## REPORT

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New Jersey Interstate Bridge and Tunnel Commission

1926



## REPORT <br> OF THE <br> New Jersey Interstate Bridge and Tunnel Commission <br> TO THE

Senate and General Assembly of the State of New Jersey

THE HOLLAND TUNNEL

THEODORE BOETTGER, Chairman THOMAS J. S. BARLOW JOHN F. BOYLE
ISAAC FERRIS

JOHN B. KATES, Vice-Chairman
WELLER H. NOYES ROBERT H. NOYES frank L. SUPLEE
E. MORGAN BARRADALE ROBERT CAREY, Counsel OLE SINGSTAD, Chief Engineer


DATED JANUARY 2, 1926
$\overline{\text { MacCrellish } \& \text { Quigley }} \overline{C_{0}}$
$\xlongequal{\substack{\text { Printers } \\ \text { Trenton, New Jersey }}}$

## New Jersey Interstate Bridge and Tunnel Commission

## ANNUAL REPORT

## To the Honorable Senate and General Assembly of the State of Nero Jersey:

The New Jersey Interstate Bridge and Tunnel Commission respectfully submits its Annual Report for the year ending December 31, 1925, dealing with the construction of the Hudson River Vehicular Tunnel, now known at "The Holland Tunnel." The Commission is also charged with the responsibility of constructing the Delaware River Bridge from Camden to Philadelphia. Its activities with respect to the bridge will be accounted for in a report to be submitted by the Delaware River Bridge Joint Commission. Harmonious relations prevail between this Commission and those of New York and Pennsylvania. The Commission is extremely pleased to report the progress on these two great structures looking to their early completion.

The Commission reorganized March 10, 1925, at its offices in the Woolworth Building, New York City, with the re-election of Theodore Boettger, of Hackensack, as Chairman, and John B. Kates, of Collingswood, as Vice-Chairman, and the re-appointment of John C. McEnroe, of Newark, as Secretary. Hon. Robert Carey, of Jersey City, has continued to act as Counsel to the Commission.

The Commission held twenty-two stated meetings during the year, all of which were open to the public and were devoted exclusively to tunnel matters. In addition, the Commission has held two special meetings devoted exclusively to the consideration of the tolls problem confronting it with respect to the Delaware River Bridge.

The year 1925 has been marked by the completion of work of constructing the iron lining in the under-river tunnels, the completion of the New York approach sections, the practical completion of the concreting of the tunnel and the progress on the New Jersey approach section under Contract No. 6 let in December of last year. Sections of the tunnels can now be seen in a practically completed state, roadways paved, sidewalls tiled and light boxes installed, all of which justifies the expectation that the completed tunnel will not only be an important facility for traffic, but an exceedingly attractive one as well. During the year there were let eight contracts. These include: Contract No. 7, for the tile lining and interior finish of the timnel; Contract No. 9, for transformers and oil switches; Contract No. 10, for the granite block tunnel roadway pavement; Contract No. 12, for the ventilation fans, motors and control; Contract No. 13, for the construction of the New York land and river ventilation buildings and the interior finish of the New York land and river ventilation shafts; Contract No. 14, for the construction of the New Jersey land and river ventilation buildings and the interior finish of the New Jersey land and river ventilation shafts; Contract No. 20, for the
power cables for carrying the power required for the operation of the tunnel; and Contract No. 24, for the pumping equipment.

Bids for these contracts were publicly advertised and publicly opened, as follows:

|  | Contract No. 7 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | L. Del Turco \& Bros., Inc., Harrison, N. J. | Rodgers \& Hagerty, Inc., 70 East 45th St., N. Y. City. | Dooley Stapleton Corp., 257 Adelphi St. Brooklyn. | Frederick Snare Corp., 114 Liberty St., N. Y. City. | Alexander \& Reid Co., 355 West 36th St., <br> N. Y. City. |
| Total of bid with |  |  |  |  |  |
| 100\% domestic tile, | \$909,180.45 | \$1,219,725.75 | \$1,233,831.35 | \$1,254,502.50 | \$1,375,030.40 |
| $75 \%$ domestic and 25\% foreign, ..... | 895,492.95 | 1,196,000.75 | No bid | 1,246,290.00 | No bid |
| 50\% domestic and |  |  |  |  |  |
| 50\% foreign, $\ldots$. $25 \%$ domestic and | 881,805.45 | 1,172,275.75 | No bid | 1,238,077.50 | No bid |
| $75 \%$ foreign, ... | No bid | 1,148,550.75 | No bid | 1,229,865.00 | No bid |
| 100\% foreign, | No bid | 1,124,825.75 | No bid | 1,221,652.50 | No bid |

Overrun over Chief Engineer's 1923 Estimate- $\$ 128,241.45$.

## Contract No. 9

## Name and Address of Contractor

General Electric Company, .........
120 Broadway, New York City.
Westinghouse Electric \& Mfg. Co., 150 Broadway, New York City.
Underrun under Chief Engineer's 1923 Estimate- \$62,505.00

## Contract No. 10

Name and Address of Contractor

Poirior Contracting Co., Inc., . . . . . .
1476 Broadway, New York City.
Public Service Production Co., . . . . .

## Contract No. 12

Name and Address of Contractor
B. F. Sturtevant Company, Boston, Massachusetts.
Wagner Engineering Co., Inc. 598 11th Avenue, New York City
Buffalo Forge Company,
39 Cortlandt Street, New York City.
Green Fuel Economizer C
90 West Street, New York City.
Amount of Bid $\$ 571,631.00$

655,130.00
684,095.00
$776,975.00$

Underrun under Chief Engineer's 1923 Estimate-\$119,833.00

## Contract No. 13

Name and Address of Contractor
DeRiso Construction Company,
\$1,277,953.00
921 Bergen Avenue, Jersey City, New Jersey.
D. C. Serber, Inc., . . . . . . . . . . . . . . . . . . . .

George Colon \& Co., Inc., . . . . . . . . . . . . . . .
81 East 125th Street, New York City.
Emil Diebitsch, Inc., . . . . . . . . . . . . . . . .
70 East 45th Street, New York City.
70 East 45th Street, New York City.
Thos. J. Waters Co., ..........................
210 East 33d Street, New York City.
Fred Snare Corp.,
114 Liberty Street, New York City.
Lustig \& Weil, .........................
103 Park Avenue, New York City.
Niewenhous Co., Inc., . . . . . . . . . . . . . . .
16 East 43d Street, New York City.
16 East 43d Street, New York City.

$$
103 \text { Park Avenue, New York City. }
$$

1,291,130.00
1,359,227.00

Overrun over Chief Engineer's 1923 Estimate--\$500,635.00
Contract No. 14
Name and Address of Contractor
Amount of Bid
DeRiso Construction Co.,
921 Bergen Avenue, Jersey City, New Jersey.
G. DeKimpe, Inc.

1,587,331.00

30 Church Street, New York City.

The English Construction Co., Inc.,
15 West 91st Street, New York City.
Thomas J. Waters Co.,
eet, New York City
210 East 33d St
George Colon \& Co.,
81 East 125th Street, New York City.
verrun over Chief Engineer's 1923 Estimate- $\$ 879,033.00$.
Contract No. 20
Name and Address of Contractor
Contracto
Pittsburgh, Pennsylvania
ames Sugden Company,
17 East 42d Street, New York City.
Erickson Engineering Co., Inc., ....................
fety Cable Company, ...................
114 Liberty Street, New
Fox Reynolds Company, Inc.
81 East 125th Street, New York City,
hn W. Hooley,
70 East 45th Street, New York City
Underrun under Chief Engineer's 1923 Estimate-\$26,974.00.
Contract No. 24
Name and Address of Contractor
Booth \& Flinn, Ltd., .. .................
Shevlin Eng. Co., Inc.,
Maspeth, Long Island.
Peerless Engr. Co
71 8th Avenue, New York City.
598 11th Avenue, New York City.
Erickson Engr. Co., Inc.,

New Jersey Interstate Bridge and Tunnel Commission

A comparison of the bids on each of the above contracts will show the marked range between the low and high bids, which is evidential of the uncertainty to be met in estimating the cost in planning and conducting public works of this character. There are nine contracts yet to be let. The planning and preparation of these contracts is well under way, so that they can be awarded in time for construction work under them to commence on schedule. Barring interruption by unlooked for delays, the tunnel will be ready for operation early in the year 1927.

## REAL ESTATE AND PLAZAS

During the course of the year, negotiations have been conducted and agreements reached with the New York Telephone Company, the Western Union Telegraph Company, and the Postal Telegraph Company, for the leasing of duct space in the low-tension ducts in the tunnel walls for the service of this important line of operation.

One of the most important steps in the progress of the year has been the satisfactory negotiation with the Delaware, Lackawanna and Western Railroad Company for the necessary lands and easements for the construction, maintenance and operation of the tunnel in the terminal yard properties of that company. A large number of important conferences were held during the course of the negotiations, and the Commission is gratified to report the successful negotiation upon a basis materially to the advantage of the State.

The property required for the needs of the plazas in New York City and Jersey City have now practically been acquired, with the exception of four parcels in New York City and sixteen parcels in Jersey City. Condemnation proceedings have been commenced and the right to actual possession acquired, so that no delay will be met with in the development of these plazas for tunnel purposes. The negotiations with the authorities of the City of Jersey City for the vacation of 11th Street, though not yet consummated, in all probability will be amicably adjusted to the satisfaction of all interested parties.

## ORGANIZATION

The Commission regretfully recalls the sudden and unexpected death of Milton Harvey Freeman, its Chief Engineer, on March 24, 1925, and of John C. McEnroe, its Secretary, on June 2, 1925. On April 7, 1925, the Commission named Ole Singstad, of Brooklyn, New York, as Chief Engineer, to fill the vacancy caused by the death of Mr. Freeman. Mr. Singstad had been Engineer of Designs under both Mr. Holland and Mr. Freeman. It was another evidence of the sterling qualities of Mr. Holland in forming an engineering organization so competent as to enable the Commissions to fill the vacancies caused by his death and of Mr. Freeman from the staff. On July 7th, the Commission named E. Morgan Barradale, of South Orange, New Jersey, as Secretary, to fill the vacancy caused by the death of Mr. McEnroe.

The Commissions had not fully recovered from the shock of the loss of its first (he Chief Engineer, Clifford Min Freeman, Chief Engineer to the Commissions, who sdden death of Milton Harvey Frema, died at his home at Valhalla, New York, on March 24, 1925, less than five months fter his assumption of the heavy duties of Chief Engineer. Mr. Freeman had been with the tunnel project from the organization in July 1, 1919, and was recognized in the engineering profession as an unusual tunnel engineer. His indefatigability and sincerity of purpose were hidden behind a modesty which permitted but few to enjoy a complete realization of his sterling worth and high talents. It can be truly said that he gave himself completely to his professional work, and pat Commissacrifice through his sincerity of purpose. His loss was keenly felt by the Commin sacrifice thr ond whis had learned his real worth, his quiet and unassuming mansions and the staff, which had learned his high purpose. At a joint meeting with the ner of accomplishing great results, and Commission, held on April 7, 1925, the fol New York State Bridge and
lowing resolution was adopted:

Again the New York and the New Jersey Bridge and Tunnel Comsions meet in special session with a vacancy in the office of Chief Enmineer. Milton H. Freeman, Chief Engineer to the Commissions, an gineer. The final summons on Tuesday, March twenty-fourth, nineteen swered the final surty-five, midway in the fifty-fifth year of an active, usehundred and twenty-fir, Engineer December 1, 1924, to succeed the late ful life. Appointed Chief Engineer December 1, Clifford M. Holland, he brought to the office emical experience. It may be education, trained judgment and wide ply to the building of the Holland said that he gave himself too unsparingly to the biring, his ways so quiet and Tunnel. His service was intensive and un ban so courteous as to unobtrusive, his words so considerate and his manner so courteous as to inspire respect and affection, making every member of our Commissions ensible to a personal loss and of the loss to the great undertaking in which we are engaged.

Resolved, That the foregoing be adopted and inscribed in the minutes fe New York and New Jersey Commissions as an appropriate tribute the Nos copy of this resoluto the late Milton H. Freem, with a suitable expression of our sincere sympathy.

## JOHN C. McENROE

At its meeting on June 2, 1925, the Commission received the sad news of the death, that morning, of its Secretary, John C. McEnroe, of Newark, New Jerthe death, Mr. McEnroe had been at the office the day before attending to his duties, sey. with practically no hint of his impending end he died in the midst of a very and with practically no hint of his impen the Commission as Secretary for a little more
than a year. He had come to the Commission with a high reputation for integrity and ability, having served his City and State in various capacities which demonstrated his ability and purpose. On the date of his death, the Commission adopted the following resolution, and adjourned out of respect to his memory:

It has pleased the all-wise power of Providence to visit its unknow able purpose again by removing from our midst John C. McEnroe, Secretary of the New Jersey Interstate Bridge and Tunnel Commission, and translate him to the greater life.

Mr. McEnroe served the Commission and the people of New Jersey in his present position since March, 1924. He had enjoyed the acquaintance and friendship of many men and women in public life, had served his native City as Deputy Commissioner of Public Safety, his State in the Department of Institutions and Agencies and finally through his connection with the Interstate Bridge and Tunnel Commission. In al his relations, both private and public, he earned the esteem of those with whom he served and the well earned commendation of those for whom he served. His capacity for endeavors and his sustained interest in his work wherever he found his interest, marked him among his fellowmen as a leader whom all enjoyed to follow. His ability in carrying on the work in which he was engaged for the Commission has left its impress and marked him as an upright, honest and capable public servant.

## DELAWARE RIVER BRIDGE TOLLS

Reference to the 1924 Report of the Delaware River Bridge Joint Commis sion will show that the New Jersey Interstate Bridge and Tunnel Commission had taken the position that the collection of tolls on the Camden-Philadelphia Bridge rested upon a legal and moral obligation to the citizens and bondholders of the State of New Jersey for the amortization of the cost of the structure. In May, of 1925, the Pennsylvania Legislature adopted a statute providing for a Commission to operate the bridge, and defined its powers, declaring for a toll-free bridge, and took from its operating Commission the power to levy tolls. The New Jersey Interstate Bridge and Tunnel Commission immediately took steps to establish New Jersey's rights. It is the decision of the Commission to let no new contracts until the impasse now existing between the States has been closed to the satisfaction of the Commission.

With respect to the question of collecting tolls on the Delaware River Bridge, this Commission calls attention to the statutes under which it is now operating, and particularly to paragraph 8, of Chapter 69, of the Laws of 1919, which provides as follows:
8. The Interstate Bridge Commission, upon the completion of such bridge, is authorized and empowered to enter into agreements with the State of Pennsylvania, or its properly constituted agency or authority, to provide for the joint operation, maintenance and repair of such bridge,
for regulating its traffic and policing and protecting the same, for the fixing and collection of tolls and charges for the use of such bridge and for the regulation of such other matters as are incidental thereto, which or the regulation of sepeal agreements the said commission is authorized Sthe State of Pennsylvania, or from time to time, upon agreement with the its agency as aforesaid, as and the completion of the
Under existing statutes, this Commission must ant with State of Pennbridge before it has authority to enter into an agreement wait of the bridge and for the sylvania for the joint operation, maintenance respectfully invites the attention of fixing and collection of tolls. The Commssity to enter into such an agreement at the Legislature to the necessity for authority to once.

