(No Model.) 3 Sheets—Sheet 1.

H. P. McDONALD.

APPARATUS FOR CONSTRUCTING SEWERS, SUBWAYS, CONDUITS, &c.

No. 551,042. Patented Dec. 10, 1895.

Fig. 1.

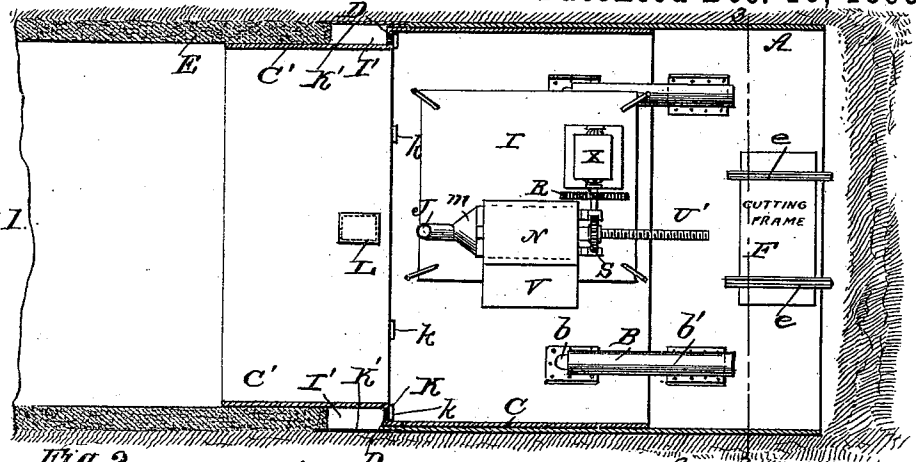


Fig. 2.

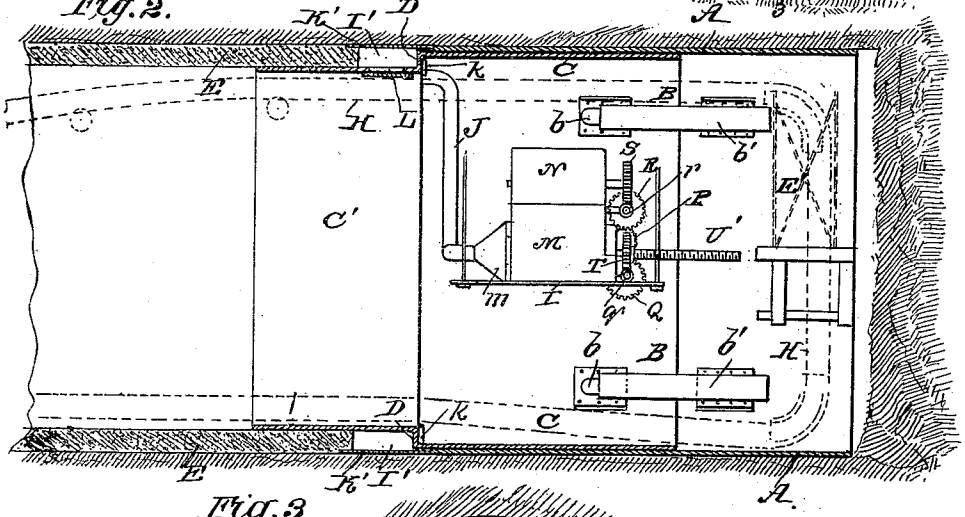
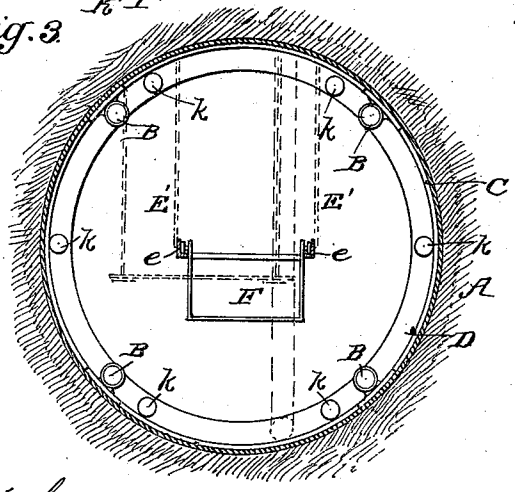


Fig. 3.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 4.

