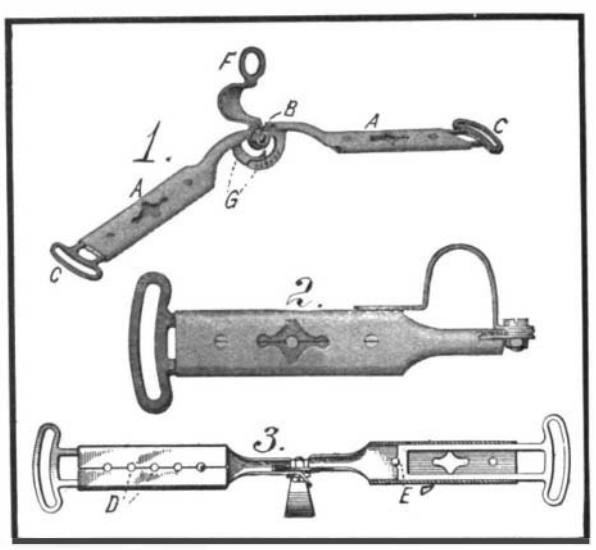


A NOVEL ELECTRIC MOTOR.

circuits are so arranged that as the shaft *F* is rocked back and forth by the rotation of the power shaft the current is alternated, thus alternating the polarity of the electromagnets. When starting the motor, it is merely necessary to rock the armature out of the neutral position, after which it will continue to rock and acting through arm *C* and pitman *D*, keep the power shaft in motion. Mr. Gustaf Seidel, of Saunderstown, R. I., is the inventor of this electric motor.

IMPROVED GARMENT HANGER.

One of the objections to the ordinary garment hanger is the fact that the arms are set at a fixed position which cannot be altered to suit different styles of garments, and the length of the arms cannot be adjusted to meet various requirements. The garment hanger which is illustrated herewith is designed to overcome these faults. The two arms *A* are formed of sheet metal and are reduced at one end where they are joined by a bolt or pivot *B*. The body of each arm is folded over, forming a flat sleeve adapted to receive an extension member *C*. The outer end of each member *C* is shaped to support the shoulder of the garment. At the under side of each arm *A* are a number of openings *D*, adapted to receive a projection *E* on the inner end of the extension member *C*. Thus, when the extension member is drawn out to the desired degree it will be held in place by engagement of the projection *E* with one of the apertures *D*. Each arm *A*, at the pivot end, is provided with an arcuate extension *G*. One of these arcs is provided with a number of projecting teeth which are adapted to be engaged by a single tooth on the other arc, to hold the two arms at the angle at which they are set. The hanger *F*, which is secured to the pivot bolt, is offset so that when the two arms are folded together it may be turned down against their edges (Fig. 2). The inventor of this garment hanger is Mr. Reginald C. Thomas, of 337 State Street, Brooklyn, N. Y.



IMPROVED GARMENT HANGER.