In the year 1923, revised estimates of the cost of the bridge and of the cost of In the year 1923, reditted to the Legislature as the basis for the bond issue of the tunnel were submitted to the Legisant contracts have been let for the construc1924. Since that time, eleven important contracts have $\$ 1,028,938.45$, and twentytion of the tunnel, which have developed an ortion of the bridge which have developed two contracts have been let for the construction of the the tunnel and five contracts overruns. There are still nine contracts to be will be required for New Jersey's on the bridge. Based on these overruns, the sum of $\$ 2,500,000$, and recommendashare for the completion of both projects the sum of $\$ 2,500,0,0$, moment, so that tion is made that this sum be made available at tho most important structures, there may be no delay in the completion of these two most for the State.
which will, upon their completion, become income


ffiltan $\mathfrak{H}$ H. Tfreeman

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION
AND
NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION

REPORT OF CHIEF ENGINEER
DECEMBER 31, 1925

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## REPORT OF CHIEF ENGINEER

New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission:
Gentlemen-Submitted herewith is my report for the year 1925. Prior to March 24, 1925, the work of this year was under the direction of the late Milton H. Freeman, Chief Engineer of the Commissions.

The year 1925 was marked by the preparation and awarding of a large number of contracts, eight in all. These include the more important of the equipment and finish contracts, and were scheduled so that construction work under them could be started as soon as the progress under the earlier contracts would permit. The eight contracts involved the preparation of 347 contract drawings and the publishing of contracts and specifications comprising a total of 1252 pages of printed matter, all of which represents nearly twice the number of contract drawings and nearly 80 per cent of the printed matter contained in all previous construction contracts and extending over the preceding four years of tunnel construction. These contracts include tiling the tunnel walls, tunnel roadway pavement, ventilation fans and motors, electrical transformers and oil switches, tunnel power cables, pumping equipment, and the four buildings to house the ventilation equipment.

The work of constructing and equipping the Holland Tunnel is being done under twen-ty-three contracts. Six of them, namely, those comprising the tunnel structure proper, with the under ground portions of the approaches, had been let and prosecuted prior to 1925, one of which, Contract No. 1, for the land shafts, New York, had been fully completed and accepted by the Commissions and the final estimate approved.

Two of these six contracts were let in 1924, the one for the New Jersey approach from the westerly limit of the tube construction to the points where the tunnel meets the street surface; and the other for the New York approach from the portals to the easterly limits of the tunnel at its junction with the street grades. The outstanding feature of tunnel construction during 1924 was shield driving. With the exception of a comparatively short stretch in the north tunnel west, New Jersey, the bores of both tunnels were practically completed from their easterly limits at the land shafts, New York, to their westerly limits beyond the land shafts in New Jersey. The two shields in the north tunnel, one driven westward from New York and the other eastward from New Jersey, had been brought together in November. Those in the south tunnel were within 2.2 feet of each other on January 1, 1925. These were brought together and the compressed air was discontinued in the south tunnel on February 22, 1925. The last shove of a shield in any section of the tunnel occurred in the north tunnel west, New Jersey, on March 6, 1925, and compressed air was removed from this section on March 23, 1925

During the year 1925, in addition to the preparation and awarding of contract work previously outlined, construction work on existing contracts continued and was begun on most of the contracts let this year.

These construction activities included completing, except for minor details, the underer tunnel contracts, Nos 3 and 4. The closer rings were placed at the junctions of the hields, most of the tunnels and the shafts were placed, and the concrete turel lining and interior construction, which had been started in 1924, were carried practically to ional partically to completion. The placon finish required for all air passages, the occuronal care and skill because of the smooth find ence of niches of various sizes, manholes and ore castand interfere with the placing of forms. The small clearances, esent further difficulties in iron flanges
concreting.
The construction work on the New York approaches, Cor numerous surface and including the completion of the tunnel structure and the restoration of numerous ondy a few minor items of cleaning up to be done.

Early in the year, construction work was started under Contract No. 6 . Thilding and the air is for the tunnel approaches, the foundations for the land ventilatew Jersey. By a coinciduct construction between this building and the land shaf the thirty foundation caissons dence, the use of compressed air required for the sinking of the the comfor the land ventilation building, New Jersey was started on the same cay the ir for the land from the last tunnel section, March 23, 1925. Compressed air has pressed air was en interruptions, for this work throughout the year. The work under this been used, with few interupe over and in close proximity to the tunnel structure of the contract carried both tunnels over and and D., L. \& W. railroad yards. Special precauHudson \& Manhattan R. R. tions had to be taken in prosecuting in the co-operation of the Hudson \& Manhattan tunnels, and in carry R R Company has been accorded us Chief Engineer of the Hudson \& Manhat 5 and 5-A will be completed early in 1926, and

The work under Contracts Nos. 3, 4,5 and ork is now in progress on the preparation of the final estimale and will be completed The construction work unde
during the summer of 1926 .
Work has been in progress on all of the eight contracts let this Power Cables, which wo, No. 14, Ventilation Buildings, New Jersey, and No. 20, Tunnel Power Cables, which were awarded on December 22, 1925. Work under Contract No. 7, Tile and Tunnel has proceeded to a point where about $44 \%$ of the tile has been manufactured, and thaft,
 New York, and in the south tunnel from the portal half way to the land shaf, New Under Contract No. 10, Tunnel Roadway Pavement, work has been progr a considerable nearly one-half of the tunnel roadway has been paved with granit the work of tunnel conquantity of granite
struction permits.
Construction plans of steel and concrete details and the Nos. 3 to 7, inclusive, 9, 12 drawings have been in progress during the year for Contracts Nos. plans and specifications and 13. Work has been in progress on the preparation of contract plans and salf of 1926 for the remaining nine contracts, most of which will be let during the first


Studies and investigations have been continued on the architectural, mechanical and electrical features of the tunnel, protective coatings for steel, earth pressure on the tunnel lining and caissons, including physical properties of silt, and other subjects which aid in explaining tunnel movement phenomena.

The Contractor's plant and equipment in Canal Street, Spring Street, on the land shafts and on Pier 35, New York, were removed; the power house dismantled and the building razed, marking the completion of the work for which they had been installed. Nearly all the temporary clay blanket over the tunnels, 174,626 cubic yards, was removed from the river channel to conform with the requirements of the permit from the Secretary of War.

The lease from the City of New York for Pier 35 was terminated and a new lease was entered into for a 20 -foot roadway over this pier to provide access, for construction purposes, to the river shaft. An agreement was negotiated with the Delaware, Lackawanna \& Western Railroad Company for permanent and temporary rights-of-way in the Company's yards in Jersey City. Agreements were entered into with the Erie Railroad Company modifying the provisions for the support of warehouse loads on the air duct structure at the land shafts in the Erie Railroad yard; to provide four temporary pile clusters to serve as a proection for the New Jersey river shafts during the construction of the Erie Railroad pier around the shafts and over the tunnel and a lease was negotiated with the Erie Railroad Company for the rental of plant site in the Erie Railroad yard required for the prosecution of the construction of the ventilation buildings, New Jersey, under Contract No. 14.

Negotiations have been in progress with New York City and Jersey City relative to adjustment of street grades and other matters related to the paving of the plazas, and with the power companies on both sides of the river for the supply of electric power to operate the ventilation and other equipment of the tunnel

The co-operation of the Fine Arts Commission of the State of New York was obtained and the final plans and architectural treatment of the ventilation buildings, New York, received the approval of that Commission.

Plans of the Erie Railroad Company for their new pier to be constructed over the tunnel and around the river shafts, New Jersey, were approved in accordance with the agreement between the Commissions and that Company. Work has been in progress on the construction by the railroad company of this pier and special precautions have been required to be taken by the Company to avoid damage to and undue displacement of the tunnel in the silt. This work has been carried on with the fullest co-operation between the Chief Engineer of the Erie Railroad Company and your Chief Engineer.

# SCHEDULE OF CONSTRUCTION AND EQUIPMENT CONTRACTS 

Contracts Let Prior to 1925

II-CONSTRUCTION PROGRESS

Progress of construction is described in detail under the different contracts.
Contracts Nos. 3 and 4

Contractor,
Date of Contracts,
Date of Delivery of Contracts
Contract Time,

## Contract Bid Price,

Contract Bid Price plus estimated oversm, Estimated Value of Contract to date,

Booth \& Flinn, Limited March 28, 1922 Apri1 11, 1922 Three Years Contract No. 4. $\$ 12,132,100.50$

11,935,532.55

Tunneling-
The shield driving in the portions of the tunnels to be built under Contract No. 3 was The during 1924, but for reasons of convenience the New York shields were driven
 over the dividing lin lime lits of Contract No. In the North Tunnel New Jersey shields were made within the limits of Come the compressed air was removed on the last shove was made on


PLATE No. 2-Closer Ring at Junction of Shields, North Tunnel.


January 3d, 1925, and the last regular cast-iron ring was erected on January 27th. In the South Tunnel the last shove was made on January 10th, 1925, the compressed air was removed on February 22d and the last regular ring was erected on February 28th. The two shields which met in each tunnel were dismantled, the outside cylindrical portions or "Skins" being left in place and the cast-iron lining erected inside them. The narrow space left between the last two rings erected in each tunnel was closed in the North Tunnel on June 30th, by means of a special cast-iron ring, where the space was considerable, and on or about March 15th, by special wedge shaped steel plates. in the South Tunnel where the space was smaller.

In Contract No. 4 tunneling was completed in 1924, except for the North Tunnel West, which had been advanced about 610 feet from the North Land Shaft, with 172 feet still to be driven. The last shove in the North Tunnel West was made on March 6th, 1925. The nature of the material through which this last tunnel was progressing was such that it slowed down the rate of driving considerably. This tunnel shield passed diagonally under the 8 -foot steel sewer in the Erie yards on the prolongation of Twelfth Street. The supporting material of this sewer consisted of stone fill, which had apparently been dumped here for the purpose. The large stones comprising this fill extended down for a depth of about 15 feet, below which was a 5 -foot stratum of silt overlying fine running sand. The top of the heading was so close to the surface of the ground at this point that none but the lowest air pressure could be used. This made it impossible to dry out the sand in the bottom. The air escaped freely through the spaces between the stones above, so that an abnormally large air consumption was unavoidable. The shoving of the shield pushed stones up against the bottom of the sewer, heaving its invert as much as three feet in some places and allowing the water to pour into the tunnel. The low pressure air, gas and water lines under which the shield passed had to be by-passed on account of the heaving of the ground.

In spite of these obstacles the work was finished successfully and the tunnel built close to line and grade. Before taking the compressed air from the heading the Contractor constructed a sump of pea gravel under the shield, with the idea that this sump would help him in draining the ground for the section of the North Tunnel to the west of this work and included in Contract No. 6. Concrete cut-off walls were built under the north and south lower quarters of the cast-iron lining with a view to expediting the excavation for the North Tunnel under Contract No. 6.

Summary of Progress in North Tunnel West-New Jersey

|  | Station | Date | Time Days | $\begin{gathered} \text { Act. } \\ \text { Work } \\ \text { Days } \end{gathered}$ | $\begin{gathered} \text { Prog. } \\ \text { Feet } \end{gathered}$ | $\begin{gathered} \text { Feet } \\ \text { Work } \\ \text { Day } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Shield erection begun, | ....... | 7/21/24 |  |  |  |  |
| Shield erection completed, | ....... | 9/2/24 | 43 | 36 | $\ldots$ | $\ldots$ |
| Compressed air applied, |  | 9/2/24 | $\ldots$ | $\ldots$ | ..... |  |
| Removal of west bulkhead of land shaft begun, | ...... | 9/2/24 |  |  | $\ldots$ | $\cdots$ |
| Removal of west bulkhead completed, ......... |  | 9/9/24 | 7 | 6 | $\ldots$ | $\ldots$ |
| Shield advanced excavation begun, ............ | 24/24.9 | 9/10/24 | 1 | 1 |  |  |
| Iron erection begun, ........................ | 24/28.0 | 9/11/24 | 1 | 1 |  |  |
| Iron erection completed, | 16/42.5 | 3/5/25 | 175 | 145 | 785.5 | 6.7 |
| Shield at end, | 16/29.4 | 3/6/25 |  |  | 795.5 | 6.8 |
| Compressed air removed, |  | 3/23/25 | 202 | 168 |  |  | boulders.

Concreting Tunnel Lining.
The conspicuous work of 1925 was lining the tunnel with concrete. Therefore this feature will receive more detailed treatment than in last year's report.
eature will receive more detailed Contract No. 3, the concrete lining of the tunnel between
At the first of the year, under Contract York, was about $85 \%$ completed in the North the Land Shafts and the River Shafts, New York, was about been done west of the River Tunnel and $60 \%$ in the South Tunnel. No concreting had 1924 in the South Tunnel West Shaft. Under Contract No. 4, the lining was Legun Shafts, New Jersey. and in the River Tunnels between the Land and River Shafts, New Jersey.

During 1925, under Contract No. 3, the concrete lining was completed except en tens electric tunnel rings at the River Sump and River Shaft, New York. The
ducts were also placed. The tunnel was cleaned in preparation for the work of tile setting under Contract No. 7.

Under Contract No. 3, immediately following the lowering of the air pressure to normal in the North 'Tunnel, the demolishing of the concrete bulkhead and the removal of the air in the No equipment was begun. The corresponding bulkhead in the South Tunnel was locks and equipment was begun. The work of concreting was started in the North Tunnel at the New York removed later. The work of concreting was startaltaneously similar work was begun near the River Shaft and proceeded westward, while simultaneously simila in the portion of the tunnel middle of the river and carried eastward.
below the sidewalk level. Upon the completion of this portion of the lining in the Nortated by increasing the form were transferred to the South Tunnel and the concreting accelerated increasing begun in length from 60 feet to 75 feet. Searching out and stopping leaks in the concrete, begun in the spring, had to be discontinued in the warmer months because of the wal interfered with in the tunnel. This moisture, condensing upon concrete and exposed metal interfered with in the tunnel. locating leaks as well as contractor to finish 1,000 feet of this tunnel ready for tile setting
however, permitted the Con however, permitted the Contr

Under Contract No. 4, concreting in the South Tunnel West was begun at the western
Under Contract No. 4, concreting in the South Next the North Tunnel East, between end and proceeded easterly toward the Land forer concting. This last concrete work was the Land and River Shafts, was prepared for concreting. started just east of the air lock bulkhead used for driving the Northe from the Land in place. The work in both North and Souiting the moving of the forms, except those Shafts eastward to the River Shafts, thus permitting the moving of the forms, except those for the ceiling slab, toward the mixer at the river shafts while tran of an elevated trackway. Meanwhile forms were started at the middle of the river and progressed westward. The entire tunnel, under Contracts Nos. 3 and 4, has been lined with gressed westward. and at the tunnels' junctions with the shafts, to permit the erection of special connecting and at the tunnels' junctions with the shafts, rings and for joining the work more advantageously with that of future contracts. There rings and for joining the work more advantage cencrete in approximately 140 feet of the roadway ceiling also remains to be poured the concrete in approximats Shafts, New Jersey.
slab in various parts of the tunnels west of the River




CONTRACT Ne 4 CONCRETING SCHEDULE This method of Construction was used up to Deeember 19e2
offer which the mettrod used for Controct Ne 3 Wos sodppled


CONTRACT No 3 CONCRETING SCHEDULE

## SOUTH TUNNEL <br> THE HOLLAND TUNNEL CONTRACTS №s 3 and 4 CONCRETE TUNNEL LINING PROGRESS PROFILES



PLATE No. 6-New Erie Railroad Pier, New Jersey. Looking East from Bulkhead.

