Aug. 3, 1937. W. W. HAMILL 2,088,955

WALL AND LIKE PLUG

Filed Oct. 28, 1933

Fig. 1.

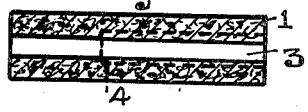


Fig. 2.

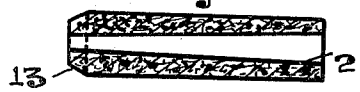


Fig. 3.

Fig. 4.

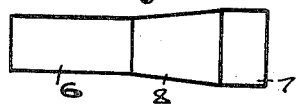


Fig. 5.

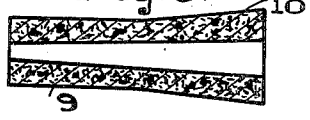


Fig. 6.

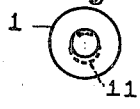


Fig. 7.

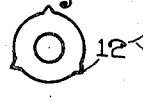


Fig. 8.

Fig. 9.

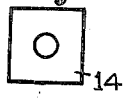


Fig. 10.

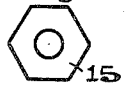


Fig. 11.

Fig. 12.

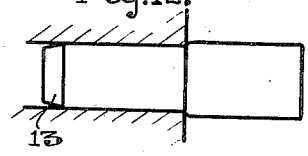


Fig. 13.

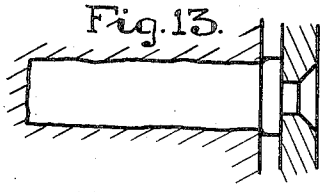
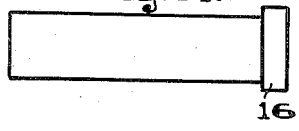


Fig. 14.



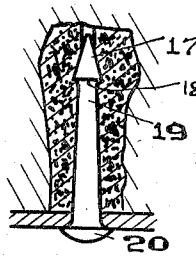


Fig. 15.

Fig. 16.

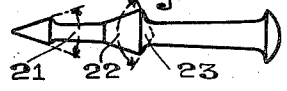


Fig. 17.

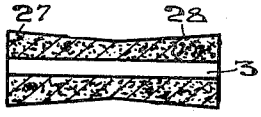


Fig. 18.

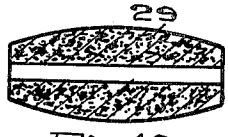


Fig. 19.

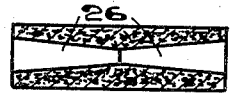


Fig. 20.

Inventor: William Wilson Hamill
By
Wm A. Davis. Attorney.

Patented Aug. 3, 1937 2,088,955

UNITED STATES PATENT OFFICE

2,088,955

WALL AND LIKE PLUG

William Wilson Hamill, Four Oaks, England

Application October 28, 1933, Serial No. 695,706
In Great Britain November 8, 1932

4 Claims. (Cl. 85—2.4)

This invention relates to plugs for insertion in walls, floors, ceilings, and other places for supporting objects therefrom or attaching them thereto.

Wall plugs according to prior proposals do not meet fully the desiderata of the subject since known wall plugs are liable to be affected by vibration, to set up local zones of high pressure intensity, and under certain conditions are liable to produce cracking, crumbling and/or disintegration of the medium in which they are inserted.

One object of the invention is the provision of a wall plug which possesses the quality of accommodation to irregularly-shaped holes; another object is to provide a wall plug which is not liable to be affected by vibration; another object is an improvement in pressure distribution over the periphery of the plug when in situ; and another object is the production of a wall plug in which economical industrial processes are utilized; other objects will appear from a perusal of the following specification.

