

one of turning on the water. Under automatic control the voltage of the generator is adjusted and stabilised, and the set connected to the lines. Voltage regulation raises the voltage with the load and lowers it with decrease of load, though this relation is only maintained up to the output capacity of the set because otherwise when it is supplying the system alone—it takes the night load here, as previously mentioned—the amount of any overload would be increased by the automatic rise in voltage until the set would shut down. To avoid this, the voltage is adjusted from a predetermined value of load to give a constant current output.

Should the current, even at a predetermined minimum, exceed the safe continuous value, the circuit breaker is tripped by an overload coil, this being fitted with a time lag to prevent its operation on momentary surges of current. In the event of the machine being disconnected owing to overload, the supply is restored by means of a periodic reclosing relay, which repeatedly recloses the circuit breaker until such time as normal conditions are re-established, though should the fault persist, the set is locked out pending inspection. It will also be locked out in the event of reversal of current, sustained over-voltage and over-heated bearings.

blowing is directed only to the part to be repaired, and at the same time the triangular piece intended to fill the void is made red hot. When the edges of the opening and the piece named have arrived almost at a white heat, and the whole almost in a state of fusion, the charcoal is removed, the ashes blown off, and the whole strewn with borax. Then, seizing the piece referred to with the tongs, they plunge it into the opening, and make it penetrate with light blows of the hammer. The friction derived from these blows causes an increase of heat on the edges which melt and adhere to each other as one whole; the operation is ended, the fire slowly let out, the waste cleared off, and the bell recovers its tone.

"If it were attempted to heat only the edges of the opening, for the purpose of soldering, the difference of the dilatation would infallibly crack the bell in other places; if great care is not taken there is a risk of melting the bell."

Whether or not such a method would be really efficacious even in the case of a smaller bell is open to doubt; but certainly in this case the size of the bell precluded any attempt to repair it in this manner.

It was, however, decided to raise the bell, and Monsieur Montferrand, who was appointed to prepare the plans and to direct the operations, reached Moscow on March 25th, 1836. Some time was spent on excavations, and in due course a "strong coffer of carpentry" was built around the giant, a further six weeks being employed in the erection of scaffolding and other preparations. Everything being in readiness, it was decided that the attempt should be made on May 1st.

At 10 a.m., the *Te Deum* having been sung, and in the presence of an immense crowd, the signal was given for a number of soldiers to operate the twelve capstans which had been arranged around the bell.

It was a critical moment for the engineer. One can appreciate the depth of feeling in Monsieur Montferrand's remarks in his preface: "... And,

The Raising of the Great Bell of Moscow

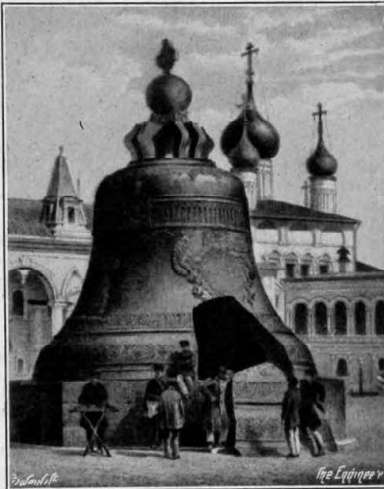
By J. R. NICHOLS

SOME time ago—August 27th, 1937—in a reference to the Great Bell of Moscow in the correspondence columns of *THE ENGINEER*, the present author mentioned that the raising of so great a weight over a century ago no doubt presented some problems. As a result of this remark, an interesting translation of an account of this feat has been received, and the

fire at the Kremlin in 1701. Montferrand gives the weight as 12,000 poods (about 193 tons), and the dimensions as follows:—Diameter, 22ft. 8in.; height, 20ft. 7in.

Unfortunately, long before the bell was hoisted a serious mishap befell it. Some wooden constructions which had been built above the pit caught fire and blazing rafters fell on the bell. In their anxiety to save it, the people threw water on the bell, but their zealous efforts occasioned a contrary effect; the bell was cracked and a large piece of about 11 tons weight detached itself.

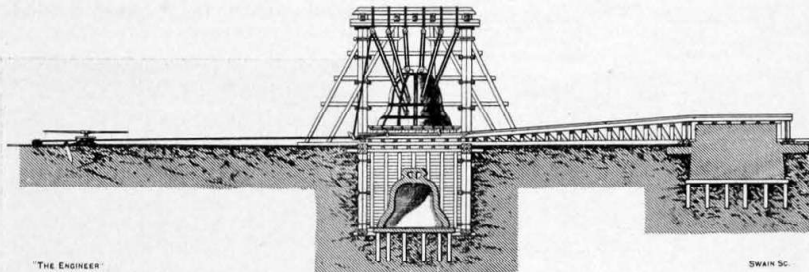
In 1797 the Emperor Paul I encouraged "an able mechanic named J. Guirt to devise methods to raise the bell," but the plans, though well conceived, were not proceeded with, for fear of further damage



GREAT BELL OF MOSCOW

following notes may be of some interest. The author of this account is Monsieur Auguste de Montferrand, who was responsible for raising the bell from the pit in which it had been cast (wherein it had remained for 103 years), and placing it on the pedestal on which it still stands.