Throughout the tunnel the iron was cleaned and caulked and made water tight, preparatory to concreting the lining. The placing of concrete, which was begun in 1924, was continued during 1925 with greater activity, as the Contractor was able to improve his organi zation and methods from his previous year's experience.

The arched portion of the tunnel, besides the usual difficulties of concreting as experienced in all tunnels, was particularly subject to most of the complications heretofore men tioned, and an attempt was therefore made to deposit this portion of the concrete lining, and later the ceiling slab, by blowing it into place with compressed air, but due principally to the scant clearances, this method did not prove satisfactory and hand shoveling was resumed. In the case of the ceiling slab the Contractor abandoned the method of blowing, because the general delays incidental to this method more than offset the speed of actual depositing.

## Mixing and Transporting-

The mixing plants were constructed in the river shaft caissons with timber bins for storage of aggregate placed above them. The cement storage was on the top of the shafts convenient to barge shipment and the cement was conducted to the loading hoppers through pipes into the tops of which the bags were emptied. A track high enough to be out of the way of the progress of all forms except the arch form was hung from the top of the tunnel iron, over which elevated railway the concrete was delivered to the different parts of the tunnel. This railway was taken down after serving the arch form and concrete for the ceiling was delivered on a track laid on the completed roadway of the tunnel, and raised to the ceiling slab by means of an elevator at the point of deposit.

Specially designed collapsible concrete forms, 60 feet in length, carried on a movable steel frame, were employed in this work. There were five types of forms for the differen parts of the lining.

Plate No. 5 will assist in what follows.
The procedure of concreting consisted of nine distinct steps, beginning, first, with the pouring of the invert concrete in the lower air duct. This was done without the use of a form. Second, Form No. 1 served from this point for the roadway slab, and the sides to the bottom of the expansion chambers. The third step, for which a detached portion of the No. 2 Form was used, brought the concrete to the high tension duct bench on the one side and to the nosing level on the opposite side. The fourth stage of the procedure consisted of laying the high tension ducts below the sidewalk level. Fifth, the No. 2 Form was employed to concrete the sidewalk on one side and the low tension duct bench on the opposite side of the roadway. The sixth stage comprised laying the low tension ducts and pouring concrete behind them. The seventh stage was carried on by Form No. 3, for side walls to the top of the ceiling slab level. Eighth, Form No. 4 serves for the arch concreting at the top. The ninth and last stage was the pouring of the ceiling slab for which Form No. 5 was put in place.

Subsequent to lining the tunnel with concrete the granite curb was laid and the space behind it concreted. Approximately 24,070 lineal feet of granite curb have been set, about 5,850 lineal feet still remaining to be placed.

Six days were required for the setting of the concrete in the ceiling slab before drawing the forms. In order to compensate for the resulting delay, the ceiling forms were lengthened from 60 to 120 feet.

## Midriver Sump-

At the beginning of the year excavation for the sump had been practically completed. The concrete invert, sidewalls and pump chamber floor were placed. The cast-iron for the arch was erected and grouted, and also the special cast-steel taper ring at each end which joins the sump iron to the tunnel iron. A special ring at each end joins the cast-steel taper ring to the straight cast-iron sump rings. A certain amount of caulking and the lining of the arch with concrete remains to be done.

Just before the compressed air was removed from the North Tunnel, a temporary conJust before the compressed north end of the sump, sealing this sump opening. Comcrete bulkhead was built at the north enmp when taken off the South Tunnel. The concreting pressed air was removed from the sump when taken off the South Tunnel . The concreting of the sump and pump chamber walls and bench had been completed by this time and the straight cast-iron roof rings of the pump chamber had been erected. A temporary waterproof seal was placed between the sump iron and the tunnel
be removed before the special rings were made and placed.

Land Shafts, New York-
Between the first of August and the latter part of October the roofs of the land shafts, New York, were completed.

Removal of Contractor's Plant, Contract No. 3-
Early in the year the overhead gantries in Spring and Canal Streets, New York, and the Contractor's equipment except the concrete mixers in the River Shaft, New York, were the Coned from the tunnel and from the top of the land shafts and the cages and head removed frames are now being removed from the River Shafts. The power-house on the canal Street park site was dismantled, the building razed, concrete foundation removed, the sidewalks and roadway restored, and the Canal Street park graded. This included the bypassing of conduit, water and gas lines and the restoration of street surface. The Contractor removed his materials and equipment from Pier No. 35 and the pier was turned over to the City, the Contractor retaining the use of a portion of the west end and a 20 -foot strip on the north side from West Street to the west end of the pier.

Temporary Clay Blanket-
On August 19 dredging to remove the temporary clay blanket over the tunnels began, and by November 14 a total of 174,626 cubic yards had been removed toward bringing the river bottom in the 2,000-foot channel to the depth required by the War Department Material dumped into the slip between Piers 34 and 35 was left in place by arrangement with the Department of Docks of the City of New York, as the City expects to build the new pier on this site during 1926 .


ринииця
and concrete for the foundation and basement of the Ventilation Building on Washington

Plate No. 7
: slab before draw eiling forms were
actically completed. he cast-iron for the at each end which the cast-steel taper and the lining of
l, a temporary conap opening. Comap opening. Comlel. The concreting
$y$ this time and the I temporary watercompressed air could
$s$ of the land shafts,
ets, New York, and ft, New York, wer the cages and head house on the Canal n removed, the sideis included the bysurface. The Conpier was turned over and a 20 -foot strip
$r$ the tunnels began ved toward bringing he War Department place by arrangemen expects to build the
table of decompressions at various pressures and cases of compressed air illness (bends) up to december 31, 1925



Erie Pier-
On the Jersey side, Piers Nos. 8 and 9 of the Erie Railroad were demolished during the summer and dredging for the new Erie pier completed. On August 13th the driving of piles for the new pier over the North and South tunnels was begun. Timber piles 85 to 110 feet in length are being driven closely together from the river bulkhead to the pierhead line in three groups, one group north of the North Tunnel, one between the two tunnels and the third south of the South Tunnel. The total number of piles required is 8,686 , of which $65 \%$ have been driven to date. Daily surveys and close inspection accompany the driving of these piles to observe the effect upon the tunnels. As the piles drop of their own weight through the silt to the spring line of the tunnel or below it, the chance of driving a pile against the outside of the tunnel is remote. But there has been observed some vertical movement of the tunnel together with some lateral movement. By careful control of the order of driving in the three different groups, the lateral motion of the tunnel has been kept within two inches. During the pile driving the tunnel rises for a length extending back of the pile driver about half-way to the bulkhead, and then settles gradually. The maximum rise has not exceeded four and one-half inches to date, and subsequent settlement has reduced this amount to about two and one-half inches. The removal of the old piers and construction of the new is being done by contractors for the Erie Railroad Company

The demolition of the working platform constructed by the Contractor for Contract No. 4, in 1922, around the site of the river shafts, was begun in November and has been completed so as to permit the construction of the new pier about the river shafts.

| Contractor | Rodgers \& Hagerty, Inc. |
| :---: | :---: |
| Date of Contract | July 17, 1923 |
| Date of Delivery of Contract | July 28, 1923 |
| Contract Time | Two Years |
| Contract Bid Price | \$3,467,413.50 |
| Estimated Value of Contract to Date | \$3,294,785.57 |

The work under this contract included the construction of two tunnels, one beginning at the shaft in Canal Street, and extending eastward under Canal Street to the east side of Hudson Street, and the other beginning at the shaft in Spring Street and extending eastward in Spring Street to Hudson Street, thence curving southward to the north side of Dominick Street. The work also included the foundations for the Ventilation Building on the west side of Washington Street between Canal Street and Spring Street, the construction of ventilation ducts between the Canal Street and Spring Street shafts and the Ventilation Building, and the removal of certain buildings.

The tunnel structure in general is of steel bent and concrete construction. The actual work under this contract was successfully completed during the year, except for a few minor items of cleaning up. The north structure was practically completed in the previous year, together with a portion of the south structure and the excavation for the Ventilation Building. There remained, principally, the erection of steel and placing of waterproofing and concrete for the foundation and basement of the Ventilation Building on Washington

Street ; the completion of concreting and waterproofing of the south structure and the restoration of subsurface structures interfered with during the work of tunnel construction.

In general, the Contractor's methods and the chief difficulties encountered in the prosecution of the work were described in the last report. No additional difficulties were met with, except for a break in the bottom of the 16 -foot Canal Street sewer at Washington Street, which occurred on February 7th, and caused the flooding of both tunnels east of the shafts, resulting in delaying the work about one week.

The restoration of subsurface structures involved considerable work, since, in addition to the Contractor's obligation to replace structures to their original condition, many changes were required on account of interference with the tunnel structure. Plate No. 10 illustrates in part the condition encountered at Spring and Hudson Streets and is typical of conditions met elsewhere.

In order to provide adequate protection against fires which may occur in the tunnel or Ventilation Building, a separate system of six-inch water mains is provided. These were laid along Canal, Washington and Spring Streets and in the Ventilation Building. The water pipe was placed in the streets instead of within the tunnel structure, wherever practicable, to prevent freezing. They are interconnected and tap the city mains at three different points to insure a supply of water at all times. These independent mains are conferent
nected to the tunnel at intervals of about required in Desbrosses, Hudson, Canal and Spring Streets. These varied in size from 15 -inch vitrified pipe to two feet eight inches by four Streets. These varied in size from 15 -inch vitrified pipe to feet six inches, egg-shaped concrete sewers cast in place and, with the exception of the Desfeet six inches, egg-shaped concrete sewers cast in place and, with the exception of the Des-
brosses Street sewer and that on the north side of Spring Street between Greenwich and Washington Streets, were located under the sidewalks.

The raising of Hudson Street from Vestry to Watts Street, and Canal Street from Watts Street to about 200 feet east of Hudson Street, was accomplished with but minor inconvenience to the public, the work being done in sections as far as possible in order to permit operation of traffic.

Finally, the Contractor's plant was entirely removed and the tunnel cleared and cleaned for the use of other Contractors, especially in preparation for the setting of tile under Contract No. 7, and the roadway paving under Contract No. 10.

The work of preparing the final estimate for this Contract is now under way.
Contract No. 5-A
Contractor
Date of Contract
Date of Delivery of Contract
Contract Time
Contract Bid Price Price
Contract Bid Price .................
Estimated Value of Contract to Date November 25, 1924 December 13, 1924
10 months
. ........................... \$259,260.18
The work under this Contract comprised the construction of two approaches in open cut, including a short stretch of subway construction, one beginning at the tunnel portal in Canal Street near the east side of Hudson Street, and extending eastward along Canal Street to grade at the west side of Varick Street, and the other beginning at the north side of Dominick Street and extending under Dominick Street to the northerly building line of Broome

Street. This Contract also included the retaining walls and backfill necessary for raising the grades of Dominick Street and the extension of manholes up to the new grades.

The tunnel structure under Dominick Street is of steel bent and concrete construction. The open approaches are of reinforced concrete, with provisions for securing a facing of granite masonry to be included in a future contract.

The actual construction work under this Contract was completed according to schedule. A small amount of cleaning up remains to be done.

Excavation for the north approach was begun on March 9th and for the south approach on April 27th. Steam shovels were used on both sections, being supplemented at Dominick Street by a derrick operating an orange peel bucket, and by a locomotive crane on the south approach using a similar bucket. New sewers were built in Varick and Dominick Streets and on the south side of the structure along Canal Street. Ground water was encountered in the excavation for the north approach, but was easily taken care of by subdrains leading to a sump.

The buildings at Nos. 38 and 46 Dominick Street located on each side of the cut, were required to be underpinned, as well as No. 576 Broome Street.

The roof of the tunnel crossing Dominick Street was required to be built above the existing street grade, thereby necessitating the raising of the street about $51 / 2$ feet, dropping to the old grades at Hudson and Varick Streets. This grade change entailed the altering of all the areaways and stoops as well as the raising of a gas main and electric conduits. To insure sufficient water supply for the tunnel service a new 12 -inch main was laid from Hudson Street to Varick Street, replacing the old 6 -inch main.

By agreement between the city of New York and the Commissions, a new granite curb was placed to the new grade on the south side of Canal Street from Hudson to Varick Streets, the new street pavement being provided by the city.

The Contractor has removed his plant and, except for a few minor items of cleaning up, has left it in an acceptable condition for the use of other contractors.

The work of preparing the final estimate for this Contract is now under way.

| Contractor | Booth \& Flinn, Limited |
| :---: | :---: |
| Date of Contract | November 25, 1924 |
| Date of Delivery of Contract | December 17, 1924 |
| Contract Time | Eighteen Months |
| Contract Bid Price | \$2,582,969.75 |
| Estimated Value of Contract to Date | \$1,396,412.23 |

This Contract provides for the construction of two tunnels westward from the ends of the cast-iron tunnels constructed under Contract No. 4, about 1,000 feet west of the river bulkhead in the Erie and Delaware, Lackawanna \& Western railroad yards, Jersey City. The north tunnel consists of a cóvered section, 675 feet long, constructed of steel bents and concrete, passing under the Delaware, Lackawanna \& Western railroad yards, and an open approach section, 470 feet long, terminating at grade in Fourteenth Street at the east side of Provost Street, Jersey City. The south tunnel consists of a covered section, also of steel bents and concrete, 400 feet long, and an open approach section of reinforced con-
crete, 513 feet long, terminating in Twelfth Street at the east side of Provost Street. In addition to the tunnels, this Contract includes the construction of air ducts below the surface of the ground in the vicinity of the New Jersey land shafts and the sinking of thirty small caissons in the same locality for foundations for these and for the Land Ventilation Building. The tunnel construction necessitates the reconstruction and relocation of several large sewers in the vicinity of the entrance and the exit.

During the year 1924 and in the early part of 1925, the Erie Railroad cleared a certain part of their yards to accommodate the construction of the south tunnel. Similar work was begun by the Lackawanna Railroad December 9, 1924, and completed January 29, 1925.

South Tunnel-
A program for the construction of the south tunnel was decided upon in conference with the Erie Railroad with a view to allowing the railroad to operate trains on certain essential sidings. This program called for immediate work on the covered section, the part west of the portal being postponed until the covered section was completed. One track is to be maintained over the cut near the east end. This track is supported on timber piles that will carry it until the steel bents have been placed for the tunnel, after which the load will be transferred to the tunnel.

Excavation was begun March 13, 1925, with a dragline, a cut of about ten feet being made. This was followed by driving wood sheeting and placing its bracing. Derricks were erected at the sides of the cut and excavation continued to subgrade. At the east end of the Contract the cut reaches its greatest depth. Here steel sheeting was driven from the surface of the ground to about five feet below subgrade before excavation was begun.

