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PROCESS FOR THE STRENGTHENING OF SHELTER COVERS
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Fig. 1.

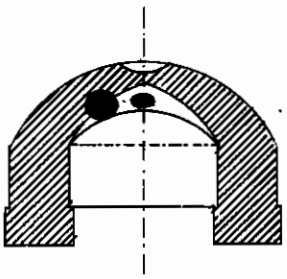


Fig. 2.

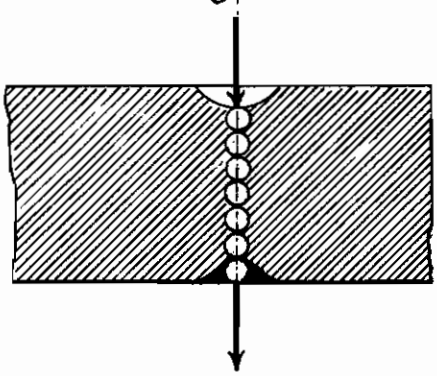
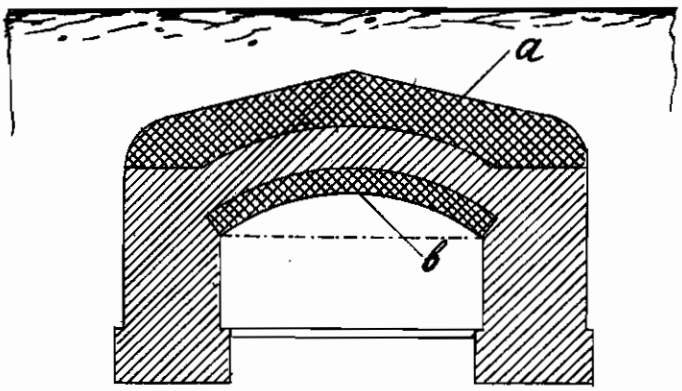


Fig. 3.



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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE STRENGTHENING OF SHELTER COVERS

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The impact of a bomb on the roof of a shelter causes the penetration of the bomb into the concrete to a certain distance. The penetration is due to the breaking up of the concrete resultant on the impact of the bomb and the crumbling and shifting of the concrete. The latter is caused by the conical head of the bomb which at the moment of impact acts as a wedge and displaces the concrete in every direction.

The explosion of the bomb after impact causes the enlargement of the funnel-shaped hole already formed and causes violent vibration of the concrete particles beneath the hole so formed.

Experience and tests undertaken have shown that the impact and the explosion of the bomb on the vault or covering of the shelter produces the two following spheres of destruction:—

1. In the upper portion a shattering of the structure of the concrete and destruction of the steel reinforcement, which causes the enlargement of the funnel-shaped hole,

2. in the lower portion under the funnel-shaped hole, as the first indication of destruction, a partial falling away of the concrete.

By the increase in the weight of explosive in the bomb, the volume of the concrete displaced is increased, so that its volume may be thirteen times as large as that of the corresponding funnel-shaped hole, as shown in Fig. 1.

The fact of the falling away of the concrete from the under side of the vault or covering is explained by the fact that the explosion causes a violent vibration through all parts of the undestroyed concrete and therefore also underneath the funnel hole. One can explain this fact, as regards this elastic section of the concrete—see Fig. 2—by the simile of a number of elastic balls, so that the violent impact on the first ball causes the displacement of the last ball on the underside of the vault, whenever the strain caused by the vibration is greater than the tensile strength of the concrete.

The above shows that, in the case of shelters made of concrete or reinforced concrete, the greatest danger is caused by the destruction of the inner structure and this insofar as the tensile and shearing strength of concrete is only about one tenth of its compressive strength.

It is well-known that, due to the small and variable tensile strength of concrete, this factor is not taken into consideration in calculations for reinforced concrete construction.

Therefore, in order to strengthen the resistance of vaults or coverings for shelters and for lessening their thickness, the following measures are necessary:—

1. The strengthening of the compressive and shearing strength of the upper part of the concrete, whereby the dimensions of the funnel-shaped hole are rendered less—see Fig. 3*a*—and

2. the strengthening of the tensile strength of the concrete in the lower part to prevent shattering—see Fig. 3*b*.

For this purpose, concrete reinforced with wire, "Felted Concrete", is recommended. In such concrete, thin short iron wires of soft consistency are introduced, in such a manner that they spread in all directions similar to the threads in felt. Such wires are from 1 to 1.2 mm. in diameter and from 12 to 15 cm. long. The wires are uniformly distributed in the concrete, so that its shearing, tensile and compressive strength is considerably increased in every way.

This may be explained through the fact that the use of thin wire gives the greatest possible contacting and adhesion surfaces between the predetermined quantity of iron and concrete. Experience and tests have shown that the comparatively thick iron reinforcements in reinforced concrete construction stimulate the transmission of vibration. By such transmission, the concrete becomes separated from the reinforcement and thus destruction is commenced. This disadvantage is avoided by the present invention.

The thin wire distributed uniformly in the concrete produces the homogeneity of the wire-reinforced concrete with regard to its composition as well as the mechanical conditions.

Therefore this "Felt-concrete" is particularly suited for the construction of columns carrying heavy loads, foundations for steam-hammers and buildings subjected to earthquakes and bombardment. The use of this "Felt-concrete" in the construction of shelter covers decreases the necessary thickness for concrete vaults to 55% to 60% or in the case of covers or vaults of ordinary reinforced concrete to 30% to 35%.

By using wire of from 12 to 15 cm. long and stone ballast of an average of 4 cm., there will be attained:—

1. that each wire encircles or embraces several particles of the ballast.

2. that all wires are uniformly distributed throughout the concrete so that they are in the interstices between the particles, so that each particle is woven around on all sides by the wire. Experience proves that when using 50 kilograms of cut wire to 1 m^3 of concrete, each particle of ballast will be in every direction surrounded by four to six wires,

3. that in the concrete mass all these wires will form a reinforcement, woven into the mass in the manner of felt. The reinforcement is automatically attained at the pouring and ramming of the concrete.

4. that, due to the use of wires of 12 to 15 cm. long, there remains on the upper surface of each rammed layer of concrete a sufficient number of wires, of suitable length, to act as a strong connection with the next layer of concrete.

The most suitable composition of the "Felt-concrete" is as follows: to one cubic metre of concrete containing 400 kilograms of cement, about 50 kilograms of cut soft iron wire of a diameter of from 1 to 1.2 mm., and a length of from 12 to 15 cm. Asphalt bitumen may also be used, instead of cement, as a binding agent.

The method of construction with "Felt-concrete" is as follows: to the prepared plastic concrete, of composition as above, is added about 50 kilograms of cut soft iron wire, of dimensions as given above; these wires are by means of forks distributed as evenly as possible in the mass of the concrete before and during the pouring. In each rammed layer, the end of the wires are drawn out by means of forks in order to assure a strong connection with the next layer of concrete.

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