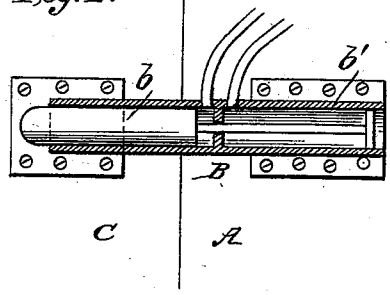

Fig. 5.

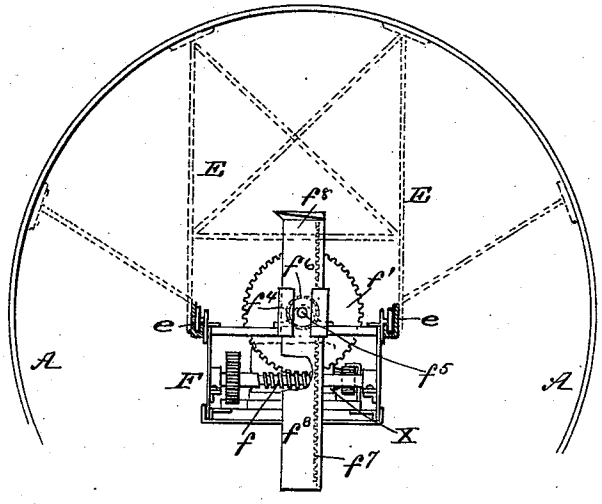

Fig. 6.

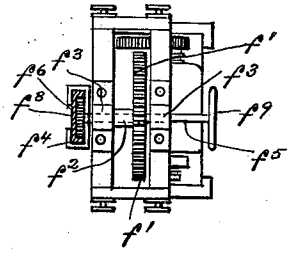

Fig. 7.

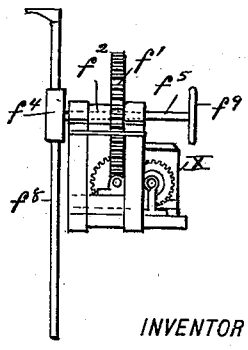

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Fig. 8.

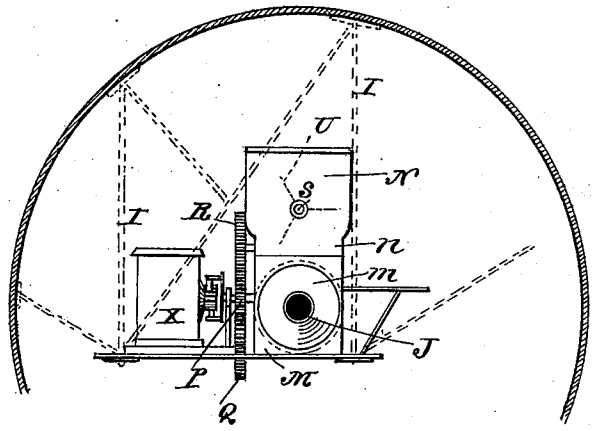


Fig. 9.

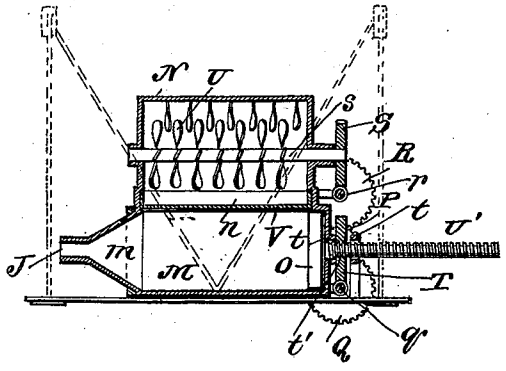
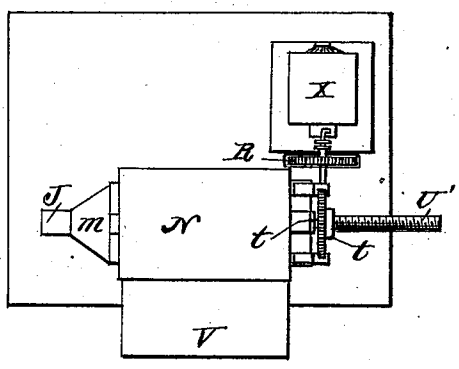


Fig. 10.