The presence of the tunnel of the Hudson \& Manhattan Railroad close under the subgrade of our structure required special precautions in driving sheeting and in pumping operations to reduce to a minimum the disturbance of the ground around the tunnel. Surrations to reduce to a minimum the disturbance of the ground around the the the Hudson
veys at regular intervals have been made in co-operation with the engineers of the \& Manhattan Railroad to watch for any movement in their structure

The deeper excavations presented difficulties in drainage. The material encountered was cinders and other fill for a depth of ten feet from the surface and below this, a stratum of silt about fifteen feet deep. Under the silt is a fine quicksand, the drainage of which necessitated the exercise of utmost care. A sump constructed of steel sheeting driven to a depth of twelve feet below subgrade was built before general excavation was begun. As soon as the sand was reached in the sump, it boiled up. No pumping device attempted served to remove the water without the sand. However, by sinking a number of sumps, each served to remove the water without the sand. However, by excavation had advanced, the water was eventually drained off and the excavation was completed without the surrounding structures or the tunnel structure suffering settlement or other disturbances.

The progress to date in the steel bent and concrete covered section of the south tunnel may be summarized as follows:

Excavation $100 \%$ complete, steel $77 \%$ erected and $75 \%$ riveted, concrete $65 \%$ complete. The 8 -foot steel sewer, located in Twelfth Street, has been reconstructed in a new position to avoid interference with the tunnel. The reinforced concrete bulkhead, constructed under Contract No. 4, at the west end of the cast-iron tunnel, has been removed and a wood-and-mud bulkhead built in the tunnel as a safeguard against flooding.


The Erie Railroad shops on the south side of Twelfth Street east of Provost Street have been underpinned with steel cylinders filled with concrete.

North Tunnel-
The Contractor began excavation for the open approach of the north tunnel on April 15, 1925. A five-foot steel sewer located in Thirteenth Street and a five-foot six-inch steel sewer running south on Provost Street from Fifteenth to Thirteenth Street and turning there into Thirteenth Street, were reconstructed in new positions lying north of the north tunnel. The five-foot six-inch steel sewer carries water from the higher section of Jersey City, west of the Palisades formation, and is under a heavy pressure in a rainstorm. Special by-passes of three-foot diameter pipe instead of the usual open flumes were employed during construction. The relocation of the five-foot sanitary sewer has presented no special difficulty. An abandoned section of the five-foot six-inch sewer, 200 feet long, was again put in service and thus utilized in the reconstruction of the five-foot sewer.

Excavation for the open approach section of the north tunnel was carried on simultaneously with the sewer work. The greater part of this section was excavated without sheeting. After digging through the filled-in ground that underlies this part of Jersey City, a material composed of partly decayed roots and grasses was encountered. This was deemed to be an unsatisfactory foundation for the tunnel structure and so wooden piles were driven for a length of 280 feet of the tunnel.

The construction of the reinforced concrete roadway and retaining walls has been carried forward rapidly. West of the portal, excavation is now practically complete and $90 \%$ of the concrete is poured.

Excavation for the covered section of the north tunnel was delayed pending protracted negotiations among the Commissions, the Contractor, the Lackawanna Railroad Company and the receivers of the Philippine Vegetable Oil Company, over arrangements for providing facilities for the operation of the Oil Company's plant. This plant has been closed down for some time. The negotiations resulted in an agreement whereby the Railroad Company took over the Oil Company's lease and the Contractor was allowed to undertake construction without the necessity of maintaining the plant in a condition for operation.

As in the south tunnel, the first step was the digging of a trench by dragline methods Sheeting and bracing the excavation followed immediately. The part of the covered section of tunnel attacked did not include the east end, since the location of the eight-foot steel sewer here interfered. The by-passing of the sewer could not be undertaken at that time without cutting off access to the work in the vicinity of the land shafts. The west end also had to be left untouched until the relocation of the large sewers on Thirteenth Street had been completed.

Where work has been in progress, the draining of the fine sand encountered under the silt presented the same difficulties as in the south tunnel. The surrounding ground has proved very unstable, and movements causing damage to sheeting and timbering have had to be overcome. Work is now well under way. Excavation of the steel bent and concrete covered section is $58 \%$ complete, $34 \%$ of the steel has been erected, practically all of which is riveted, and $12 \%$ of the concrete has been poured.

Large air ducts and other passageways are to connect the land shafts with the site of the Ventilation Building. These ducts are all below the surface of the ground. Thirty concrete foundation caissons and about three hundred timber piles form the foundation for the air duct structure, the Ventilation Building, and certain structures to be constructed by the Erie Railroad Company.

Sinking of these caissons was started January 20, 1925. Up to the present time, eight caissons have been put down to bedrock, and all but six of the remaining ones are under way Certain of these caissons go down through an old crib filled with riprap and now completely covered over by filled-in ground. Compressed air was used on these cylinders during the time that the cutting edges were passing through the crib. Other caissons encountered nothtime that the cutting edges were passing through the crib. Other caissons encountered noth-
ing but filled-in material and silt. These latter were sunk by excavating with a small orange-peel bucket in normal air. At about elevation 228 the cutting edges entered the stratum of sand, gravel and boulders overlying bedrock. Air locks were then put on and the remainder of the sinking done under compressed air, as required by the Contract, with pressures up to 37 pounds per square inch. Bedrock, which is serpentine, was met at various elevations between 205 and 212.

The caissons are reinforced concrete cylinders of from five-foot to six-foot six-inch diameter. The working chambers are of steel. The caissons were all sealed with concrete to the rock under compressed air and in most instances the sealing and the filling of their in teriors with concrete were done in one operation, the air pressure being gradually reduced as the column of concrete was poured. The cylinders were relatively light so that they were as the column of concrete was poured. The cylinders were relatively light so that they were
sunk by jetting and weighting with pig iron. In some cases the skin friction was broken by raising the air pressure beyond that actually required for the given depth to cause the air to blow out around the cutting edge. This procedure was effective but rendered the ground above porous, thereby making it difficult to hold the air during later sinking

Excavation for the air ducts and Land Ventilation Building has been partly completed In the chamber east of the land shafts, the erection of steel and pouring of concrete is well under way. West of the land shafts foundation piles have been driven, and the six-inch base of concrete has been poured and ply-waterproofing applied. In the area between the site of the Land Ventilation Building and the north land shaft, driving of foundation piles is progressing.

All concrete for the north and south tunnels is mixed in a central plant. Fine and coarse aggregates are raised to elevated bins in bucket elevators. Bags of cement reach the mixer platform on an endless belt. The inundation method of sand and water measure ment is being used with excellent results. Mixed concrete is transported to various parts of the job in Ford trucks. Concrete for the caissons and the air ducts is mixed at a second plant and is distributed from a tower by a chuting system.

| CONTRACT NO 7 <br> NEW YORK STATE BRIDGE AND TUNNEL COMMISSION AND <br> NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION THE HOLLAND TUNNEL. CANVASS OF BIDS RECEIVED APRIL 71925. |  |  |  | L.DEL TURCO \$ BROS INC. |  | RODGERS\&HAGERTY INC. |  | DOOLEY STAPLETON CORP. |  | FREDERICK SNARE CORP. |  | - ALEXANDER 4 REID CO. |  | ENGINEER'S ESTIMATE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | CLASSIFICATION | UNIT | OUANITY | PRICE | AMOUNT | PRICE | AMOUNT | PRICE | Amount | PRICE | amount | PRICE | Amount | Price | amount |
| 26-a | Cement cove for filled walls | Lm.Et | 34800 | 20 | 6800000 | - ${ }^{1 / 12}$ | 3191000 | ${ }^{+1}{ }^{\prime \prime}$ | ${ }^{3} 1740000$ | - ${ }^{22}$ | 748800 | II | 3740000 | 20 | 680000 |
|  | * base without gutter |  | 17000 17000 |  | 255000 |  | 2125 |  | 204000 4165100 |  | 374000 561000 |  | $\frac{200000}{425000}$ |  |  |
| 37 | Hollow tile masoncy ${ }^{\text {a }}$ | cuived | $\underline{17000}$ | 456 | 510000 121.5000 |  | $\frac{425000}{1350000}$ | $43{ }^{24}$ | 4/16.500 <br> 161000 | 4533 | 5 61000 7215000 | 30.25 | 425000 $8,3 / 600$ | 40380 | 510000 080000 |
| 86ち | Salvanized steel loxes for fype A sand nich | Each | $\frac{57}{26}$ | 2200 | 125400 |  | 131100 | ${ }^{2750}$ | 156750 | $\xrightarrow{2300}$ | 13/31,00 | 8500 | 482500 | 7000 | 390000 |
| 87-a | zinc slides. tyoe A6 with bronze quide rods and bolts |  | 196 | $\frac{4430}{630}$ | 1/23400 | 48 | 110560 | $\underline{4} 400$ |  |  |  |  | 230000 |  | 130000 |
|  | "\% ${ }^{\text {a }}$ |  | 482 | $\frac{630}{830}$ | 4530060 | \% 840 | 404880 | ¢ ${ }^{450}$ | 265100 | 880 | 1709700 | 7 7180 | 201880 356680 | 360 400 | ${ }^{588800}$ |
|  | " "C6" " " | - | 16 | 1030 | 119480 | 1070 | 124120 | 840 |  | 1050 | 1218100 |  | 139700 | 860 |  |
| d | 04 | - | 222 | 960 | 199860 |  | 204240 |  | 186480 | 900 | 190800 |  | 2053.50 |  |  |
| - | 05 |  | 222 | 960 | 213120 | 900 | $\frac{219780}{13860}$ | 6,50 | $\frac{184300}{98500}$ | 9,50 |  |  | 2,785800 | 5 | 149850 |
| - |  | . | $\frac{310}{105}$ | $\underline{900}$ | - | 920 | 1800280 | 750 | 2885000 | 900 | 98100 | I125 | 122625 | 525 |  |
| 95.8 | cast-iron relay boxes type a | . | 32 | 3900 | 124860 | 4000 | 188000 | 16700 | 533400 | 7500 | 240000 |  | 180800 | 7500 |  |
| - |  |  | 12 | 4200 | 50400 | 4000 | 488000 | 18400 | 196800 | $\xrightarrow{9000}$ | 108000 | 51730 | -615600 | 8500 | 102000 |
|  | -" fire alacmeno tolenhoog hoxes |  | 64 | 460 |  | 2000 | 128800 | 380 |  | 2000 |  |  |  | 460 |  |
| 106-a | Applying neutralizing wash to ceiling | $10059 .{ }^{\text {fr }}$ | 3750 | 125 | 468750 |  | 225000 | 48 | 180000 | 100 | 375000 |  | 262500 | 260 | 750000 |
| $\frac{-6}{108-c}$ | oouble broach coat of eaint" " |  | 7500 | 18200 | 1125000 | \% 75 | 562500 1008000 | 19804 | 480000 $7 / 2800$ | 140 31000 | 1050000 1115000 | 250 1400 | 1050000 | 2 2500 | $\frac{550000}{666000}$ |
| -d | Single " Fire alarm on telephone niches | Each |  | 1750 | 154000 | 40100 | 352000 | 1815 | 159720 |  | 440000 | 3300 | 290400 |  | 176000 |
| - | ". ". "type A fire extinguisher " |  | 127 | 6125 | 777875 | 14200 | 1803400 | 6625 | 841375 | 14000 | 1778000 | 24000 | 30488000 | 4500 | 371560 |
| - |  | set | 39 | 143061 | 843700 | 29200 | 1722800 | 1150180 | 915090 | 30000 <br> 26500 | 1770000 1033500 | $\xrightarrow{35000}$ | 2124000 | 16500 |  |
| -9 | Four-door setfor large low-tension solicing chambers ltumell | " |  | 42560 | 1360000 |  | 2563200 | 46200 | 1478400 |  | 1033500 |  | 4720000 |  | 468000 |
| 7 | Two-panel " "mall " | $\cdots$ | 26 | 160100 | 416000 | 33700 | 876200 | 17500 | 455000 | 32560 | 845000 | 410 | 10666000 | 17560 | 455000 |
| - | Bronze doors of L.T. splicing chambers(shafts and misc. brenze | $\stackrel{16}{6}$ | 15000 |  | 1080000 | 125 | 1875000 |  | 1155000 | 125 | 1875000 | 125 | 1875000 |  |  |
| -k | Single bron3e doons for Xelay boxes | Each | 44 | 53.25 | 234300 | 10600 | 466400 | 5750 | 253000 | 19500 | 858000 | 8750 | 385000 | 100100 | 410000 |
| - | Docible " " " typer A sand niches | Sef | 57 | 20060 | $1 / 40000$ | 32500 | 18.52500 | 21890 | 121477 30 | 34000 | 1938000 | 560100 | 3192000 | 20060 | 1180000 |
| -m |  | " | 26 | 20700 | 538200 77200 | 38200 | 9, 9132200 | $\frac{22550}{21065}$ | 586300 84260 | 27000 | 9,62000 | 135100 | 11310000 |  | 678020 |
| -0 | - type a fire hose niches | - | 116 | 14160 | 16.35600 | 23600 | 2737600 | 15323 | 17974688 | 23060 | 2668000 | 42250 | 4510000 | 9000 | 1044000 |
| - | $\cdots{ }^{\text {- }}$ B | $\cdots$ |  | 13100 | 327500 | 23000 | 575000 | 14235 |  | 22000 | 550000 | 42250 | 1056250 | 10000 |  |
| -9 | Single " " . "Aflushing | Each | 116 | 3000 | 3888000 | 11000 | 1276000 | 3210 | 372360 | 10000 | 1160000 | 16000 | 1856000 | 3000 | 348000 |
| -. 3 | - to pumo room \& H.T. solicing chamberg (shafts) | : | 10 | 17200 | 172000 | 29200 | 2792000 | $\frac{187100}{}$ | 187000 | ${ }^{100000}$ | 250000 300000 | 160000 35000 | 4,500000 | 3000 25000 | 27500 720 |
| - | " ${ }^{\text {" for light boxes }}$ |  | 1774 | 1700 | 30158600 | 26100 | 26124800 | 1760 | 3122240 | 4060 | 7096000 | 2475 | 4390655 |  | 9757000 |
| - | Pouble "cre" "tre side air duct manholes | set | 196 | 12200 | 73200 | 23400 | 140400 | 13200 | 729200 | 22000 | 132000 | 422 50 | 253500 | 8550 | 151000 |
| - ${ }^{\text {d }}$ | pronze screens, type Ab for exhaust air ponts |  |  | $\frac{1100}{4100}$ | 215600 236500 | 1050 | 205800 | $1{ }^{1176}$ | $2{ }^{2} \mathbf{0} 3056$ | 17000 1500 | 333200 322500 | $\frac{1250}{1050}$ | $\frac{245000}{2(25750}$ | 1100 | 215660 |
| -x | - 83-3 | $!$ | 109 | 1348 | 146932 | 155 | 168950 |  | 149548 | 1500 | 163500 | 1050 | 1/44 |  |  |
| -y | c6 |  | 116 | 2697 | 312852 | 16.50 | 191400 | 2857 | $33 / 4 / 2$ | 3000 | 348000 | 2050 | 237800 | 1800 | 208860 |
| -3 | " 03. | - | 158 | 1057 | 167006 | 770 | 121600 | 1052 | $1662 / 6$ | 1200 | 180600 | 9100 | 172200 | 800 | 126560 |
| -ab | " " " 04.05 " " " " | \% |  | 1562 |  | 930 1200 | $\frac{206460}{266400}$ |  |  | $\frac{1700}{2000}$ | 3774000 | 12.50 <br> 14.50 <br> 1.5 | 277500 | 10.50 | 2333100 |
| - $-\frac{a b}{-a b}$ | $\cdots \stackrel{*}{*}$ | * | $\frac{222}{130}$ | 1913 2264 | 4226886 | 1800 <br> 1500 | $\frac{266400}{1065000}$ | 2000 2380 | 3/440000 | $\xrightarrow{20000}$ | 4440000 3013000 | 1750 <br> 1750 <br> 150 | 3292900 | 1300 <br> 1500 | $\frac{288600}{19} 6$ |
| -ad | air outlet covers at refuge niches, tube section |  | 64 | 780 | 49920 | 1580 | 101120 | 748 | 47872 | 2300 | 147200 | 1375 | 88000 | 1200 | 76800 |
| -as | "H. " grilles." " steel bent section |  |  | 56.5 | 6780 | 350 | 4200 | 511 | 6132 | 1800 | 21600 |  | 2760 | 560 | . 6000 |
| 117 | Cutting out and draining concrete contraction cracks | Lin.ft |  | 150 | 750000 |  | S00000 |  | 540000 |  | 1000000 |  | 500000 |  |  |
| $\frac{161-a}{-6}$ | Gavary tized and painted handrail eosts ond fastenings | $\stackrel{\square}{*}$ | 8465 | 1185 | 973475 | 125 | 1658125 177765 | 188 | $\underline{9} 1 / 42820$ | 180 | 931/50 | 115 | 973475 | 120 | 1015800 |
|  | Baked enamel hand cailieosts and tastenings . | " | 846.5 | 185 | 1566025 | 210 | 1777650 | 180 | 1523700 |  | 15237100 | 190 | 16.08 .50 | 235 | 1904625 |
|  | TOTALS ALL ITEMS EXCEPT 38 |  |  |  | 28868045 |  | 38022575 |  | 288481.35 |  | 44055250 |  | 4807800 |  | 354,45100 |
| $38 i$ | Totals all items except 38 White glazed till - 4 enamels $100 \%$ domestic seucce | 5.Ft | 365000 | 170 | 288668045 620150000 | 230 | 83950000 | 259 | 905 35000 | 223 | 24055250 81395000 |  | 4807880 80 |  | $\begin{aligned} & 35455100 \\ & 69350000 \end{aligned}$ |
|  | 38 i TOTALS ALL ITEMS |  |  |  | 009180 45 |  | 121972575 |  | 1233831 |  | 254.502 .50 |  | 37503040 |  | 104795100 |
|  | Totals all items exceot 38 |  |  |  | 28868045 |  |  |  |  |  | 240,55250 |  |  |  | 35445100 |
| $38 / 1$ | White glazed tile \& enamels $25 \%$ domestic source 25\% foreign | " | $\frac{273750}{91250}$ | 170 |  | 230 204 | 62962500 |  |  | ${ }_{2}^{21 / 4}$ | 61046250 |  |  | 190 | $\frac{52012500}{156 / 12500}$ |
|  |  |  |  |  |  |  |  |  | Nobia | 214 | 10527500 |  | No | 170 | 155125100 |
|  | 38ii TOTALS ALL ITEMS |  |  |  | 89540295 |  | 119600075 |  |  |  | 246120000 |  |  |  | 102070100 |
| 38 III | Whals allitems except 38 / $50 \%$ domestic source |  |  |  | 28808074 31025000 |  | $\frac{38022575}{41975000}$ |  |  |  | (44056250 |  |  |  | 35445100 |
|  |  | * | 182500 | 155 | 28287500 | 204 | 372, 30000 |  | Nobid | $2{ }^{2} 4$ | ( 40697500 |  | No bia |  | 346755000 |
|  | 38iii TOTALS ALL ITEMS |  |  |  | 88180545 |  | 117227575 |  |  |  | 238072.50 |  |  |  | 10114.5100 |
|  | Ootals all items except 38 all |  |  |  |  |  | 38022375 |  |  |  | 140552550 |  |  |  | 5445500 |
|  |  | $\cdots$ | $\frac{91250}{273750}$ |  | No bid | 230 204 | 55885000 |  | Vobid | 214 | 203587500 |  | No |  | -76537500 |
|  | 381 V totals ALL ITEMS |  |  |  |  |  | $1148.550175$ |  |  |  | 22086500 |  |  |  | $20320160$ |
|  | Totals all items except 38 |  |  |  |  |  | $\frac{38022575}{7846000}$ |  | Nobid |  | 1470.55250 |  |  |  | 35445100 |
| 38 | white glazed tile \& enamels $100 \%$ foreign soune | - | 36.5000 |  | Wobid |  |  |  |  |  | 78110000 |  |  |  | 20.500100 |
|  | 38 V TOTALS ALL ITEMS |  |  |  |  |  | 1,124825.75 |  |  |  | 6221652.50 |  |  |  | 974,951.00 |

