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PATENTED JAN. 3, 1905.

E. W. MOIR.

APPARATUS FOR FORCING LIME GROUT, CEMENT, OR THE LIKE.

APPLICATION FILED JULY 7, 1904.

2 SHEETS—SHEET 1.

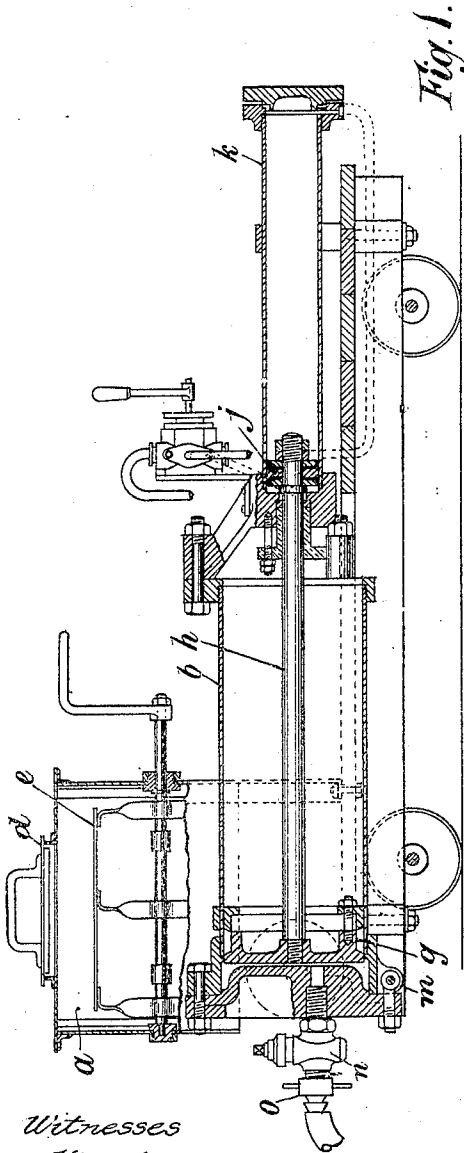


Fig. 1.

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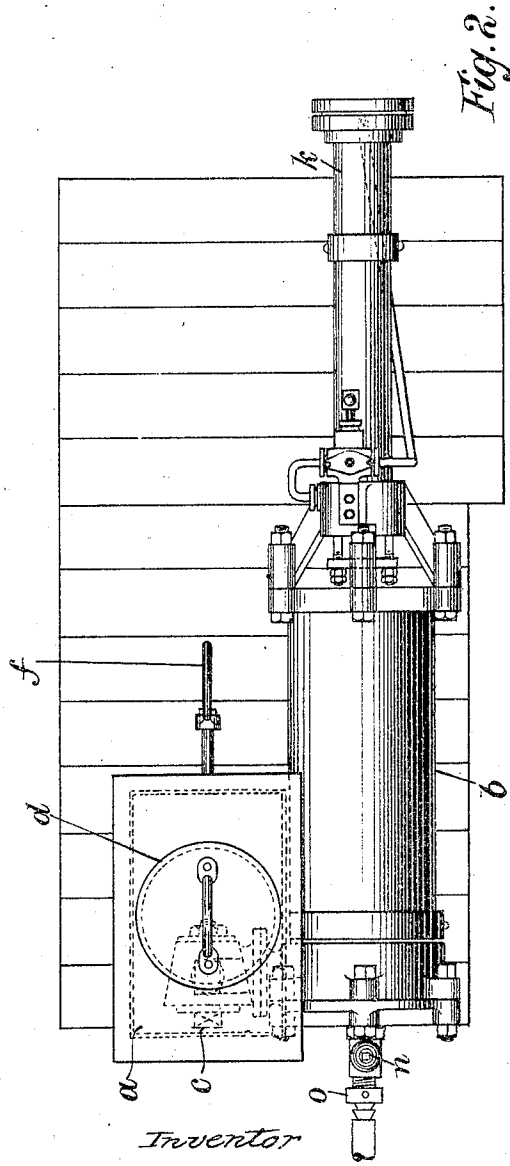


Fig. 2.

