This invention relates generally to mine shaft construction and more particularly to a mine shaft comprising a lining made up of segmental metal lining plates held together to form an inner lining for the shaft.

Mine shafts lined with exposed concrete are now in use but such shafts have several disadvantages which are eliminated by the provision of a shaft embodying my invention.

Concrete shafts in time crack, thereby allowing water to enter the concrete, and if freezing alternates with thawing, the effect is to rapidly disintegrate the concrete and cause it to fall to pieces. In order to make a concrete lined shaft effective against leakage it is necessary to make the concrete lining so thick as to greatly increase the cost of the construction.

By providing a mine shaft with an inner lining of segmental metal liner plates in accordance with my invention and arranging a thin wall of concrete around the outside of the inner metal liner, the cost of the construction is materially reduced.

In mine shafts air is blown into the shaft by a blower, and if the air entering the mines is moist, it freezes on the walls of the shaft. Where concrete is used as an inner lining for mine shafts, it is very difficult to remove the ice without injuring the walls, whereas if a metal liner is employed there is no danger of injuring the liner by removing the ice from the walls with picks or other implements. It is necessary to remove the ice from the walls of the shafts occasionally in order that there will be sufficient space in the shaft to allow the mine cage to move through the shaft.

If the lining of the shaft is not waterproof, water leaks through the lining and into the shaft and meets cold air flowing down the shaft from the outside. If the air is cold enough it causes the water which has seeped through the lining to freeze, forming icicles along the side walls of the lining. The more water-tight the lining is, the less danger there is of forming ice on the walls of the shaft.

Ice can also be formed near the bottom of the shaft in another manner. If the outside temperature is very cold, as is often the case in winter, the cold air flowing down the shaft cools it to below freezing temperature. It sometimes happens that the weather becomes warmer and this is often accompanied by rain which saturates the air. When this saturated air flows down the shaft, it becomes cooled, due to the previous inflow of very cold air, and the moisture is precipitated in the form of ice which clings to the lining of the shaft. The warm air continues to flow down the shaft and finally melts the ice which has been formed. In some cases, however, due to weather conditions, the ice does not melt, but has to be removed by mechanical means.

If an inner lining constructed in accordance with my invention is employed, it may be thoroughly waterproofed by sealing the joints between the segmental liner plates with a sealing material such as tar.

Because of the fact that when a metal liner is used the amount of concrete or other filling material employed is reduced, the total cost of a mine shaft construction made in accordance with my invention is less than one in which concrete alone is employed.

In the drawings, which show the present preferred embodiment of my invention,

Figure 1 is a longitudinal section of a mine shaft construction embodying my invention, parts being shown in elevation, and parts being broken away;

Figure 2 is a plan view of the construction shown in Figure 1; and

Figure 3 is a perspective view of one of the segmental liner plates employed to form the inner lining of the shaft.

Referring to the preferred embodiment of the invention shown in the drawings, the inner lining 2 of the shaft is made up of a plurality of segmental metal liner plates 3 which are connected together. As shown in Figure 3, the liner plates are provided with end flanges 4 and side flanges 5, the flanges being provided with openings 6 adapted to receive bolts 7 (Figure 1) in order to secure the plates together. The inner lining made up of the liner plates 3 may be waterproofed by lining the joints between the plates with a waterproofing material such as tar.
Arranged outside of the inner liner is a lining of any suitable filling material. I prefer to use concrete in order to form this lining. Corrugated sheet iron plates are arranged outside of the concrete lining, and these corrugated sheet metal plates are belled out at points spaced longitudinally of the shaft, as indicated at 10. Water rings are provided in order to collect any water which contacts the outer surface of the concrete lining. These rings preferably are formed by bending the corrugated sheet iron plates in order to provide the water ring, but if desired the water rings may be made by simply digging out a portion of the rock surrounding the shaft in order to provide a space which will collect the water. Conduits are embedded in the concrete lining and are connected to the water rings in order to carry off the water collecting in the rings and deliver it to a drain pipe, not shown. The corrugated sheet iron plates are supported by plugs driven into the wall of the shaft. In wet sections it is preferred to employ wooden plugs.

If desired, the mine shaft may be divided so as to provide for downdraft and updraft by arranging a partition such as the metal partition shown in Figure 2 extending longitudinally of the shaft. The ends of the partition are connected to the inner lining made up of segmental metal plates by any desired means. Horizontal supporting members and vertical supporting members may be connected to and supported by the partition in order to provide a stairway employed for entering and leaving the mine.

Instead of forming the lining of concrete, granulated slag or other material may be used to partially replace concrete. This partial substitution of slag for concrete may be accomplished by building up the inner lining of segmental metal liner plates to a certain height, and likewise building up the lining made up of corrugated sheet metal plates and then pouring a concrete toe ring of about three or four feet in depth to provide a foundation for the slag. The slag is then packed in between the linings until the space between these linings is filled up. This provides an outer lining surrounding the inner metal lining, which outer lining is composed mainly of slag but which has toe rings of concrete spaced longitudinally of the shaft. This construction presents considerable economy and is very satisfactory for the reason that after the slag has been packed, it hardens so that it is approximately as tough and strong as concrete.

In many cases it is unnecessary to provide any backing outside of the filling material. This would be the case where copper water rings are employed.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same and that the invention may be otherwise embodied without departing from the spirit of the invention or the scope of the following claims.

I claim:

1. A mine shaft construction comprising a plurality of metal liner plates connected to form an inner lining for the shaft, an outer lining of concrete, water rings arranged outside of the concrete lining, and means for draining the water collected by said rings.

2. A mine shaft construction comprising a plurality of metal liner plates connected to form an inner lining for the shaft, an outer lining of concrete, water rings arranged outside of the concrete lining, and conduits embedded in the concrete for draining the water collected by said rings.

3. A mine shaft construction comprising a plurality of wrought metal segmental liner plates connected to form an inner lining, an outer lining of concrete, and a lining of corrugated sheet iron arranged outside of the concrete lining, said sheet iron being belled out beyond the wall of the shaft at points spaced longitudinally of the shaft in order to increase the bearing surface of the concrete lining.

In testimony whereof I have hereunto set my hand.

ROBERT V. PROCTOR.