Contract No. 7

| Contractor | L. Del Turco \& Bros., Inc. |
| :---: | :---: |
| Date of Contract | April 21, 1925 |
| Date of Delivery of Contract | May 6, 1925 |
| Contract Time | 16 Months |
| Contract Bid Price | \$881,805.45 |
| Estimated Value of Contract to Date | \$144,361.56 |

This Contract provides for lining the tunnel with tile, placing bronze doors and other trim, erecting sidewalk handrail, and painting the ceiling.

The specifications for tile lining the walls of the Holland Tunnel are unique, in that they provide requirements more rigid than those usually satisfactory in tiling work. The maximum permissible absorption is five per cent. by weight. The tests specified are severe, in order to insure a product that withstands extremes of temperature and freezing action, or a tile that will be non-crazing and non-spalling

The tunnel tile is square, $41 / 4$ inches by $41 / 4$ inches. The decision as to size was reached after the completion of an extended series of investigations, including the placing of sample sections on the tunnel wall, the sections being laid up in tile of different sizes. The light reflection characteristics of tile of several makes were carefully determined and an appropriate standard fixed as a specification for the tunnel tile, in order to secure an increased efficiency of the tunnel lighting system.

The color of the tile is white, care being taken to eliminate tile containing blue, green or red tints. These tints were declared unfavorable, in the expert advice of a color psychologist, because of their depressing effects. The color of the borders was arrived at by a process of elimination of suggested colors, rejected for various reasons, until the choice finally settled upon light orange.

## North Tunnel-

Work was begun on this Contract in the north tunnel on August 6th near the portal of the New York approach, the first operation being the placing of hollow tile in the side walls of the steel bent section. After this was completed the mortar scratch coat was applied.

On September 1st, the first shipment of glazed wall tile arrived and the work of setting was begun on September 7th, being completed from the portal to about 155 feet east of the river shaft by the close of the year. Tile for the north tunnel is being furnished by the American Encaustic Tiling Company, Zanesville, Ohio.

About September 15th, the work of setting bronze frames was begun, those for the light boxes being the first placed. After this work had been completed as far as the New York river shaft, bronze frames for the other niches were set; also cast-iron frames for relay boxes and fire alarm boxes. This work was completed to the river shaft by December 31st.

## South Tunnel-

Work was begun erecting the hollow tile in the side walls of the south tunnel about September 1st, being completed on October 6th. The placing of the scratch coat was started on November 23d, and about December 1st the setting of glazed wall tile was started near
the portal, being completed to about 508 feet east of the Canal Street shaft by the end of the year. Tile of foreign manufacture is being used in the south tunnel and is furnished onehalf each by Villeroy \& Boch, Mettlach, Germany, and Rakovnik and Unter Themenauer Ceramic Works, Rakovnik, Czechoslovakia.

## General-

The delay in beginning work on this Contract was primarily due to the difficulties experienced by the manufacturers of the tile in turning out a product which met the stringent perienced by the manufacturers of the tile in turning out a product which met the stringent
requirements of the specifications for this work. These difficulties appear to have been successfully overcome and deliveries are now being made regularly.

## Contract No. 9

Contractor
Date of Contract Date of Delivery of Contract Contract Time Contract Time Contract Bid Price
Estimated Value of Cont...........
This contract provides for the furnishing and delivering, but not installing of the power transformers for transforming the high tension current supplied by the power companies to the voltages required for the various motor units, and for the oil switches for the main control system.

The current which is to be provided by the power companies will be delivered at a nominal voltage of 13,200 volts. The transformers to be furnished under this contract will re duce this incoming pressure to the nominal operating voltages of 2,200 and 440 . The oil switches included in the contract will be used to control the distribution of this current both before and after transformation.

The Contractor has begun to assemble material for the manufacture of this equipment and shop drawings have been submitted by him for approval. These have been checked and returned to him. To date, no payments have been made on this contract.

Contract No. 10
Contractor
Date of Contract
Date of Delivery of Contract Contract Time
Contract Bid Price
Estimated Value of Contract to Date
This contract covers the paving of both tunnel roadways, including the approach sections, and comprises a total area of about 44,500 square yards

The qualities of granite block pavement, as regard durability, minimum amount of maintenance and quick repair governed the choice of surfacing. Existing granite block pavements long subjected to continuous heavy traffic were carefully studied, and data were

William J. Fitzgerald May 19, 1925 June 4, 1925 14 months \$329,655.00 \$141,323.10
The General Electric Company July 7, 1925
July 31, 1925
11 months 11 months \$298,166.00

collected from various sources, of actual experience in use and maintenance of several standard types of road surfacing. Finally, the experience of the United States Bureau of Roads was also drawn upon and studied and conference was held with that Bureau's best qualified personnel, early in the year.

The chief limitation in the size of the block adopted was that of depth. A limit was necessary in this dimension, so that sufficient depth of cushion could be provided between the block and the concrete floor and still not encroach upon the limited vertical clearances of the tunnel. Further study was made in the proportion of the block to minimize breakage due to impact on the surface of the pavement and to conform as far as possible with standard dimensions followed in cutting at the quarry. The resulting dimensions adopted were as follows: length 7 to 11 inches; width $33 / 4$ to $41 / 2$ inches and depth 4 to $4 \frac{1}{2}$ inches.

The smoothness of the wearing surface of the paving was considered to be of prime The smoothness of the wearing surface of the paving was considered to be of prime
importance in reducing the effect of vibration with resulting noise. For this reason the top surface of the block has been specified to be somewhat smoother than that required in ordinary paving block practice.

The blocks are laid in the usual sand cement cushion layer, about one inch thick.
For filling the joints between blocks, asphalt is applied hot, after being mixed with heated sand. The mixture is poured in between the blocks and the joints completely filled. Then, by means of squeegees, a thin coating, later sprinkled with sand, is left upon the surface. The resulting pavement provides a smooth resilient, long wearing surface, that will help deaden the sounds due to traffic and at the same time can be more quickly repaired than a concrete road.

With the lack of ventilation in the tunnels while this paving proceeds, it is necessary to heat the asphalt and sand outside, to avoid the smoke and fumes. The hot asphalt is delivered in motor truck tank wagons to the site of the work, where it is kept at the required temperature in a 500 gallon heating kettle. An oil burner furnishes sufficient heat for this kettle with but little or no smoke. A portable mixer is used to mix the hot sand and asphalt immediately before it is applied to the paving block. As the work of filling the joints takes but a small part of the time in laying the block, the heating kettle with its atendant fumes, needs to be kept going only at infrequent intervals.

The granite block is obtained through J. Leopold \& Co., Inc., from quarries at Vinalhaven, Hurricane Isle and Long Cove, Maine, where it is cut to size and shipped by barge to New York City. Sufficient space is allowed the Contractor to store a whole shipment of block at a time, so that no delay can occur from lack of material. The first shipment of block was received about August 15th, and the placing of the block was started on September 14th in the north tunnel just west of the open approach section of the New York side. Work was started October 27th on the paving of the south tunnel at the New York end. By the end of the year the paving was completed from the eastern limits of both open approaches to a distance of about 1,700 feet west of the New York river shaft in the north tunnel and to the east side of the New York river shaft in the south tunnel. Sufficient block is stored to supply the work to be carried on throughout the winter season, mainly in the under-river stretch between the river shafts.

## Contract No. 12

Contractor $\qquad$ B. F. Sturtevant Company Date of Contract of Contrac $\qquad$ September 22 1025

Date of Delivery of Contract
Contract Time
September 26, 1925
Contract Bid Price 14 months 2 weeks

Estimated Value of Contract to Date
This contract provides for the furnishing and installing of the ventilation and transformer blower fans and the motors, transmission and control for same

The fans to be provided under this contract are of the backward curved blade type. Under different conditions, one, two or three ventilation fans may be operated on one tunnel duct at any one time and the fans must have characteristics that will insure their satisfactory operation when run in parallel without the danger of any one fan assuming more than its share of the load and thereby overloading the motor. They must also maintain satisfactory efficiency for any stage of loading from $35 \%$ to full load.

The motors for driving the ventilating fans are to be of the wound rotor, 3 phase type, the smaller at 440 volts. This type was ben chosen because of the possibility of speed variation inherent therein. between motor and fan.

The smaller fans to be used for cooling the power transformers will be direct connected to 440 volt 3 phase squirrel cage motors, the load on these units being uniform.

The Contractor has begun to assemble material for this equipment, tests have been made on sample fans to check up performance data submitted with the proposal and shop drawings have been submitted for approval. These have been checked and returned to the manufacturer.

Work on the actual fabrication of the fans is scheduled to begin shortly after the first of the year.

To date no payments have been made on this contract.
Contract No. 13

| Contractor | ReRiso Construction Company |
| :---: | :---: |
| Date of Contract | October 20, 1925 |
| Date of Delivery of Contract, | October 24, 1925 |
| Contract Time | 14 months |
| Contract Bid Price | \$1,277,953.00 |
| Estimated Value of Contract |  |

Estimated Value of Contract to Date
This contract provides for the construction of the two buildings on the New York ide of the river in which the ventilation equipment is to be housed and also for the finishside of the river in which the ventilation equipment is
ing of the interiors of the New York ventilation shafts.