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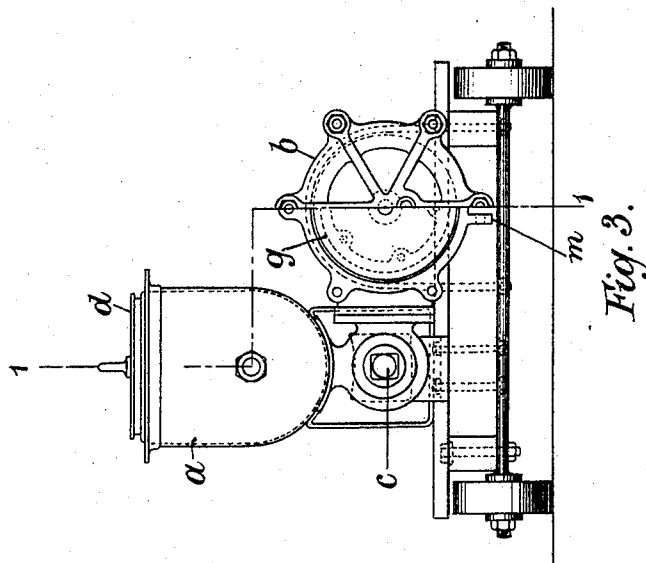
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Witnesses

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ERNEST WILLIAM MOIR, OF WESTMINSTER, ENGLAND.

APPARATUS FOR FORCING LIME-GROUT, CEMENT, AND THE LIKE.

SPECIFICATION forming part of Letters Patent No. 778,878, dated January 3, 1905.

Application filed July 7, 1904. Serial No. 215,890.

To all whom it may concern:

Be it known that I, ERNEST WILLIAM MOIR, M. Inst. C. E., of 10 Victoria street, Westminster, England, have invented a certain new and useful Improved Apparatus for Forcing Lime-Grout, Cement, and the Like; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to apparatus which is adapted to facilitate the supply under pressure of lime-grout, liquid cement, or other viscous fluids which have the quality of quickly solidifying for the purpose of filling up vacant spaces—as, for example, the spaces surrounding the metal sections which form the lining of tunnels of modern construction. According to the arrangements at present in use for this purpose in tunnel construction a mixing vessel is provided having a cover which is adapted to be opened to receive the materials which compose the grout and to be closed in an air-tight manner after the mixing has been effected. Air under considerable pressure having previously been forced into a reservoir by an air-pump driven by an engine or otherwise, a communication is made between the reservoir of air and the upper portion of the mixing-chamber, and the grout is thereby forced through a stop-cock opened for the purpose into a flexible pipe which leads to the place where it is wanted. Delay in starting the forcing of the grout or any subsequent cessation of the forcing which may occur before the vessel and delivery-pipe are emptied of their contents gives an opportunity for the partial setting of the grout and necessitates the provision of a very considerable pressure in the air-reservoir to overcome the initial resistance on starting or restarting, whereas a very moderate pressure will in general be sufficient to maintain the flow of grout against the normal working resistance. In consequence of this large, powerful, and costly air-pumping appliances are required, which are quite incommensurate with the average duty to be performed.

The merits of this invention consist, first, in the avoidance of the use of air-pumping

apparatus; second, in the substitution for this of hydraulic power which in general is provided for other purposes and which is readily available for this; third, in the much more economical employment of the power used, and, fourth, in the more rapid and practically-continuous delivery of the grout for the filling operation.

The accompanying drawings show a convenient and effective form of construction for carrying out this invention.

Figure 1 is a vertical longitudinal section taken along the line 1 1 in Fig. 3. Fig. 2 is a plan; and Fig. 3 is an end elevation, partly in section.

In the drawings, *a* is the mixing vessel, so placed that its semiliquid contents can gravitate to the lower-situated cylinder *b* to the left-hand end thereof, as viewed in Figs. 1 and 2, at suitable times on the opening of a stop-cock *c*. The mixing vessel has a large opening at the top for the insertion of the materials to compose the grout. This is fitted with a loose lid *d* to prevent the splashing of the contents when the mixer *e* is revolved by the cranked handle *f*. In the apparatus hitherto in use it is necessary for the lid of the mixing vessel to be adapted to be secured in a manner sufficiently air-tight to withstand considerable pressure. The liability to spilling of the cement-powder on the flanged surfaces tends to aggravate the time-expending character of this operation, so that its avoidance, which is an incidental advantage of this invention, is of not inconsiderable value in practice.

The cylinder *b* is fitted with a packed piston *g*, which by means of its attachment by the plunger-rod *h* to the piston *j* of the hydraulic cylinder *k* is adapted to be urged by water-pressure either to the left or to the right. The cylinder *b* is permanently open at the right-hand end, the left-hand end being closed by a door so fitted on a hinge *m* that it can be opened and closed expeditiously if after a period of rest it should be necessary to remove remnants of consolidated material or for the purpose of cleansing the cylinder after use.