My invention consists in a wall or like plug made of rubber and provided with a longitudinal cavity or aperture adapted to receive an instrument of expansion by which the process of fixing is effected in two stages in each of which a different property of the plug material is utilized: the first, a considerable elastic deformation and flow below the yield point; the second, virtual incompressibility. In order to secure a grip on the cavity which will enable the plug to withstand substantial loads without loosening, it is necessary firstly to enlarge the plug periphery so that the voids are removed and the cross-sectional spaces filled between the cavity bore and the plug periphery, and secondly to provide an instrument of expansion which will enable high expansive pressure to be obtained. Before the spaces are filled by flow of the rubber, there is no substantial grip, since expansive pressure is expended in deforming or changing the shape of the rubber; until the rubber is completely confined by the surrounding walls, the incompressibility characteristic of the rubber cannot be utilized to transmit the high pressure required for a secure grip. In the second stage, augmentation of hand pressure is needed to obtain high unit pressure between the rubber and the surrounding cavity walls. I therefore use as an instrument of expansion a device which provides a mechanical advantage as compared with pressure applied directly by the hand. A driving nail can be forced into the plug by percussive action such as that of a hammer, while a screw increases pressure by the advantage of the thread and that of the lever arm of the turning tool. It should be noted that before the second or pressure-applying stage can be reached, the cross-sectional area of the nail or screw plus that of the rubber sleeve must equal the cross-sectional area of the cavity bore.

Hitherto the irregularities of the hole have been undesirable but with my improved plug the periphery fits closely into the irregularities in the bore of the hole with a keying effect. The resilience of the rubber permits of a certain amount of yield without sensibly decreasing the grip, as contrasted with the loosening which accompanies non-resilient plugs in like conditions.

The high co-efficient of friction of rubber or the like assists in the production of an initial grip on the peripheral walls of the hole adapted to resist the turning tendency of the screw and such grip may be augmented by suitably shaping and/or dimensioning the exterior of the plug so that it requires to be deformed or compressed for insertion in the hole and thereby produces a resultant outward reaction when in place in the hole.

The shape or configuration of the plug in a lengthwise sense is susceptible of considerable variation as is also the hole through the plug and the cross-section of the plug examples of which will be described and illustrated.

My improved plug possesses other properties which render it particularly valuable for surface wiring and other electrical applications since it has a high di-electric value, is non-hygroscopic, and is therefore not liable to absorb moisture from the atmosphere. It can also be inserted in damp walls, advantageously with a protruding part or head as hereinafter described, without subsequently losing or suffering a noticeable diminution in its insulating value.

Though I have referred to the material of which the plug is made as rubber, I wish it to be understood that compositions used commercially and including various kinds and proportions of drugs, fillers, etc. in various degrees of hardness and elasticity, are included.

Various embodiments of the invention are illustrated in the accompanying sheet of drawings in which:

Figure 1 illustrates in sectional view one form of wall plug according to the invention.

Figure 2 shows a modification in the bore of the plug.

Figure 3 shows another modification in the bore.

Figure 4 is an elevation of a variation in the external configuration and Figure 5 is a sectional view showing another external variation.

Figures 6–10 indicate various cross-sections.

Figure 11 shows in transverse section in a diagrammatic manner the way in which the improved plug fits closely to the surface irregularities of an irregularly-shaped hole.

Figure 12 is a sectional view of a wall cavity with a partially-inserted slightly-oversize plug.

Figure 13 shows a plug expanded in situ so as to provide a cushion between the supported object and the wall face.

Figure 14 is an elevation of a construction of plug with moulded head.

Figure 15 illustrates sectionally a plug expanded by a driving nail in an undercut cavity.

Figure 16 shows another form of driving nail and Figure 17 a wood screw provided with enlargements, which may be used in conjunction with the improved plug.

Figures 18, 19 and 20 indicate other variations in the internal and external shape of the plug.