The buildings to be constructed under this contract will be of steel frame construc tion, five stories in height, with brick curtain walls, granite base, granite and limestone trim, reinforced concrete floors with steel beams and girders and reinforced gunite and hollow tile partitions.

| CONTRACT NO 13 <br> NEW YORK STATE BRIDEE AND TUNNEL COMMISSION AND <br> NEW JERSEY INTERSTATE BRIDGE AND TUNNEL COMMISSION THE HOLLLAND TUNNEL CANVASS OF BIOS RECEIVED OCTOBERR 6,1925 . |  |  |  | DE RISO CONSTRUCTIONCO. |  | D.C. SERBER INC. |  | GEORGE COLON \& CO. inc. |  | EMIL DIEBITSCH inc. |  | THOS.J. WATERS co. |  | FRED SNARE CORP. |  | Lustig 4 WEIL |  | NIEWENHOUS CO. inc. |  | JOHN T. BRADY \& co. |  | Engineer's estimate. |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | CLASSIFICATION | UNiT | OUANITr | PRICE | Amount | PRICE | Amoc | Price | Amount | PRICE | Amod | PRICE | Amou | PRICE | Amount | Prick | Amou | PRICE | Amount | Pric | Amocan | price | amo |
| $\frac{27-d}{t \cdot e}$ | concrate and mo | c.e.k | ${ }^{2000} 5$ | $\xrightarrow{271700}$ | ${ }^{108000000}$ | 3000 1600 | ${ }^{180} 16000000000$ | ${ }^{361973}$ | ${ }^{1 / 471000000}$ | 3! | $\frac{18200000}{818000000}$ |  |  |  | 144100 |  |  |  | ${ }^{204600200} 7150$ |  |  | (2400 | 96 |
| $\frac{7.7}{7.9}$ | 3isemite salas | sa.e. | $\begin{array}{r}140000 \\ \hline 6000 \\ \hline\end{array}$ |  | ${ }^{183640000} 6$ | $\xrightarrow{130}$ | $\xrightarrow{1820000000000}$ | $\stackrel{130}{137}$ | 188206500 885000 | - | 1888800000 <br> 400000 | -120 | 16800000 <br> 605000 | 130 140 140 | $\xrightarrow{188200000000}$ | - 1100 | 10000000 <br> 100000 | - 1380 | $\xrightarrow{1884800000} 7$ |  | $\xrightarrow{175000000}$ | $\xrightarrow{100}$ | $\frac{140}{140}$ |
| $\frac{27-h}{2-h}$ |  |  |  | $1{ }^{175}$ | O, 85300 | $1{ }_{1}$ | - 9 , 730000 | ${ }_{1}^{196}$ |  |  | S 685850 |  | ${ }^{8} 8.385300$ | 7180 | ${ }^{3} 97606000$ |  |  | 140 | ${ }^{96805000}$ |  | $\stackrel{3}{9} 1000100$ |  | 00 |
| - | 12. [Geinite cootiog | . | 25000 | +51 | 12350000 | , 506 | ${ }^{137300000}$ | 5 | ${ }^{13} 7595000$ |  | $\xrightarrow{140000000}$ | ${ }^{17}$ | ${ }_{\text {l }}^{1,185000}$ | St | ${ }_{14}^{140505000000}$ | cos |  | \% | 13.475000 |  |  | 40, | ${ }^{10} 30$ |
| \%-2 | Sunite columineroraction | Cuk | 3, 3.50 |  |  | 12000 | 4200060 | ${ }^{12890}$ | 4410000 | RTV | ${ }^{44} 7{ }^{7172000}$ |  | 403850000 | ${ }^{123}$ | 43775000 |  | 46600 |  | 4550000 |  | 42tioct30 | \%0, | 75 |
|  | Sill |  |  | ${ }_{3} 355000$ | ${ }_{\text {cosezico }}$ | 7ococ | ${ }_{\text {col }}$ | 410 | \% | 85 | ${ }^{7} 172,2505$ | 40000 |  |  | 4 4,50000 | ${ }_{330}{ }^{30}$ | $4{ }^{\text {4,505000 }}$ |  | ${ }_{\text {che }}$ | dos | \% |  |  |
| $\stackrel{1}{13}$ |  |  | ${ }^{800}$ | ${ }^{\text {12200 }}$ | $\frac{7360000}{720006}$ | 1780 |  | $\frac{9460}{2600}$ | $\frac{18,60000}{765000}$ | 14.10 | $\frac{6480000}{814200}$ | ${ }^{1650000}$ |  | 12000 | $\frac{84,00000}{720000}$ | -108200 | $\frac{600000}{7}$ | 127800 | ${ }^{10320000} 7170400$ | $\frac{102}{80}$ | $\frac{4160030}{488000}$ | 11000 | $\frac{8800000}{606000}$ |
| $\stackrel{78}{15}$ | Expancta meatal and wire me |  |  |  | ${ }^{40505000}$ | ${ }_{2 S 5000}^{23000}$ | ${ }^{40} 800000000$ | $\xrightarrow{25800}$ |  |  | 40,92900 |  |  |  | 41, 500900 | 24000 | ${ }^{3671700000}$ | ${ }^{266150}$ | 41820000 | ${ }_{6}^{2000}$ | ${ }^{46} 4800900$ |  |  |
| ${ }^{1148}$ | sqineerst fiela office |  |  | 110000 | 100000 | 10000 | $\underline{1000000}$ | 10.5100 | 10asoloo | 21560 | $2{ }^{215600}$ | 10000 | 100000 | 30000 | 300000 | 60000 | ${ }^{10} 0000100$ |  | 2200000 |  | 25 |  | ${ }_{2}$ |
|  |  | mo. |  |  |  |  | ${ }_{\substack{\text { Sibod } \\ \text { Sbod }}}$ |  | ${ }_{4}^{42680800}$ |  | ${ }^{161636300}$ | - | (16900000 |  | ${ }^{5600000}$ | - | $\begin{array}{r}123.3000 \\ 123000 \\ \hline 1800 \\ \hline\end{array}$ | - | ${ }_{4}^{4} 100000000$ |  | ${ }^{26}$ |  | $\frac{500}{50}$ |
| Stiod | $\because \quad$ " Morth Rever Shat |  |  |  | ${ }_{1}^{1 / 30000000}$ |  |  |  |  |  | ${ }_{22646400}^{226500}$ |  | ${ }_{\text {cter }}^{27000000}$ |  | $\xrightarrow{23000000}$ |  | (1862000 |  | 104460000 <br> 800000 |  | 30000000 310000000 |  | 7 |
|  | New Cement sicemalk | 3, | 600 | ${ }^{350}$ | ${ }^{2} 100000$ | 400 | 2400000 |  | 2,263200 | 36 | I 1760000 | 45 | ${ }^{2700000}$ | 300 | 180000 | 450 | $\frac{270000}{2000}$ | ${ }_{5}^{500}$ | ${ }^{3} \mathbf{3} 000000$ | 54 | ${ }^{3} 8280650$ | ${ }^{4600}$ | ${ }_{2} \frac{10000000}{2}$ |
| - 181 | Seneral construction Lana vent. blog. | Lemp sim |  |  | ${ }_{27}^{273600000}$ |  | ${ }^{236} 58000000$ |  |  |  |  | , | ${ }_{\substack{\text { a } \\ 3 / 50000000}}^{2000000}$ |  |  |  | coize |  |  | 45 |  |  | ${ }^{2210000000000}$ |
| $\frac{183}{215}$ |  |  |  |  |  |  |  |  |  |  | $\frac{30860000}{4684200}$ |  | ${ }_{\text {200 }}^{20000000}$ |  |  |  | 26909660 <br> 44272700 |  | ${ }_{\text {2 }}^{24635000}$ |  | $\frac{307000}{43000}$ |  | ${ }_{165}^{22}$ |
|  | Elec. Cond. for land bldg 4 f land shafto |  |  |  | $\frac{7600000}{2800000}$ |  | ${ }^{300000000}$ |  | ${ }^{2306700} 30.6600$ |  | ${ }^{266175500}$ |  | ${ }^{\frac{2}{26} 5000000}$ |  | ${ }_{2}^{280000000}$ |  | ${ }^{245500000}$ |  | ${ }_{26}^{26,5000000000}$ |  | 26000 280 |  |  |
|  |  |  |  |  |  |  | $1-1$ |  |  |  |  |  |  |  |  |  | $\underline{1}$ |  |  |  | $\bigcirc$ |  | 1372500 |
|  | totals |  |  |  | 1,27, 253.00 |  | , ,201,130.00 |  | , ,350,227.00 |  | 1,380,580.6 |  | [,395,183.00 |  | , ,465, 15.00 |  | [,47,415 |  |  |  |  |  |  |



PLATE No. 11-Laying Granite Block Pavement. Contract No. 10.

| CONTRACT NOL <br> NEW YORK STATE BRIDGE AND TUNNEL COMMISSION Arto <br> NEW JERSEY INTERSTATE BRIDEE AND TUANEL COMMISSION THE HOLLAND TUNNEL CANVASS OF GIDS RECEIVED DECEMBER 15, ig2E. |  |  |  | DE RISO CONSTRUCTION CO. |  | G.DEKIMPE INC. |  | THE ENGLISH CONSTRUCTION CO. INC. |  | THDMAS J. WATERS CO. |  | GEORGE COLON \& CO. |  | ENGINEERS ESTIMATE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | CLAESIFICATION | Oner | geamint | price | ampont | Price | AMOURT | prece | AmDunt | Price | AMOCNT | Price | AMOUNT | PRICE | amocint |
| 278 | Concrete and mortar top course | Curd. | 6000 | 3500 | 210000000 | 3600 | 21600000 | 5100 | 12100000 | 3500 | 81000000 | 3978 | 23868000 | 2850 | 1711000100 |
| 27e 278 | Cinder concrete | Sg. Ft. | 530 125000 | 1500 | 8885000 20625000 | 10,0 180 | \%5500,00 | 1700 181 | 2235000 | 1500 168 | 8825000 | $\begin{array}{r}1827 \\ \hline 177\end{array}$ | 1004855 | 1100 | 6103500 |
| 279 |  |  |  |  | 85000 |  | 950100 | - 87 | 935500 | 178 | 185000 | 183 | 91500 | 138 | $\begin{array}{r}63750 \% 0 \\ 690000 \\ \hline\end{array}$ |
| 27 h | $4^{+}$ |  | 13000 | 175 | 2625000 | 190 | 2850000 | 192 | 28880000 | 175 | 251230100 | 188 | 2820000 | 141 | 2205000 |
| 271 | 4\% |  | 300 | 150 | 54000 | 210 | 630001 | 198 | 1594100 | 130 | 154000 | 193 | 57900 | 156 | 46800 |
| 27 J | fand ${ }^{\text {a }}$ Gunite coating |  | 14500 |  | 1450000 |  | 1595000 | 110 | 1595000 | 30 | 1305000 | 107 | 1551500 |  | 739500 |
| 27 k | 2. Gunite protestion |  | 17200 | -150 | 2560000 | 165 | 2838000 | 1651 | 23.38009 | 140 | 24080.00 | 161 | 2769200 | 95 | 1634000 |
| 271 | Gunite colomn protection | comed | 4000 | 122000 | 4800000 21590000 | 13000 13500 | 52000.0 | $\begin{array}{r}13200 \\ 13200 \\ \hline\end{array}$ | -5280000 | $\frac{12000}{12000}$ | 4800900 | $\frac{12900}{13180}$ | 5160000 | 12500 12500 | 5000000 |
| 106 | Miscellaneous steel anditon |  | 12 | 141500 | 498000 | 47000 | 564000 | 49500 | 59400 | 44000 | 528000 | 50500 | 220600 | ${ }^{123500}$ | -1250000 |
| 12 | Steel beams 2 Chamels $\%$ comections |  | 100 | 11000 | 1100000 | 12000 | 8400000 | 13200 | 92400800 | 9800 | 6860000 | 10621 | 1434700 | 10000 | 1000000 |
| 13. | Steel rods \& bars for reimforeing | 。 | 10 | 16000 | 1120000 | 12000 | 840000 | 17600 | 1232900 | 15000 | 10,50000 | 16100 | 1127000 | 12000 | 81400100 |
| 74 | Expanded metal ard wire mesh |  | 159 | 30000 | 8500000 | 33000 | 1950000 | 33000 | 49500000 | 29000 | 4350000 | 32200 | 488300,00 | 25400 | 38180000 |
| -75h | $\frac{\text { Special steel structures }}{\text { Engineer's filld }}$ | Per morth | 125 | 41.500 | 5187500 | 47000 | 5875000 | 49500 | 6187500 | 44000 | 55000100 | 57700 | 1212500 | 33500 | 4187500 |
| $\frac{1288}{1910}$ | Engineert gille office services | Ler month |  | 20000 | 1900000 | 10000 | \$50000 | 16500 | 115500 800000 | 10000 | 41700000 | 14000 | 986000 544900 | 10000 | 9700000 |
| 131f | $\cdots$ - $\quad$. |  |  |  | 1000000 |  | S35000 |  | 800000 |  | 4200500 |  | 546200 |  | 900000 |
| 1919 | N. River |  |  |  | 1800000 |  | 1502000 |  | 1287200 |  | 3100000 |  | 1706700 |  | 1000000 |
| 1315 | S. |  |  |  | 2115800 |  | 1602000 |  | 23658800 |  | 3600000 |  | 27101900 |  | 1200000 |
| 182 | General construction Land vent. Blag. M.J. |  |  |  | 1255100000 |  | 23493250 |  | 285141100 |  | 33200000 |  | 28200000 |  | 22356200 |
| 184 | General construction River .il |  |  |  | R1500000 |  | 18585850 |  | $\frac{18464900}{3654200}$ |  | 18800000 338000 |  | 22800000 |  | 16790000 <br> 1350000 |
| 221 | Mumbing, hearing, water sopply Elec. Cond. for land Sldg. \& Land shafts |  |  |  | ${ }^{31} 1000060$ |  | 39,00.00 |  | 1354200 |  | 2150000 |  | 4273000 |  | 1350000 3230000 |
| 223 | Elec. $"$ R River $n$ - River ${ }^{\text {a }}$ |  |  |  | 3300000 |  | 36100000 |  | 38.35 noo |  | 3785900 |  | 37185000 |  | 344400100 |
|  | totals |  |  |  | 1,577,953.00 |  | ,587,331.00 |  | 1,771,131.00 |  | 1,110,000.06 |  | 1,712.698.50 |  | 1,325,000.00 |

The buildings are to be erected complete with heating and hot water plants, plumbing, elevators, ash hoists, Eivase' stacks, damper equipment, trolley beams, electric conduits with necessary boxes but excluding wiring and fixtures which are to be furnished and installed under Contract No. 19

The work in the shafts includes the erection of stairs, landings, parts of floors, gunite air duct partitions, gunite wall protection, conduits, piping, reinforced concrete and structural steel.

Work has been begun on the fabrication of the structural steel, some of it has been delivered on the site and erection has been started in the Canal Street shaft. Shop drawings have been submitted by the various subcontractors for approval. These have been checked and returned either approved or with notations of necessary corrections marked thereon.

To date no payments have been made on this contract.

## Contract No. 14

| Contractor | DeRiso Construction Company |
| :---: | :---: |
| Date of Contract | December 22, 1925 |
| Date of Delivery of Contract, | December 29, 1925 |
| Contract Time | 12 months |
| Contract Bid Price | \$1,577,953.00 |
| Estimated Value of Contract to Date |  |
| - |  |

This contract provides for the construction of the two buildings on the New Jersey side of the river in which the ventilation equipment is to be housed and also for the finishing of the interiors of the New Jersey ventilation shafts.

The work to be done under this contract is, except for minor details, identical in scope with that called for under Contract No. 13.

Nothing has been done on this contract to date
Contract No. 20
Contractor .... $\qquad$
Date of Delivery of Contract
Contract Time $\qquad$
$\qquad$
$\qquad$
$\qquad$
Contract Bid Price

## 10 months

This contract provides for the furnishing and installing, in the tunnels and ventilation buildings, of the cables required for the distribution of the power for the ventilation equipment, pumps and lighting systems.

These cables will convey power furnished by the power companies on both sides of the river to step-down transformers located in the two land ventilation buildings. From these points the cables will carry power through ducts located under the tunnel sidewalk up to the various shafts to the four ventilation buildings where it will be distributed to the ventilating fans, lights and miscellaneous tunnel equipment.