The grout is admitted only to the left end of the cylinder *b* by drawing the piston *g* to the right, when after intimately mixing the

grout by the stirrer *e* the stop-cock *c* is opened. By the combined effect of gravity and atmospheric pressure the whole of the contents of the mixing vessel *a* will be rapidly drawn into the cylinder, and ordinarily the cylinder *b* will contain also a small volume of air.

Leading through the lower side of the door of the cylinder *b* is a passage commanded by a stop-cock *n*, adapted by a union *o* for the attachment of a flexible hose, whereby the grout is conducted to the place where it is required to be delivered under pressure.

To deliver the grout, the stop-cock *c* is closed and *n* opened, after which the piston *g* is forced from right to left. The first effect will be the compression of the air confined in the cylinder until a sufficient pressure is reached to force the grout along the delivery-pipe into the space to be filled. Inasmuch as the quantity of such air is small, only a small movement of the piston will be required to attain that sufficient pressure. The confined air will interpose itself as a cushion between the hydraulic press and the flowing grout and prevent undue pressure and shock. The operation of forcing the grout will accordingly be due to hydropneumatic action. While the delivery of one charge of grout is taking place another charge may be prepared in the mixing vessel and be ready for reception by the cylinder immediately the first is evacuated, or if longer time is required for effective mixing an additional mixing vessel may be provided similarly fitted on the other side of the cylinder *b*. By such means a nearly-continuous stream of grout can be maintained and the trouble of semihardened plugs of cement in the delivery-pipe avoided. At the end of the operation the delivery-pipe can be cleared of its contents by drawing a volume of air or water into the cylinder and discharging it through the delivery-pipe.

Inasmuch as a less force will be wanted to move the piston to the right than to the left—that is, less pressure will be required to draw the grout into the cylinder than to deliver it for use—a comparatively large plunger *h* is employed to connect the hydraulic piston *j* with the piston *g*, and thus economize the expenditure of water-power.

The apparatus is mounted on wheels to facilitate the movement required to follow the work to be done.

I claim—

1. An apparatus adapted to effect a mixing of materials to form lime-grout, liquid cement, or the like, and force it under pressure into cavities to be filled thereby, consisting of a mixing vessel, a cylinder and piston, a passage leading downward from the mixing vessel to

one end of the said cylinder, which passage is commanded by a stop-cock, a second passage, also commanded by a stop-cock, leading from the same cylinder end to the place of required delivery of the grout, and means for urging the piston along the said cylinder from and toward the end to which the grout is adapted to be admitted.

2. An apparatus adapted to effect a mixing of materials to form lime-grout, liquid cement, or the like, and force it under pressure into cavities to be filled thereby, consisting of a mixing vessel, a cylinder and piston, a passage, leading downward from the mixing vessel to one end of the said cylinder, which passage is commanded by a stop-cock, a second passage, also commanded by a stop-cock, leading from the same cylinder end to the place of required delivery of the grout, and means for urging the piston by hydraulic pressure along the said cylinder from and toward the end to which the grout is adapted to be admitted.

3. An apparatus adapted to effect a mixing of materials to form lime-grout, liquid cement, or the like, and force it under pressure into cavities to be filled thereby, consisting of a mixing vessel, a cylinder and piston, a passage, leading downward from the mixing vessel to one end of the said cylinder, which passage is commanded by a stop-cock, a second passage, also commanded by a stop-cock, leading from the same cylinder end to the place of required delivery of the grout, and a second cylinder fitted with a hydraulic plunger-piston, the plunger being connected to the first-mentioned piston.

4. An apparatus adapted to effect a mixing of materials to form lime-grout, liquid cement, or the like, and force it under pressure into cavities to be filled thereby, consisting of a mixing vessel, a cylinder and piston, a passage, leading downward from the mixing vessel to one end of the said cylinder, which passage is commanded by a stop-cock, a second passage, also commanded by a stop-cock, leading from the same cylinder end to the place of required delivery of the grout, a cover for the cylinder at this end adapted to be removed and replaced fluid-tight with facility, and means for urging the piston along the said cylinder from and toward the end to which the grout is adapted to be admitted.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ERNEST WILLIAM MOIR.

Witnesses:

N. J. LEIG,
OTTO MUNK.