In the embodiment of the invention shown in Figure 11, the plug **1** is parallel throughout its length and is of constant cross-section such as circular annular as indicated in Figure 6, thereby lending itself to economical fabrication by the known process of extrusion in long lengths which are afterwards cut to the desired short lengths. The aperture running axially of the plug may be tapered as at **2** Figure 2 with the larger diameter at the outer end; or with a double taper having the smaller diameter at the middle as at **26** Figure 20; or may be parallel as at **3** Figures 1 and 18; or stepped with two parallel diameters as at **4** shown dotted in Figure 1; or moulded as a counterpart **5** of a wood screw Figure 3. The parallel hole is capable of formation also in the extruding process, but the tapered forms of hole have the advantage that they provide a lead for the nail or screw and thereby facilitate insertion of the screw and, additionally, reduce the tendency of the plug to rotate by turning of the screw at the commencement of expansion.

Most requirements are met by the parallel configuration of the outer surface, but the plug may be provided with an enlargement or head either at the inner end or at the outer end. The former makes it possible to use an undercut hole in the wall or the like since the plug can be compressed or reduced in external diameter or size when provided with a through aperture, and can be inserted in the hole in a contracted condition. Holes made by unskilled operators in the wall or the like are frequently bell-mouthed and a larger diameter at the outer end meets this condition. In Figure 4 the plug exterior comprises two parallel parts **6**, **7** connected by an intermediate taper part **8**; in Figure 5 the plug is made up of a parallel part **9** and a conoidal part **10**; in Figure 18 is shown a waisted plug comprising two conoidal parts **27**, **28** with the larger diameter at the extremities; and in Figure 19 a barrel shaped embodiment **29** is shown.

The aperture in or through the plug in the generality of applications is placed centrally though it may be in eccentric relation to the periphery of the plug as indicated at **11** Figure 6 for use when oscillation may occur or movement take place of the supported object about the axis of the plug; the aperture may stop short of the inner end of the plug, or as shown it may be continued therethrough. As generally a screw of the kind described as a wood screw will be used as the instrument of expansion, a former of similar configuration may be used as a core to form the threaded cavity or aperture in the plug and a plurality assembled on a moulding plate from which the moulded products can be removed by hand or by a mechanical device adapted to rotate the cores in groups or the whole batch in one movement. A region of higher radial pressure at the inner part of the wall cavity is obtainable by a suitable proportioning of tapered and parallel sections in respect of length and/or diameter, the objective being an enlargement of the plug periphery throughout its whole length but with lower pressure towards the wall or like face to lessen the risk of damage thereto.

To counter the rotational tendency of the screw during insertion, the exterior of the plug may be shaped to present corners or edges projecting more or less radially from the periphery of the plug. Longitudinal ribs **12** Figures 7 and 8 project outwardly beyond the general surface of the plug and are readily produced in an extrusion process by the provision of grooves in the die. Right hand threads being general in wood screws, it is advantageous to dispose one face of each rib on a radial line, and to provide a chamfered or bevelled end **13** Figures 2 and 12 on the entrant end of the plug to indicate the correct way of insertion. Or as shown the ribs may be positioned symmetrically about a radial line so that the plug may be inserted either way. The grade of rubber used has sufficient elasticity and deformability to allow the ribs to be flattened out and merge into the periphery of the plug when the screw or nail is driven home so as not to detract from the close fitting characteristic of the invention. Conveniently and generally, the annular plug has a cylindrical cross-section though for some applications, the cross-section may be other than that of a hollow cylinder; a polygonal form such as a square **14** Figure 9 or hexagonal **15** Figure 10 may be employed and fitted in a correspondingly shaped hole or in a hole of approximately circular cross-section. Other means for resisting torque consists in making the outside diameter of the plug slightly larger than the nominal size in order that the plug must be subjected to slight compression for insertion into the hole and by subsequent expansion against the bore of the hole may exert a slight initial grip thereon; such an embodiment is illustrated in Figure 12.

An enlarged cross-sectional view of a hypothetical hole showing the manner in which my improved plug adapted itself to and fits closely against the irregularities of the hole is the subject of Figure 11.