The contract has been let but has not yet been delivered.

Contract No. 24.

| Contractor | Booth \& Flinn, Ltd |
| :---: | :---: |
| Date of Contract | October 20, 1925 |
| Date of Delivery of Contract | October 26, 1925 |
| Contract Time | 6 months |
| Contract Bid Price | \$37,700.00 |
| Estimated Value of Contract |  |

This contract provides for the furnishing and installing of the pumping equipment, including motors and control in the various pump chambers at the foot of each shaft and at the midriver sump.

The pumps are of two kinds, drainage pumps, automatically controlled by floats in the sumps, to remove all water finding its way into the tunnel and shafts, and booster pumps which are to take water from the city mains and deliver this water at an increased pressure to high pressure mains extending throughout the tunnels and ventilation buildings.

The Contractor has placed orders for valves and is preparing to begin work shortly after the first of the year 1926.

## III. DESIGNS, STUDIES AND INVESTIGATIONS

As in previous years, the work of the Designing Department has consisted of studies, investigations and designs, preparation of contracts and specifications, making of contract, construction and record drawings, checking shop drawings, preparing estimates of cost of the various contracts, preparing condemnation maps and descriptions and making studies of mechanical, electrical and architectural features of the tunnel and its appurtenant structures.

Work has been continued during the year on Contracts Nos. 3, 4, 5, 5-A and 6, furnishing construction drawings of steel and concrete details, water supply and subsurface changes, and checking, correcting and approving drawings submitted by the Contractor. These contracts cover the construction of the tunnels and the approaches thereto.

Surveys of the tunnel air ducts were completed and previous calculations of power. requirements for the ventilation fans were modified to meet the actual duct areas available.

Curves for the adjustment of the fresh air and exhaust air ports are in course of preparation. Air measuring apparatus which will be installed in the ducts will serve as a check on the amount of air flowing, thus insuring the correct setting of the ports to provide proper on the amount of air flowing, thus insuring
distribution of air throughout the tunnel.

Specifications were prepared and contract drawings made for Contract No. 7, Glazed Specifications were prepared and contract drawings made for Contract No. 7, Glazed
Tile, Bronze and Other Interior Finish; Contract No. 9, Furnishing Transformers and Oil T.ile, Bronze and Other Interior Finish; Contract No. 9, Furnishing Transformers and Oil
Switches; Contract No. 10, Tunnel Roadway Pavement; Contract No. 12, Fans, Motors and Control; Contract No. 13, Ventilation Buildings, New York; Contract No. 14, Ventilation Buildings, New Jersey; Contract No. 20, Power Cables, and Contract No. 24, Pumping Equipment. The above contracts, a total of eight, have all been let. Construction drawings were made for Contracts Nos. 7, 12 and 13.

The preparation of contract drawings for the ventilation buildings involved an unusually large amount of work, there being 140 drawings required for Contract No. 13 and 144 drawings for Contract No. 14. Changes in the ventilation equipment, to meet



PLATE No. 12-Completed Tiling in North Tunnel, New York Approach. Contract No. 7.


PLATE No. ${ }^{13}$-Tiled Refuge Niche, North Tunnel, New York. Contract No. 7.
the requirements of the manufacturers neces sitated revision of the structural steel with its attendant changes in not only the steel drawings but of all related drawings as well. Suggestions of the Fine Arts Commission of the State of New York, to whom the drawings of the buildings were submitted for criticism, also resulted in a number of revisions, The drawings for the ventilation buildings, New York, as finally issued, received the approval of the Fine Arts Commission. Contracts Nos. 13 and 14 also include, in addition to the buildings proper, the completion of the interiors of the ventilation shafts and cer tain items of ventilating equipment such as flue clampers, motors for operating them and the control for the motors.

Estimates and studies are being made and specifications are in course of preparation for Contract No. 15, Architectural Work at Entrance and Exit Plazas, New York; Contract No. 16, Architectural Work at Entrance and Exit Plazas, New Jersey; Contract No 17, Emergency Equipment Building, New York; Contract No. 18, Emergency Equipment Building, New Jersey; Contract No. 19, Lights, Traffic Signals and Supervising System; Contract No. 22, Emergency Equipment; Contract No. 23, Plaza Pavement, New York and Contract No. 26, Plaza Paving, New Jersey. All the remaining contracts, required for the completion of the tunnel, are scheduled to be let during the early part of 1926.

The scope of this work previously listed and to be completed in 1926 may be briefly summarized as follows

Contracts Nos. 15 and 16, for the architectural treatment of the entrances, exits and plazas will cover the pylons, granite facing of the open approach sections, open plaza railings, together with their footings, foundation walls and granite bases, and inclucle the installation of light fixtures around the open approaches.

Contracts Nos. 17 and 18, for the Emergency Equipment Buildings in New York and New Jersey, will provide for their complete construction and equipment. These buildings, besides housing the emergency trucks and the ir equipment, to be furnished under Contract No. 22, will contain the offices for the exec utive heads of the tunnel's operating force locker, rest and lunch rooms for employees, showers, carbon monoxide recording apparatus, and electrical and telephone equipment necessary.

Contract No. 19, provides for the installation of the power transformers and oil switches furnished under Contract No. 9; lighting of the tunnel plazas and buildings complete, including reflectors, receptacles for lights and distribution wiring, except for the lighting of the open approaches as noted above; secondary wiring for lighting the plazas and lighting fixtures for the same; traffic signals complete, telephone and fire alarms, complete; supervisory system, complete, including control boards and connections at the various shafts; and a central control board and apparatus for recording continuously the amount of carbon dioxide in the tunnel.

Contracts Nos 23 and 26, for the paving of the plazas, will include provision for razing of buildings, changing necessary pipes and subsurface structures, resetting old pavement and curb to new grades, new paving and curbing, modification of buildings to conform with new grades, together with regrading and possibly some electrical conduit installation for lighting on the New Jersey side of the river.

Contract No. 25 includes the furnishing and placing of fire extinguishers in the niches provided in the tunnel and miscellaneous fire extinguishing equipment, such as fire hose and racks for each fire hydrant in the tunnel and buildings, as well as flushing hose buckets and shovels for sand niches, trolley hoists and electric hoists in all buildings.

Negotiations have been initiated with the power companies, one in New York and one in New Jersey, for the power supply required for operating the ventilating and auxiliary equipment. The principal items of the electrical equipment have been decided upon and most of them are under contract. Step-down transformers of the air blast type will be used to reduce the high tension power supply to the voltages required for operating the motors and lights. Motors of the wound rotor type will drive the fans and pumps, permitting variations of speed where required. The switches controlling the power are to be of the oil immersed truck type, insuring maximum safety of operation and ease of replacement when repairs are necessary. The layout of the power cables has been planned to provide maximum flexibility and assurance of continuity of the power supply. Power is to be furnished by the power companies through three independent cables from each side of the river, there being at least two different sources of supply on each side, and the cables will be operated radially, each bus being sectionalized into three parts, one for each cable. The various groups will be operated by control apparatus operated from a centra switchboard situated in each building and ultimately a single control board may be used for controlling all the equipment from one place.

The investigation of the tile to be used for lining the tunnel was continued during the early part of the year, for the purpose of determining the most suitable size and a specification for this important item which would insure the permanence of the tile finish. After this work was placed under contract, studies were made of decorative ceramics, also other details of the tile, bronze doors and trim.

An understanding was reached with the Erie Railroad Company extending and clarifying the Commission's right to the use of the new pier as it was conferred under the original Erie Agreement, and a lease was entered into with the Railroad Company for the use of certain portions of the railroad yard, all for the purposes of the construction of the ventilation buildings.

Negotiations are now under way with the City of Jersey City and the Erie Railroad Company in connection with the regrading and paving of the areas to be included in the New Jersey entrance and exit plazas. The purpose of these negotiations is to insure that the work to be done by the Commissions will conform to the contemplated operations in the vicinity of the plazas by the above named parties

Similar negotiations are also under way with the City of New York regarding the New York plazas.

During the year maps and descriptions were drawn up covering all the parcels of land needed for the purpose of constructing the tunnel, buildings and plazas, hoth in New York and New Jersey, which had not been acquired in previous years, and an agreement negotiated with the Delaware, Lackawanna and Western Railroad Company covering the temporary and permanent easements required for the North Tunnel and approach which are being constructed under Contract No. 6.
IV. MISCELLANEOUS INVESTIGATIONS AND SPECIAL STUDIES

During the year, studies previously begun were continued, including seawater tests on cement, protection coatings for steel, daily record of weather, air temperatures and the temperature of Hudson River water, investigations of earth pressures upon the tunnel lining and caissons, including the physical properties of silt and other phases of the subject which aid
in explaining tunnel movement phenomena. In addition to this many other tests and studies were conducted primarily to determine the quality and physical properties of the materials used and proposed for use in the works. The more important of these investigations were
(a) Determination of the strength and deflection of tunnel ceiling slab in order to fix the minimum time that should elapse before stripping the forms
(b) An investigation of the physical properties of Lumnite cement concrete to determine the advisability of its use in the ceiling slab, because of its early strength developing properties. These were demonstrated, but the time interval for stripping the forms was shortened sufficiently with the use of Portland cement, by lengthening the forms for each concrete pouring section.
(c) Finishing a portion of the tunnel for the purpose of determining a suitable size and color of tile, width of border, type of handrail, effectiveness of lighting system, etc.
(d) Investigations of strength and deflection of gunite concrete slabs for the purpose of determining safe unit stresses and other data for the design of the air ducts of the ventilation buildings.
(e) A study of the effect on the tunnel of dredging and the driving of piles for the new Erie Railroad Company Pier No. 9, in Jersey City. This study included the measurement of pressures, against the New Jersey river shafts, caused by the pile driving, to forestall possible movement of the shafts by properly controlling the pile driving accordingly

The operation of dredging over the tunnel in the slip was also carefully supervised to prevent possible rising of the tunnel due to insufficient cover
(f) Exhaustive tests were made and are still under way to determine a suitable paint for coating the tunnel ceiling. The conditions of alkali and moisture which obtain in the ceiling slab have subjected the paints to a severe test and most of them have, under these conditions, proven unsatisfactory for the purpose
(g) Tests to determine the adhesion of the different makes of tile used to the setting mortar specified for the work
(h) Determination of the correct percentage of moisture to be used in the sand cement cushion of the granite block roadway pavement, and tests of the physical properties of mixtures, containing different percentages of moisture.
(i) Miscellaneous and routine tests on asphalt, cement, cementing materials, expansion joint material, lime, liquid waterproofing materials, sand and tile.
(j) Investigation of the earth pressures on the outside of the tunnel structure have been continued.

Photographs were taken during the year of the various phases of the construction work for record purposes and also of all features having special interest.

## V. INSPECTION OF MATERIALS

The quantities of the principal materials required for work now under contract as supplied by the subcontractors and the approximate quantity manufactured during 1925 and the quantity manufactured to date are listed herewith :

| Material Unit | Approx. Quantity | Subcontractor | Mfd. <br> During <br> 1925 | Total $M f d$. <br> to Date | $\begin{aligned} & \% \text { Com- } \\ & \text { pleted } \\ & 12 / 31 / 25 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Cast-iron tunnel lining, ........... Ton | 37,852 | Davies \& Thomas Co., Catasauqua, Pa., . |  | 37,852 | 100 |
| Cast-iron tunnel lining, ........... Ton | 69,140 | Bethlehem Steel Co., Bethlehem, Pa., . |  | 69,140 | 00 |
| Cast-steel tunnel lining, ............ Ton | 7,784 | Bethlehem Steel Co., Bethlehem, Pa., .. |  | 7,784 | 100 |
| Structural steel for caissons, ....... Ton | 4,507 | $\begin{aligned} \text { Bethlehem Steel } \\ \text { Steelton, Pa., } \end{aligned}$ |  | 4,507 | 100 |
| Structural steel for cut and cover section, Contract No. 5, .......... Ton | 4,315 | American Bridge Co., Trenton, N. J., .. | 36 | 4,315 | 100 |
| Structural steel for cut and cover section, Contract 5-A, ............ Ton | 121 | American Bridge Co., Trenton, N. J., .... | 121 | 121 | 100 |
| Structural steel for cut and cover section and air ducts, Contract No. 6, Ton | 3,545 | McClintic-Marshall Co., Pottstown, Pa., ....... | 3,300 | 3,300 | 92 |
| Structural steel for New York ventilation buildings and shafts, Contract No. $13, \ldots \ldots \ldots \ldots \ldots \ldots$........................ | 2,130 | Phœenix Bridge Co., Phœnixville, Pa., | 100 | 0 | 5 |
| Tunnel bolts, Contracts Nos. 3 and 4, No. | 437,385 | Pittsburgh S. \& B. Co., Pittsburgh, Pa., | 2,380 | 437,385 | 100 |
| Tunnel bolts, Contracts Nos. 3 and 4, No. | 439,623 | $\begin{aligned} & \text { Bethlehem Steel Co., } \\ & \text { Reading, Pa., } \ldots \text {... } \end{aligned}$ | 2,829 | 439,623 | 3100 |
| Granite facing, .................. Cu. Yd. | 401 | H. E. Fletcher Co., <br> W. Chelmsford, Mass., | , .... | 401 | 00 |
| Granite curbing, Contracts Nos. 3, 4 <br>  | 31,430 | H. E. Fletcher Co., W. Chelmsford, Mass., | , 2,604 | 27,762 | 87 |
| Granite curbing, Contracts Nos. 5 and 5-A, .............................. L. Ft. | 5,339 | J. Leopold \& Co., W. Sullivan, Maine, ... | 2,682 | 5,339 | 100 |
| Glazed tile and enamels, Contract No. <br> 7, foreign, <br> ....................... Sq. Ft. | 182,500 | $\left\{\begin{array}{l}\text { Villeroy \& Boch, } \\ \text { Mctlach, } \\ \text { Rakovnik, } \\ \text { czecho, ...... }\end{array}\right.$ | . 78,000 | 78,000 | 43 |
| Glazed tile and enamels, Contract No. 7, domestic, Sq. Ft. | 182,500 | Amer. Encaustic Tiling Co Zanesville, Ohio, | 80,100 | 80,100 | - 44 |
| Bronze work, Contract No. 7, ...... Pcs. | 5,400 | The Gorham Co., Providence, R. I., ...... | . 540 | 540 | 0 |
| Granite block pavement, Contract No. 10, ................................. Sq. Yd. | 44,500 | J. Leopold \& Co., Vinalhaven, Maine, | . 29,943 | 29,943 | 3 |

The manufacture of steel and cast iron necessary for the river tunnels is practically completed.

The inspection of the ordinary items of iron and steel, such as tie-rods, tunnel bolts sheet metal air flues, copper steel plates, floor beams, ceiling angles, caisson connecting sheet metal air flues, copper steel plates, cast-steel shackles and structural steel for the cut and cover section, with the exception of rolling of steel and also the tile and bronze work and granite block, was done by the engineering staff of the Commissions. A ceramic expert has been on inspection
duty for the Commissions at the tile manufactories in Mettlach, Germany and at Rakovnik, Czechoslovakia and another at Zanesville, Ohio.

