

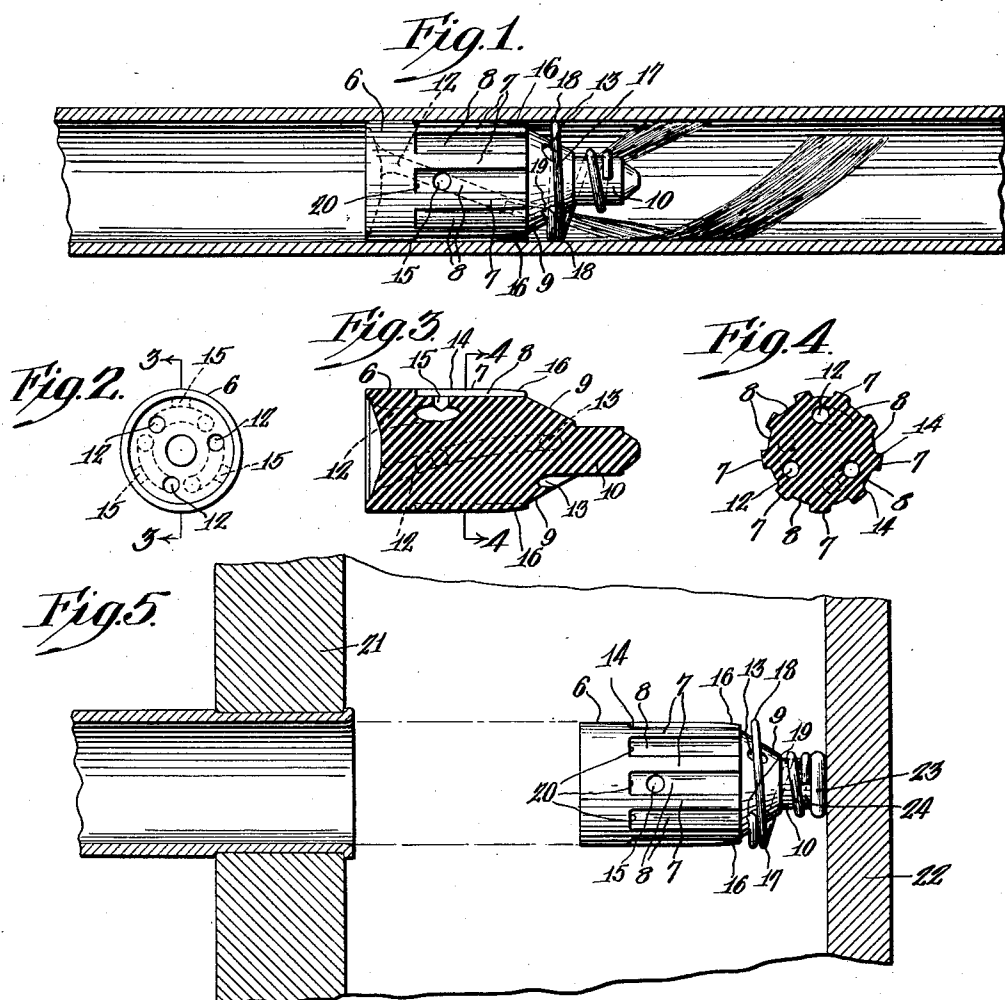
Dec. 8, 1931.

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1,835,119

ROTARY SLUG FOR CLEANING TUBES

Filed Oct. 13, 1927



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ROTARY SLUG FOR CLEANING TUBES

Application filed October 13, 1927. Serial No. 225,968.

My invention relates to slugs or plugs, preferably of rubber, intended for cleaning tubes, and finding their greatest usefulness at the present time in the cleaning of condenser tubes.

One of the purposes of my invention is to provide a slug having approximately straight fluting with a rear seal against the tube interior to facilitate driving and with diagonal through passages to cause rotation of the slug, so that the straight fluting will have a scouring effect upon the interior of the tube.

A further purpose is to provide a slug with a rear circumferential surface approximately fitting the interior of the tube and with supporting ribs extending forwardly from this surface for the purpose of keeping the slug straight and of performing a cleansing function upon the tube at the same time.

A further purpose is to provide a rubber slug with fluting parallel with the axis of the slug and with air passages discharging in the flutings to clean the flutings out as the slug advances and rotates.

A further purpose is to use longitudinally extending flutings in a rubber slug approximately in the same way that spiral flutings would be used by automatic rotation of the slug as it advances.

A further purpose is to mount a scraping or scouring member upon a forwardly projecting portion of the slug, of approximately uniform diameter, so as to make it easy to apply and remove this metal scraper and to extend the projecting portion of the slug beyond the scraper, thus preventing displacement of the scraping element by the bulging of the projecting portion when striking against an object.

A further purpose is to rotate a slug for condenser tube cleaning by passage of the driving fluid through the slug, to utilize the discharge of the driving fluid for loosening of foreign matter in advance of the slug and to scour the interior of the tube immediately back of the application point of discharge by fluted surfaces whose rotation makes them more effective.

I have preferred to illustrate my invention by one form only among the various forms

in which it may appear, selecting the form which is practical, highly efficient, reliable and relatively inexpensive and which at the same time well illustrates the principles involved.

Figure 1 is a longitudinal section of a tube containing one of my slugs.

Figure 2 is a rear elevation of the slug seen in Figure 1.

Figure 3 is a central longitudinal section of the slug taken upon line 3—3 of Figure 2.

Figure 4 is cross section of Figure 3 upon line 4—4.

Figure 5 is longitudinal section of the front end of a condenser showing the termination of a tube in a header.