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UNITED STATES PATENT OFFICE.

HARRY P. McDONALD, OF LOUISVILLE, KENTUCKY.

APPARATUS FOR CONSTRUCTING SEWERS, SUBWAYS, CONDUITS, &c.

SPECIFICATION forming part of Letters Patent No. 551,042, dated December 10, 1895.

Application filed January 30, 1895. Serial No. 536,705. (No model.)

To all whom it may concern:

Be it known that I, HARRY P. McDONALD, residing at Louisville, in the county of Jefferson and State of Kentucky, have invented a new and Improved Apparatus for Constructing Sewers, Subways, Conduits, &c., of which the following is a specification.

My invention primarily has for its object to provide an improved means whereby sewers, subways, underground pipes, &c., can be economically, quickly, and effectively constructed.

It has also for its object to provide a mechanism adapted to simultaneously dig the trench or tunnel, temporarily sheath the same as it is being cut, and apply a permanent cement lining thereto.

Furthermore, it has for its object to provide peculiarly-arranged plunger or feed devices for setting the sheathing and for compressing the concrete as the sheathing and cutter-carrying means are forced forward.

A still further object is to provide, in connection with the cutting or digging mechanism, a carrier mechanism adapted to carry off the loose earth and at the same time bring into position for use the concrete for lining the walls of the trench or conduit.

With other objects in view, which hereinafter will be referred to, the invention consists in the apparatus hereinafter first described in detail, and then pointed out in the appended claims, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a portion of a subway or sewer with the general arrangement of my improved apparatus shown in an operative position therein. Fig. 2 is a horizontal section, partly in plan view, of the parts shown in Fig. 1. Fig. 3 is a transverse section taken on the line 3 3, Fig. 1. Fig. 4 is an enlarged detail view of one of the hydraulic-jack devices hereinafter referred to. Fig. 5 is an end view of the cutting mechanism. Fig. 6 is a plan view thereof; Fig. 7, an end view of the same. Fig. 8 is an end view of the concrete mixing and compressing mechanism. Fig. 9 is a plan view of the same, and Fig. 10 is a longitudinal section taken on the line 10 10 of Fig. 9.

In the practical application of my invention I employ means whereby the trench or conduit is dug, whereby the earth as it falls is carried off and the said trench or conduit sheathed as it is dug, for applying and compressing the concrete to the side walls of the conduit, and for feeding the concrete and forcing the sheathing and the cutting devices forward as the trench is being dug. Such results I attain preferably by the mechanism shown, which I shall now proceed to describe in detail.

Referring more particularly to Figs. 1, 2, and 3, in which the relation of the cutting, sheathing, and feeding devices are shown diagramatically, A represents an iron-shell cylinder or other form such as the sewer or conduit is intended to have. C represents a second shell of a cylindrical or other shaped body held to fit telescopically but loosely within the cylinder A, which has an offset D, its depth representing the thickness of the concrete E, which forms the permanent internal wall of the conduit. In the practical construction thereof these shells are formed in sections, (not shown,) so that they may be readily taken apart or put together.

Within the cylinders A and C are disposed a number (preferably four) of hydraulic jacks B, the piston members b of which are fixedly secured to the inner shell C, while the cylinders b' are secured to the shell A, and such jacks are so arranged that pump connections may be readily made therewith for the introduction of oil, water, or other liquid, either before or behind the pistons, for the purpose of driving forward the shell A and forcing the shell C backward against the concrete in the manner presently fully described.