Sand and gravel, washers for tunnel bolts, rolling of steel, lead for caulking, grommets, cast-iron water pipe for tunnel service lines, waterproofing fabric and asphalt, noncorrosive metal, brick and paints have been inspected through the Materials Inspection Department of the Transit Commission and Board of Transportation of the City of New York as in 1924.

The sampling and testing of cement have been continued through the State Engineer's office at Albany. Approximately 146,794 barrels of Portland cement, of which 6,504 barrels were inspected by the Board of Transportation, and 2,007 barrels of mixed cement have been tested and received to date.

The continuation of the arrangement for inspection by the forces of the Board of Transportation of the City of New York and the State Engineer's office has placed the services of these experienced organizations at the disposal of the Commissions and avoided the duplication of facilities already available at a considerable saving to the Commissions.

## VI. ACCIDENTS AND DECOMPRESSIONS

During the year, three fatal accidents occurred on the work and a fourth man died of bronchial pneumonia while in the hospital under treatment for partial paralysis brought on by work in compressed air. This last fatality is the only one, to date, traceable to compressed air illness, which in this case was the secondary cause of death. A certain number of accidents, while much to be regretted, seems unavoidable on a work of such magnitude in spite of the most careful supervision and attention as to safeguards and preventative measures. Minor accidents, usual in work of this character, occurred, but, having received prompt and adequate medical attention, no serious after effects resulted

The total number of decompressions that have occurred to date is 745,882 with 528 cases of "bends." Of these, there were 27,499 decompressions with 19 cases of "bends" on all compressed air work during the year 1925; 4,899 decompressions with five cases of "bends" were on the foundation caisson work for the New Jersey land ventilation building, under Contract No. 6. Plate No. 7 presents decompression data in detail.

## VII. TRAFFIC

Study of the vehicular traffic over the ferries crossing the Hudson River has been continued. No count was made this year, the figures given below being based on data obtained from the operating companies. Distribution and classification have been determined from these data where applicable, but where the necessary figures were not available, estimates were made using percentages determined from the Commissions' counts made in previous years modified to agree with the data which were furnished.

In making summaries, the ferries have been grouped as in previous reports, namely:


The volume of traffic for 1925 as compared with that of previous years is shown in the table following. In this table the traffic for the months of November and December, 1925, has been estimated, as complete data for these months are not yet available.



| Year | six ferry group |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Total Yearly Traffic | Horse Drawn |  | Motor Driven |  | Total | PercentAnnual |
|  |  |  | Percent of |  | Percent of | Daily |  |
|  |  | No. | Total | No. | Total | Traffic | Increase |
| 1914, | 2,089,311 | 5,346 | 81.2 | 1,233 | 18.8 | 6,579 | .... |
| 1915, | 2,090,519 | 4,936 | 75.1 | 1,636 | 24.9 | 6,572 |  |
| 1916, | 2,256,501 | 4,875 | 69.1 | 2,184 | 30.9 | 7,059 | 7.4 |
| 1917, | 2,430,803 | 4,755 | 62.5 | 2,855 | 37.5 | 7,610 | 7.8 |
| 1918, | 2,669,003 | 4,594 | 55.1 | 3,739 | 44.9 | 8,333 | 9.5 |
| 1919, | 2,646,042 | 3,884 | 47.2 | 4,344 | 52.8 | 8,228 | -1.3 |
| 1920, | 2,361,727 | 2,972 | 42.0 | 4,099 | 58.0 | 7,071 | -14.1 |
| 1921, | 2,498,457 | 2,629 | 36.9 | 4,498 | 63.1 | 7,127 | 0.8 |
| 1922, | 2,903,881 | 2,842 | 32.5 | 5,903 | 67.5 | 8,745 | 22.7 |
| 1923, | 3,139,119 | 2,617 | 27.4 | 6,929 | 72.6 | 9,546 | 9.2 |
| 1924, | 3,009,052 | 2,097 | 23.6 | 6,787 | 76.4 | 8,884 | -6.9 |
| 1925, | 3,570,302 | 2,116 | 20.3 | 8,323 | 79.7 | 10,439 | 17.5 |
|  |  |  | pour ferry |  |  |  |  |
|  |  |  | Se Drawn |  | Driven | Total | Percent |
|  | Total Yearly |  | Percent of |  | Percent of | Daily | Annual |
| Year | Trafic | No. | Total | No. | Total | Trafic | Increase |
| 1919, | 2,036,421 | 444 | 8.5 | 4,780 | 91.5 | 5,224 |  |
| 1920, | 2,089,035 |  |  |  |  | 5,400 | 3.4 |
| 1921, | 2,584,691 | 455 | 6.7 | 6,329 | 93.3 | 6,784 | 25.6 |
| 1922, | 3,007,538 | 313 | 4.0 | 7,474 | 96.0 | 7,787 | 14.8 |
| 1923, | 3,353,190 | 274 | 3.0 | 8,790 | 97.0 | 9,064 | 16.4 |
| 1924, | 3,894,387 | 265 | 2.6 | 9,994 | 97.4 | 10,259 | 12.5 |
| 1925, | 4,334,676 | 239 | 2.1 | 10,877 | 97.9 | 11,116 | 8.4 |

The decrease in horse-drawn and increase in motor-driven traffic continues as was to be expected. The average weekday traffic for all ferries across the Hudson River from Manhattan is now 34,366 as compared with 31,865 in 1924, an increase of $9 \%$, while the total volume for the year for all ferries shows an increase of $10 \%$ over the traffic for 1924.

$$
1924 .
$$

The figures given above show the weekday averages based on the total traffic for the year. The average Sunday and holiday traffic for the year exceeds the weekday average by from $15 \%$ for the downtown ferries to $104 \%$ for the Dyckman Street-Engleaverage by from live for the dike manner, the peak of the traffic during the summer months is from wood ferry. In like manner, the peak of the traffic during the summer months is from
$25 \%$ to about $200 \%$ in excess of the minimum which occurs during the winter months, the smaller number applying to the downtown ferries and the larger to the two uptown ferries. These variations are due to a large extent to the ever increasing stream of pleasure motor car travel. An interesting sidelight on this subject is reported by the management of the Dyckman Street-Englewood ferry whose vehicular traffic is practically $100 \%$ motor driven, of which about $90 \%$ are pleasure cars. They state that concurrent with the increase in vehicular traffic they are experiencing a reduction in pedestrian passenger revenue.

## VIII. PROGRAM OF WORK FOR 1926

The program of work for 1926 will include the preparation of contracts, specifications and contract drawings, and the award of the remaining nine construction and equip-
ment contracts and the prosecution of the construction work under these, as well as under the thirteen which are now under contract.

Before the tunnel can be opened for public use, all the twenty-three contracts involved in its construction and equipment must be completed, except Contracts Nos. 15 and 16. These two contracts, for the architectural work at the open approaches and plazas in New York and New Jersey, respectively, could be carried on after the opening of the tunnel with little or no interference with the tunnel traffic.

Contract No. 6 for the construction of the New Jersey approach was originally scheduled to be let in 1923. The letting of this contract was postponed until December, 1924, due to lack of sufficient funds.

Every effort has been made in the prosecution of the work and the letting of subsequent contracts to make up for the lost time on the New Jersey side. Part of the plant site which is now being occupied by the contractor for Contract No. 6, is essential for the prosecution of work under Contract No. 14 on the Land Ventilation Building, New Jersey and unless this part of the plant site can be turned over to the Contractor for Contract No. 14 early in the spring of 1926, as is anticipated, there will be a corresponding delay in the completion of the tunnel. Barring such delay and other unforeseen occuring delay in the completion of is anticipated that at the end of 1926 the construction and equipment of the tunnel will be very nearly completed and, allowing for a reasonable period for testing out and adjusting the equipment, the tunnel should be ready for public use early in 1927.

To carry out this program additional funds, amounting to $\$ 3,283,300.00$ will be re quired. This will make possible the placing of all the remaining contracts. The first of these is scheduled for award about March 15, 1926, and to make this possible the additional funds will have to be made available before that date. Any delay in the award of these contracts, except Contracts Nos 15 and 16, will necessarily result in a corresponding delay in the opening of the tunnel.

## IX. ORGANIZATION

Designs were under the supervision of Mr. Ole Singstad, Engineer of Designs, until the end of March, subsequently under Mr. Ralph Smillie, Engineer of Designs; construction under Colonel Frederic A. Snyder, Engineer of Construction; the General Office under Mr. E. Morgan Barradale, Assistant to the Chief Engineer.
E. Morgan Barradale, Assistant to the Chief Engineer.
Professor William H. Burr, Colonel George L. Watson, Mr. Frederick C. Noble, Mr. Frank M. Williams, Colonel William J. Wilgus, Dr. Edward Levy, Mr. George L. Lucas, Professor Arthur C. Willard, Mr. Lewis B. Stillwell and Professor George H. Brown have been continued as consultants, and Professor C. E. Ferree was retained as special consultant on the lighting of the tunnel and the color effects of the tile and on their interrelated effects in the tunnel. Mr. Sullivan W. Jones, State Architect of New York, has continued to act as consultant on the architectural features.

Being highly sensible of the co-operation and advice received. this opportunity is taken of tendering all these gentlemen expressions of thanks and appreciation for the services in the conduct of the work

Appreciation of the loyalty and character of service of the entire staff is also expressed.

For the second time within a short period of five months, an irretrievable loss was suffered by the organization when, on March 24, 1925, its second Chief Engineer died. Mr. Milton H. Freeman had quietly assumed his appointed task of completing the work of The Holland Tunnel, when death claimed its first Chief Engineer on October 27, 1924, and was pursuing his course with all of his energy and intense devotion to duty, when he too was compelled to lay down his burden.

His practical experience, training and thoroughness in every detail, his fine sense of justice, his unusual modesty and consideration in his relations with others, his humanity, have made the loss to the organization a keen, personal one to every member with whom Mr . Freeman came in contact.

Respectfully submitted
OLE SINGSTAD, Chief Engineer.

APPENDIX

TABULATION OF BIDS

CONTRACTS Nos. $7,9,10,12,13,14,20$, and 24
(43)

New York State Bride and Tunnet Conmission ant NO. 10
Jersey Interstate Bridge and Tunnel Commission, the Holland Tunnel, Canvass of Bids Received May 5, 1925

| Item | CLASSIFICATION | Unit | Quantity | W. J. <br> Fitzgerald |  | John Meehan$\& \operatorname{Son}$ |  | Booth \& Flinn, Lit. |  | Poirier Contracting Co., Inc. |  | Public Service Production Co. |  | E. J. Flaherty Contracting Co. |  | Engineer's Estimate |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount |
| 69 173 | Asphalt coating.... Pavement ....... | Sq. yd. | 5,000 44,500 | $\$ 016$ 7 79 | $\$ 800$ 328,855 | \$0 22 | $\$ 1,100$ 330,190 | \$0 50 755 | $\$ 2,500$ 335,975 | $\$ 0$ 7 74 | $\$ 2,000$ 353,330 | $\$ 039$ 798 | $\$ 1,950$ 355,110 | $\$ 040$ 825 | $\$ 2,000$ 367,125 | $\$ 0$ 700 | $\$ 1,000$ 311,500 |
|  | Totals |  |  | $\ldots$ | \$329,655 | .... | \$331,290 |  | \$338,475 |  | \$355,330 |  | \$357,060 |  | \$369,125 |  | \$312,500 |

CONTRACT NO. 12.
New York State Bridge and Tunnel Commission and New Jersey Intekstate Bridge and Tunnel Commission, the Holland Tunnel, Canvass of Bids Received September 8, 1925, for Fans, Motors, Transmission and Control


New York State Bridee and Tunnel Commission and New Jersey Interstate Brid ge and Tunnel Commission, the Holland Tunnel, Canvass of Bids Received July 7, 1925, for Furnishing Power Transformers and Oil Switches


CONTRACT NO. 20.
New York State Bridge and Tunnel Commission and New Jersey Interstate Bridge and Tunnel Commission, the Holland Tunnel, Canvass

| Item | CLASSIFICATION | Unit | Quantity | $\begin{aligned} & \text { STAR } \\ & \text { UNDER } \\ & \text { CABI } \end{aligned}$ | NDARD GROUND L Co . | $\begin{aligned} & \text { James } \\ & \text { Con } \end{aligned}$ | Sugden mpany |  | $\begin{gathered} \text { cson } \\ \text { Co. } \end{gathered}$ NC. |  | $\begin{aligned} & \text { TBTY } \\ & \text { TPEANY } \end{aligned}$ | Fox R | YNOLDS $Y$ INC. | $\mathrm{JoH}_{\mathrm{Ho}}$ | Now. | Enat | neer's MATI |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount | Price | Amount |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Lin. Ft. Lin. Ft. | 37,000 20,000 | $\$ 2$ 1 1 12 | $\$ 78,810$ 22,400 | $\$ 215$ 1 | $\$ 79,950$ 24,000 | $\$ 2$ 1 1 | \$94,350 | $\$ 2$ 1 185 | \$86,210 | $\$ 2$ 1 159 | $\begin{aligned} & \$ 97,310 \\ & 31,809 \end{aligned}$ | $\$ 319$ 1 | $\begin{array}{r} \$ 118,030 \\ 32,800 \end{array}$ | $\$ 250$ 140 | $\begin{aligned} & \mathbf{2 8}, 5000 \\ & \hline \end{aligned}$ |
|  | For three-conductor, varnisher cambric insulated lead covered cable, complete, with potheads and their supports, racks, hangers, tags, cable supports, bonds, grounds, clamps, joints, cable protection in splicing and pull-chambers and insula- <br> (a) For 500,000 circular mil. cambric insu- |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | Lin. Ft. | 6,000 | 346 | 20,760 | 410 | 24,600 | 300 | 18,000 | 417 | 25,020 | 294 | 17,640 | 433 | 25,980 | 250 | 15,000 |
|  | (b) For 167,805 circular min, cambric insu- | Lin. Ft. | 2,000 | 235 | 4,700 | 467 | 9,340 | 300 | 6,000 | 529 | 10,580 | 191 | 3,820 | 337 | 6,740 | 140 | 2,800 |
|  | (c) For $\begin{aligned} & \text { lated } \\ & \text { lit. } \\ & \text {................................. }\end{aligned}$ | Lin. Ft. | 2,000 | 100 | 2,000 | 113 | 2,260 | 100 | 2,000 | 111 | 2,220 | 142 | 2,840 | 152 | 3,040 | 85 | 1,700 |
|  | Totals | ........ | ....... |  | \$128,670 |  | \$139,750 | ..... | \$144,350 |  | \$149,030 |  | 153,410 | ..... | $\stackrel{\text { \$186,590 }}{ }$ |  | $\stackrel{140,000}{ }$ |


with potheads and their supports, racks,
hangers, tags, cable supports, bonds,
grouds, clamps, joints, cable protection
in splicing and pull-chambers and insula-





HUDSEN RIVER CONSTRUC


## NORTH TUNNEL



SOUTH TUNNEL

## RIVER VEHICULAR TUNNEL NSTRUCTICN PROGRESS



NOTE:
Tunnel progress shown on Contracts №s 3 and 4
is exclusive of concrete lining.
Progress on Contracts Ne5, SA\&6 15 excavation only.




THE HOLLAND TUNNEL
twin cast iron tubes
PLAN PROFILE ano SECTION

