contained within the utility vault or pit. Heavy covers can cause injury or other back problems to workers during removal and reinstallation of the covers.

Utility vault and pit covers are also made of plastic but these have limited application for use in areas where they are subjected to less load, i.e. green belt or yard applications. The problem with plastic lids is that because they cannot withstand substantial loads, they have limited applicability and plastic lids provide less coefficient of friction when wet versus polymer covers. Consequently a need exists for a new utility vault and pit cover design which is light in weight, yet is durable in that it can withstand substantial loads and provide improved slip resistance over currently available covers.

SUMMARY OF THE INVENTION

The present invention in an embodiment seek to provides an improved utility vault cover or lid which is manufactured from a fiberglass reinforced polymer matrix material producing a reduced weight and increased strength cover which is lighter, stronger, has improved UV characteristics and slip resistance and is less expensive to manufacture compared to existing cover designs. The lid or cover is used for vaults, pits, chambers or boxes and for ease of presentation shall all be referred to herein as a vault. Vaults are used in a number of industries including utility, security, gas and rail, for example, where they are underground, buried or at grade level.

According to a first aspect of the present invention, there is provided a method of manufacturing a fiber reinforced polymer material lid for an utility vault comprising the steps of: mixing an unsaturated polyester thermosetting material into a resin paste; compounding the paste into a fiber reinforced composite material sheet; maturing the compounded fiber reinforced composite material sheet; cutting the matured compound sheet into a charge pattern; molding the

charge pattern in a mold cavity of a heated mold under low pressure to form the lid; and cooling and machining the lid.

According to a second aspect of the present invention, there is provided a mold for molding a fiber reinforced polymer material utility vault lid comprising: a cavity die; a core die having a telescoping shear edge for interfacing the core die within the cavity die, wherein the lid is molded between the cavity die and the core die; and a lid ejection mechanism for removing the molded lid from the mold.

The fiberglass reinforced polymer matrix (FRPM) material is a fiber reinforced polymer material which consists of an unsaturated polyester thermosetting resin matrix, glass fiber reinforcement and inorganic or mineral filler. Additional ingredients are low-profile additives including a UV inhibitor, cure initiators, thickeners, process additives and mold release agents. The formulation undergoes a cross linking reaction when cured under heat and pressure. The fiber reinforced polymer material for the cover will retain its original material

properties and dimensional accuracy over a broad range of temperatures. The cover is on average fifty percent lighter than concrete and polymer concrete covers and sixty-five percent lighter than cast iron lids.

The fiber reinforced polymer material is made as a continuous sheet wherein a resin paste is transferred to a doctor box where it is deposited onto a moving carrier film passing directly beneath. Glass fiber rovings are fed into a rotary cutter above the resin covered carrier film. Chopped fibers are randomly deposited onto the resin paste. A second carrier film is coated with resin paste and is laid resin side down on top of the chopped fibers. The layers are then sent through a series of compaction rollers where the glass fibers are consolidated with the resin paste and the air is removed from the sheet. The fiber reinforced polymer material sheet is kept in a temperature room until the desired molding viscosity is reached.

When the polymer material is ready for molding it is cut into pieces of a predetermined size. The cut pieces are then stacked and assembled into a charge pattern that is the optimum shape and volume to fill a mold cavity. The mold is then closed and the polymer material is compressed. The mold is held closed for a predetermined amount of time to allow the cover to cure. After curing, the mold is opened and the cover is ejected from the lower mold surface with the use of integral ejector pins. The cover is allowed to cool to room temperature before any necessary machining operations. The manufacturing process can be automated through the use of robotics.

The manufacturing process includes low pressure molding in combination with a mold design which incorporates a steam pot to heat the mold, which may results in lower mold cost, lower material cost and faster cycle times. The mold design may allows for low pressure molding which provides faster cycle times resulting in lower production costs while producing a reduced weight and improved performance lid.

The cover consists of an uppermost surface which is flat and in its installed condition on the vault is even with grade. The bottom side of the cover or lid has an outer rim with a recessed interior area or cavity. The cavity includes features to allow for the attachment of accessories and thru-holes as required. The bottom of the lid has continuous support ribs spaced in the cavity to transfer load and minimize deflection under load to the outer rim. The outer rim is supported by the vault, frame or other type of supporting recess. In an embodiment, the ribs are uninterrupted for the span of the cavity to the rim to provide strength to the lid.

The uppermost surface of the cover lid has a texture or a surface condition created by a pattern of features at different depths. The change of depth of the flat surfaces creates a slight protrusion into the surface to push the glass component of the material away from the surface creating a resin rich surface. The top surface also has a series of bosses having shapes of varying heights to allow for aggressive transitions in the surface of the lid. These shapes are arranged in a pattern to allow for additional edge surfaces to grip moving surfaces which may come in contact with the top of the cover. The combination of the UV inhibitor, boss design and surface texturing may creates improved UV characteristics and prevents glass fiber blooming. The elevation of the bosses, spacing and angles, along with the texturing of the surface may enhances the coefficient of friction of the gripping surface resulting in improved slip resistance.

The cover or lid is designed to allow for installation of either an "L-bolt" or a "thru-bolt" for securing the lid to the vault. Self-latching locking assemblies can also be incorporated. The lid also incorporates features to allow for the installation of a pick hole retaining cup for use in removing the lid from the vault.

These and other features of the present invention will be more fully understood by reference to the following detailed description and the accompanying drawings.