In the front end of the shell A is secured a pendent framing E', having a trackway e e, on which is held to travel a carriage F, upon which is mounted the cutting devices and the driving mechanism therefor, such cutting devices being shown in detail in Figs. 5, 6, and 7, by reference to which it will be seen the same comprises a worm-gear f, mounted on the carriage F, which drives a large gear-wheel f', which is fixedly held on a hollow shaft f^2, journaled in bearings f^3, and provided at its forward end with a tool-holder f^4. Within this hollow shaft is fitted a second shaft f^5, upon one end of which is secured a pinion f^6, held to mesh with a rack portion

f^7 on an arm f^8, which has the cutting-tool and which in turn is held in the tool-holder f^4, such shaft f^5 having a suitable hand-wheel f^9, the manipulation of which will serve to set the arm cutting backward or forward to suit the diameter of the shell A. It will thus be seen that as the main wheel f' is driven (which is done, preferably, by an electric motor X held on the carriage F) the cutter will be rotated in the arc desired, it, owing to the rack and pinion devices, being capable of a quick adjustment to cut as may be necessary.

So far as described it will be manifestly clear that, assuming the conduit or subway to have been partially made, as in Figs. 1, 2, and 3, by starting the motor X and moving the cutter up to the earth the same will sweep in a circle and cut away the earth to a diameter equal that of the shell A.

H indicates an ordinary rope conveyer driven in an ordinary manner, which travels inward at the top of the shells A and C and the finished conduit or subway portion and extends to the front end of the shell A, from whence it passes vertically downward and then rearward, as shown, such arrangement of the carrier being provided for two purposes—first, to carry off the earth rearward to a suitable discharging-point, and, secondly, for bringing inward within the shells the concrete material to a point over the mixing and concrete-discharging devices shown most clearly in Figs. 8, 9, and 10.

By referring now to the aforesaid Figs. 8, 9, and 10 it will be seen that about centrally of the shell A is secured a pendent frame I, upon which is mounted a cylinder M, on the top of which is mounted a deep trough N, which serves as a receptacle into which the concrete material brought in by the conveyer or carrier H is to be mixed.

The cylinder M and the trough N communicate at a throat portion n, over which is held a slide V. Upon the frame I is mounted a motor, preferably electric, the drive-shaft of which has a spur-wheel P, which meshes with two cog-wheels R and Q, the axles of which have worm portions r and q, respectively, which mesh and communicate motion to cog-wheels S and T, one of which, S, is fixedly secured upon a shaft s, journaled in the mixing-chamber, and which has connected therewith a series of stirring-blades U, which are adapted to sweep between similar blades secured to the sides of the chamber N.

The wheel T is held between fixed bearings $t\,t$, and has its aperture formed with internal threads t', whereby it will act when rotated as a drive-screw for the screw-shaft U′ of a plunger or piston-head O, which fits the cylinder M.

The cylinder M is open at one end and discharges into a contracted or funnel-shaped mouth m, to which is connected a feed-pipe J, which may be flexible or jointed in such a manner that its discharge end can be connected with any one of a series of openings K in the offset portion D of the shell C, which openings have flap members k, whereby such openings are held closed when not in use with the pipe J.

The reduced or rear extension C′ has near the offset D a number of band-holes L, preferably three, to admit of the introduction of iron bands, which may be built in the concrete at such intervals as may be necessary to strengthen the concrete lining where it is necessary to use the sewers, subways, or underground conduit pipes to sustain a high pressure.

When my invention is applied for use in very loose ground, which is disposed to cave in, a supplemental rim K′, of very thin iron or other material, is employed, which is attached to the shell B and shouldered so as not to increase the diameter thereof, which rim extends rearward over the space I′ and prevents any loose earth falling into such space. When working hard ground, this rim K′ may be dispensed with.

While I have not shown a pump mechanism it is manifest that any suitably-arranged means may be provided for forcing the water and withdrawing the same alternately to operate on the hydraulic jacks in reverse directions.

The complete operation of the apparatus is best explained as follows: Assuming the parts to be in the position shown in Figs. 1 and 2, after the earth has been cut away from in front of the shell A a distance shown in Fig. 1 the pump (not shown) is put in motion to force the shell A forward up close to the end of the conduit, it being understood that during this operation the shoulder or offset portion of the shell C bears against the concrete lining B. The hydraulic action on the jacks is then reversed and the shell C drawn forward, so as to make it enter again into shell B and thereby leave a vacant space I′ ready to be filled by concrete, which is done as the cutters again operate, and the carrier H carries off the loose earth in the following manner: Supposing the material for the concrete to be falling into the receptacle N, the motor being started and the wheels S and T being thereby rotated, the blades in the receptacle N will thoroughly mix the cement as the plunger in the cylinder M presses forward and forces the previously-mixed concrete held therein out through pipe J, through any one of the openings K′, into the space I′. After the plunger has traversed the length of its stroke the motor is reversed and the motion of the stirring-blades and the plunger are also reversed. By the time the plunger reaches the other end the concrete in the receptacle N will have been suitably mixed. The slide V is then drawn out to allow the mixed concrete to drop into cylinder M. The slide being again closed, further material is allowed to fall into receptacle N, while the plunger again moves forward, such operation being repeated. While I prefer to employ electric