The bell was cast in 1733, by order of the Empress Anna Ivanovna, to replace that of the Tsar Alexis Michaelovitch, which was broken at the time of the



MONTFERRAND'S SCHEME FOR RAISING AND TRANSPORTING THE BELL

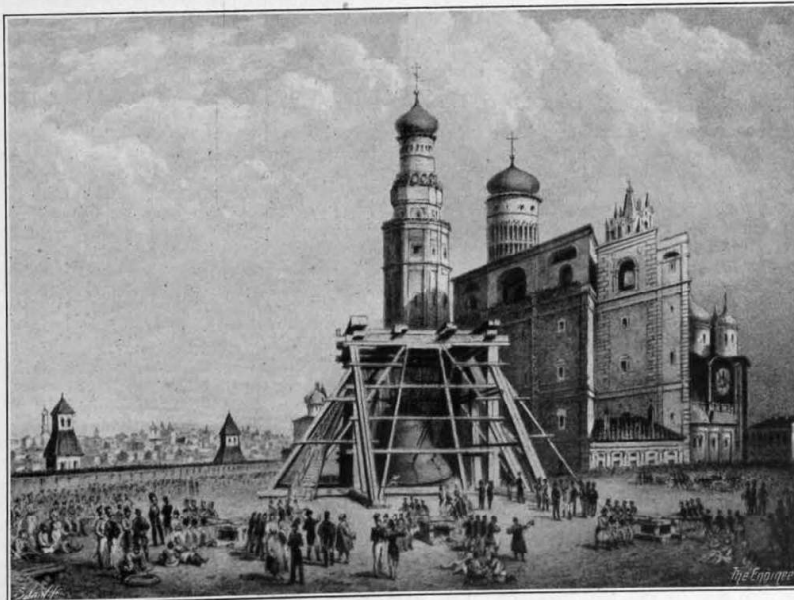
being done. Later, the possibilities of effecting a repair were considered, and here Montferrand throws an interesting sidelight on the manner of carrying out such a restoration of a bell of moderate size in those days: "This is the method of proceeding: the bell is turned mouth upwards; the edges of the crack are sawn so as to make an angular opening, in which is placed a piece of wood, cut exactly to fit the opening; this piece serves to form a mould from which to cast the piece to match the bell, and in the same metal, the fire being kept as regular as possible. Ten or twelve hours after the

nevertheless that my enterprise had not been lightly considered, and that my experience was old, I shrunk at first when I considered that any mishap would bring many harms and much revilements from the inhabitants of the city. . . . For blames and praises, honours and dishonours, commonly accompany great works, and especially such as be public. I would add that, ordinarily, people are more prompt to speak ill when things go evil, than to speak well and esteem the labour should it be in all perfection."

However, the bell began to rise slowly, but not without the breaking of two cables and a sheave of one of the pulleys. This caused the bell to assume an oblique position, and two further cables broke. The signal was given to stop, and operations were temporarily suspended. The cables, which had been in store some six months, were found to be defective, and new cables were ordered; the capstans were also increased to twenty.

All new preparations being completed, work was resumed on July 23rd at 5 a.m.; at five minutes past six the bell, "covered with its ancient dust," was seen to rise slowly from the pit. In less than three-quarters of an hour the great bell was above ground, and the pit was immediately covered with strong rafters and flooring, which received the carriage on to which the bell was lowered, and from whence it was hauled up an inclined plane to its pedestal on July 26th. The bell was subsequently surmounted by a ball and a Greek cross, and stands in the grounds of the Kremlin, on an octagonal pedestal of granite, which bears a marble slab inscribed with the following words in Russian characters composed by Monsieur Montferrand:—

THIS BELL,
CAST IN 1733, UNDER THE REIGN OF THE EMPRESS
ANNA IVANOVNA,
AFTER HAVING BEEN BURIED IN THE EARTH FOR MORE
THAN A CENTURY, WAS RAISED TO THIS PLACE
4TH. AUGUST, 1836,
BY THE WILL AND UNDER THE GLORIOUS REIGN OF
THE EMPEROR NICHOLAS THE FIRST.



RAISING THE GREAT BELL, JULY 23rd 1836

SCOTTISH SHALE INDUSTRY.—Work has begun on the sinking of a shale pit at Westmains and it is expected that the field will take about a year to complete. A new shale oil works is also to be erected at Westwood.