METHOD OF CONSTRUCTION OF TUNNEL LINING

Vladimir Alexandrovich Khodosh, U.I. Burdenko 16/12, kv. 16; Sergei Fedorovich Salov, Ul. Akademika Koroleva 9, korpus 2, kv. 284; Valentin Alexandrovich Ivanov, Ul. Konstantinova 4, kv. 25; Evstafy Andreichev Vasilenko. Ribshsky proezd 1/5, kv. 50; Leonid Ivanovich Savilev, Oktroyoe shosse 29, korpus 11, kv. 58; Evgeny Moiseevich Bolotin, Oktroyoe shosse 24, korpu., 25, kv. 12; and Leonid Konstantinovich Khardurov, Oktroyoe shosse 24, korpus 5g, kv. 31, all of Moscow, U.S.S.R.

Filed Feb. 7, 1968, Ser. No. 703,763
Claims priority, application U.S.S.R., Feb. 8, 1967, 1,133,321
Int. Cl. E01g 5/08; E21d 11/10
U.S. Cl. 61—45

4 Claims

ABSTRACT OF THE DISCLOSURE

A method of constructing a tunnel lining is disclosed in which concrete is fed behind an intermittently advancing shield during each successive stage of advancement to form a lining along the tunnel as the tunnel is being cut by the shield. The concrete is compacted during and by the progressive advance of the shield and a uniform compacting pressure is applied to the concrete with counter-pressure on the shield and the face of the tunnel at the end of each advance of the shield when the latter is stationary.

This invention relates to tunnel construction, and more particularly to methods of construction of a tunnel lining in the course of tunneling with the use of a shield, the concrete mix being compacted by the reactive force of the shield jacks.

Primarily the invention relates to tunneling in soft soil.

It is known that the material of the tunnel lining (generally concrete) is compacted under the shield shell by a reactive force of the shield jacks, said reactive force being developed in the course of shield advance. However, according to this arrangement, the force of compaction depends upon the force of shield cutting into the soil, so that the concrete mix fails to be compacted throughout by a uniform force. Besides, when a certain number of the shield packs are deactivated, for the purpose of reversing the shield, this results in non-uniform compaction of the concrete mix in the cross-sectional plane of the tunnel lining.

In mechanized tunnel cutting with the use of the tunneling shield, a frontal resistance develops which is insufficient for providing a strong and watertight tunnel lining.

It is an object of this invention to eliminate the above-mentioned disadvantages of the conventionally known method of construction of the cast-in-place compacted concrete lining of the tunnel.

This invention is an object of this invention to exhaust the advantages of the conventional methods of construction of the concrete lining of the tunnel.

In the accomplishment of this object, after each advance of the tunneling shield through a pre-set length of the tunnel, the concrete mix is subjected to additional compaction, known as after-compaction, with the shield bearing against the face of the tunnel.

The specific features and advantages of this invention will appear more completely from the following description of a typical embodiment thereof which is given by way of example with reference to the accompanying drawing, in which:

FIG. 1 shows a tunneling shield for the construction of tunnels, which insures compaction of concrete mix in the course of shield advance; and

FIG. 2 shows the same shield in the course of concrete mix after-compaction, with the shield bearing against the tunnel face.

First the concrete mix is compacted in the course of advance of the shield (FIG. 1) and rotation of its cutting head 2. At this stage the concrete mix 3 is compacted under the shell 4 of the shield 1. Following the gradual advance of the shield 1, the concrete mix 3 is forced out from under the shell 4 into the spaces between the external surface of said shell and the soil. Compaction is effected by a pressure of 75 to 225 p.s.i. produced by the reactive force of the shield jacks 5 by means of the pressure ring 6.

The lower limit of the pressure depends on the conditions for gradual forcing out of the concrete mix 3 beyond the shield shell, while the maximum pressure is determined by the optimum design characteristics of the tunneling shield with the rotary cutting head 2.

After the tunneling shield 1 (FIG. 2) advances through the pre-set length of the tunnel, the concrete mix 3 is compacted by a specified constant pressure up to 750 atm. uniformly distributed over the entire section of the lining. Compaction pressure is applied to the concrete mix by means of the pressure ring 6 to the reactive force of the shield jacks 5, said force being developed when the stationary working cutting head 2 bears against the tunnel face.

The upper limit of the compaction pressure depends on the conditions providing a strong and watertight tunnel lining, and with due consideration of the design characteristics of the tunneling shield.

What is claimed is:

1. A method of constructing a tunnel lining, said method comprising intermittently advancing a tunneling shield to cut a tunnel in successive stages, feeding concrete behind the shield during each stage to form a lining along the tunnel as the tunnel is being cut, compacting the concrete during and by the progressive advance of the shield during each stage, and separately applying a substantially increased uniform compacting pressure on said concrete with counter pressure on said shield and the face of the tunnel at the end of each advance of the shield when the latter is stationary, the tunneling shield being provided with a cutting head which rotates during each advance of the shield to cut the tunnel, said cutting head being at rest during the application of pressure at the end of each advance of the shield.

2. A method as claimed in claim 1 wherein the concrete is subjected to a compaction pressure during the advance of the shield of about 75 to 225 p.s.i. and a compaction pressure at the end of each advance of the shield of about 750 p.s.i.

3. A method as claimed in claim 1 wherein the pressure is applied to the concrete by jacks which are connected to the head and all of which are utilized to develop uniform pressure.
4. A method as claimed in claim 3 wherein the tunnelling shield is provided with a casing which extends rearwardly and forms an outer lining for the tunnel during the compaction of the concrete when the shield is advanced, the concrete being compacted into a space beneath the casing during the advance of the shield.

References Cited

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor(s)</th>
<th>Class</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>551,042</td>
<td>12/1895</td>
<td>McDonald</td>
<td>61—85</td>
<td>10</td>
</tr>
</tbody>
</table>

FOREIGN PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Country</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>431,562</td>
<td>9/1911</td>
<td>France</td>
<td>61—85</td>
</tr>
</tbody>
</table>

OTHER REFERENCES

German printed application 1,206,938, December 1965.

JACOB SHAPIRO, Primary Examiner

U.S. Cl. X.R.