power to operate the mixer and feeder devices and the cutting mechanism, it is obvious compressed air or rotary engine power may be used in place thereof. After the space I′ is properly filled with concrete and the shell A held up against the end wall of the conduit the hydraulic power on the jacks is set to force the shell C rearward to compress the cement with the offset portion D.

When it is necessary to change the grade or direction of the sewer, conduit, &c., the application of power to two of the jacks B would serve the purpose by forcing one side forward and leaving the other stand, thus changing the direction of the machine. This can also be assisted by cutting away more earth in the direction in which it is intended to turn.

The band-holes L may be of any form and number convenient and provided with coverings, if desired.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. As an improvement in means for constructing sewers, conduits and the like, a pair of telescopic shells, the rear one of which fits within the forward one, and has an annular shoulder adapted to press against the lining of the conduit, and means for forcing the said sections independently forward or simultaneously in opposite directions, as and for the purposes described.

2. As an improvement in means for constructing sewers, conduits and the like, the combination with the outer shell, A and the inner shell C having an annular offset portion D, and a rear extension adapted to fit the interior diameter of the finished part of the conduit or sewer, said portion D having one or more openings, of a concrete mixing and distributing mechanism, having a feed pipe adapted to have its discharge end connected with the opening in the said portion D of the shell C, as and for the purposes described.

3. In a means for the purposes described, the combination with the telescopic shells, the cutting mechanism, and concrete mixing and distributing devices, of a movable carrier held to travel inward at the upper end of the shells and to dump as it passes inward at a point over the concrete mixing devices, and to pass downward at the cutting end of the front shell and then rearward at the lower end of the shells, whereby to carry off the loose earth, as hereinbefore described.

4. In a means for the purposes described, the combination with the shells A and C, the jacks E connected therewith, said shell C having a rear portion of a diameter to fit the finished part of the conductor sewer, and an offset D, and provided with openings L substantially as shown and for the purposes described.

5. In a means for the purposes described, the combination of the shells A and C, the shell C having an offset D and a rear extension of a reduced diameter, and the supplemental annular rim members K all arranged substantially as shown and described.

6. In a means for constructing sewers and the like, the combination with devices for feeding the concrete to the side walls of the passage in the earth, of a forward shell telescopically joined, of a diameter equal that of the passage made by the cutting mechanism, the rear shell having a rearwardly extending portion of a diameter less than the cut passage, adapted to form a temporary support for the green concrete or brick lining, and movable forward with the body of the rear shell substantially as shown and described.

7. In a means for constructing sewers, conduits, &c., substantially as described, the combination with the shell A, of a cutting mechanism held therein comprising a movable carriage, a cutter arm having a cutting tool radially adjustable thereon and means for operating such mechanism, substantially as shown and described.

8. As an improvement in a means for the purpose described, a cutting mechanism comprising a movable carriage, a horizontal rotary shaft journaled thereon, having a tool arm carrier, means for rotating the shaft, a tool arm held for vertical movement in the said carrier and mechanism for adjusting the said arm in the aforesaid carrier, as set forth.

9. As an improvement in means for the purpose described, the combination with the shell sections A and C, and the carrier H, of a concrete mixing and distributing mechanism comprising a mixing trough, having stirring devices held therein, a cylinder open at one end, connected with the trough by a throat portion, a slide valve operating over such throat portion, a feed pipe connected with the open end of the cylinder, a reciprocating plunger operating in such cylinder and means for operating the stirring devices and the reciprocating plunger, all arranged substantially as shown and described.

HARRY P. McDONALD.

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ALFRED JOSEPH.