Excessive pressure which may result by continued overturning of the screw is safeguarded by the ability of the plug material to flow outwards and project from the wall face; such material as projects Figure 13 has the function of a resilient cushion particularly useful for brittle or easily fractured articles such as mirrors, light gauge metal articles, porcelain, etc. where overtightening is liable to cause cracking, breaking, straining, or other damage. If desired, the plug may be formed in the manufacturing process with a head or enlargement at the wall face end as shown at **16** Figure 14 corresponding in shape usually to the plug exterior, to provide a definite cushion between the object and the wall or other surface.

Where it is desirable to produce higher grip-

ping pressure at or towards the inner end of the plug, the instrument of expansion may take the form of a driving nail or a screw constructed or shaped to produce such effect and including one two or more enlargements for expanding the plug or bushing in the desired region or regions to a greater extent than in the remainder of the hole. Such a nail shape is shown in Figures 15 and 16 embodying a point 17 for easy insertion leading up to an enlargement 18 followed by a constriction 19 tapering up to the head 20. Conveniently the enlargement is of double conoidal formation with a steeper angle on the following side so that a non-return action follows the insertion of the nail or screw; the angle 21 included by the entering side may be say one half of the angle 22 included by the following side. In some specific applications, it may be desirable to arrange for a plurality of higher pressure areas, and one or more additional enlargements are therefore formed on the nail as at 23 Figure 16 situated say at the middle of the length of the nail, or as at 24 Figure 17 between the head of the screw and the first enlargement 25 next the end of the thread. By appropriate variation of the diameter and position of the enlargements, it becomes possible to vary the distribution of pressure along the length of the plug according to a curve which bears some resemblance to the outline of the inserted part of the nail, and this feature, unique in wall plugs, enables new effects to be obtained in the art. When driving home the nail or screw, a lubricant such as water may be used to facilitate passage along the bore of the plug.

Where considerable quantities are required, as for example by builders in the erection and fitting up of houses and other structures, long or continuous lengths may be supplied and cut to the required length, either before or after insertion of the plug in the wall cavity. In this application, the rubber is extruded in convenient lengths and vulcanized in a similar condition.

Rubber of appropriate quality or mix is compounded to provide the property of tenacity enabling the plug to yield and deform under the pressure set up by the instrument of expansion without splitting, crumbling, cracking, or disintegrating.

Instead of peripheral longitudinal ribs, serrations or knurling may be formed on the external surface of the plug to improve the initial and the final grip on the bore of the wall or like cavity.

Having thus described my invention, what I claim is:

1. A plug for insertion in a cavity formed in a wall, floor, ceiling or the like and including a soft rubber resilient element formed with a longitudinal bore and an expander to be inserted in and forced longitudinally of the bore of the element, the cross-sectional area of the rubber element plus that of the expander when partially inserted in the bore of the plug being not less than the aligned cross-sectional area of the cavity to thereby completely fill the cavity cross-sectionally at that point, the diameter of the expander having such relation to the diameter of the bore of the element that the further insertion of the expander gradually and progressively increases the diameter of the bore to thereby induce a flow effect in the material of the element and subject the element to gradually increasing high expansive pressure with respect to the wall of the cavity and thereby transmit to the peripheral surface of the element an expanding effect to cause the peripheral surface of the element to grip the wall of the cavity.

2. A construction as defined in claim 1, wherein the expander is formed within a portion of its length with a tapering enlargement, the larger diameter of which is greater than that of the adjoining portions of the expander, whereby to materially increase the expansive flow effect on the element in the transverse area of the element coincident with said enlargement and thus relatively increase the pressure effect of the expander within a selected region of the element.

3. A construction as defined in claim 1, wherein the bore of the element may be longitudinally tapering.

4. A construction as defined in claim 1, wherein the expander is formed at a selected area within its operative length with means to materially increase the pressure effect on the element coinciding with such selected area on the expander when the latter is in operative position.

WILLIAM WILSON HAMILL.