In the drawings similar numerals indicate like parts.

My slug is made of rubber, preferably as pure as possible, except for such filler as is required to give the slug the required "body" and firmness. It comprises, exteriorly, a rear cylindrical tube-engaging sealing portion 6, longitudinally extending ribs 7 forming the flutings 8 between them, and a forwardly extending, preferably tapered, end portion 9 terminating in a nipple 10.

The extreme rear portion of the slug is preferably recessed from the rear to direct the driving fluid into spiral passages 12 extending through the slug and coming out in the tapered portion 9 of the slug at 13. The purpose of these passages is twofold: (a) The driving fluid, whether air, steam or water, strikes the diagonal walls of the passages and discharges in a slightly diagonal direction, causing rotation of the slug with consequent scouring action of the edges 14 of ribs 7; and (b), the discharge of the fluid tends to loosen foreign matter from the interior surface of the tube in advance of the slug and, where steam or water is used, moistens the interior of the tube and thus prepares the tube for more thorough cleansing action than could otherwise be obtained from the slug.

During this scouring rotation and movement of the slug some of the grooves or flutings 8 are cleansed of material, which they have scraped from the interior of the tube, by discharge of the driving fluid through

them by way of openings 15 extending from passage 12 into the flutings and hence through the length of the flutings into the tubes in which the slugs are used.

5 To facilitate the introduction of the slugs to the tubes, the front ends of the ribs 7 are slightly reduced in diameter at 16.

For most of the work to be done by these slugs, a slug as already described is complete and is fully operative. For tubes that are 10 particularly dirty, however, or in which the dirt is hard to remove, it is desirable to utilize a metal scraper 17, which I show as of generally conical spring form. The outside 15 surface of the spring at 18 is made to fit the interior of the tube so as to spring against it and effectively scrape it as the slug advances.

The scraper 18 is wound somewhat smaller 20 in diameter than the nipple 10, so that, when the spring is forced over the nipple, it will fit the nipple. The spring may be held against rotation, where this is desired, by engaging one end 19 of the spring with one of 25 the discharge outlets 13 of the passages 12.

In operation:—During most of the time the spring is not used. The slug is inserted within the end of a tube and is driven through the tube usually by air, steam or water. As 30 the cylindrical rear portion of the slug tightly fits the interior of the tube, substantially no driving fluid passes the outside of the slug, but enough of it flows through the passages 12 to cause rotation of the slug so that 35 the advancing edges 14 and 20 of the ribs are caused to scrape the interior surface of the tube. The extent of this scraping action may be predetermined by the tightness of the fit of the ribs against the tube surface. In practice I have obtained very excellent results 40 with the rear end of the slug and the ribs the same diameter, about fifteen thousandths of an inch larger than the inside tube diameter. This is not intended as a limitation but 45 is merely explanatory.

Whatever the driving fluid, it may be caused to discharge into some of the flutings between the ribs, cleaning them, and by its discharge through the passages 12 the fluid 50 tends to clean the less tightly held dirt from the tube beyond the slug. In addition to this, if the driving fluid be steam or water, the tube is moistened by the discharge, thus further facilitating the cleaning operation.

55 As the tubes terminate in the tube-sheet 21 of a header (Figure 5), the slugs directly impinge upon the header cap 22 when they come out of the tubes. Where a scraping ring is used as shown in Figures 1 and 5, it is 60 necessary to protect against loosening the ring from the slug during impingement.

With my construction as shown, I take care of this by the extension of the nipple 10 so that the slug emerges from the tube and 65 strikes the cap 22. The nipple is compressed

and therefore enlarged at 23 in front of the ring portion 24, by which the metal scraper is mounted upon the nipple, causing the nipple to bulge greatly in front of the holding portion of the spring and preventing the scraper 70 from being driven off the slug.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the 75 art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such in so far as they fall within the reasonable spirit and scope of my invention as claimed. 80

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

1. A rubber slug for cleaning condenser tubes having a rearward cylindrical portion, 85 an intermediate portion and integral ribs on its intermediate portion, said ribs extending substantially parallel to the slug axis and being a substantial continuation of said rearward portion at the outside surface thereof. 90

2. A rubber slug for cleaning a condenser tube, said slug having a rearward generally cylindrical portion and an intermediate portion 95 externally fluted from said rearward portion to its forward end, the forwardly extending flutes being substantially parallel to the axis of the slug and the slug having an aperture extending from the rear end forwardly 100 along a spiral line to enable the driving fluid passing through the aperture to cause rotation of the slug.

3. A rubber slug for cleaning a condenser tube, said slug having a rearward cylindrical portion, an intermediate portion and a 105 forward portion of reduced section, said intermediate portion having external flutes throughout its length substantially parallel to the axis of the slug and the slug being apertured spirally from the rear into the flutings. 110

4. A rubber slug for cleaning a condenser tube, said slug having a rearward cylindrical portion, an intermediate portion and a 115 forward portion of reduced section, said intermediate portion having external flutes throughout its length substantially parallel to the axis of the slug and the slug being apertured from the rear into the flutings and spirally from the rear to the forward end of the slug.

5. A slug having a body comprising a rearward cylindrical portion, an intermediate 120 portion and a forward portion of reduced sectional area, said forward portion including an approximately cylindrical forward extension for mounting a scouring implement, said extension being throughout its 125 length of diameter materially less than that of the body and said body having an aperture from its rearward end to its forward end opening laterally of said extension. 130

6. A rubber slug having a body comprising rearward, intermediate and forward portions, said forward portion including an approximately cylindrical forward extension extending from the forward portion and of considerably less diameter throughout its length than the diameter of the body, and a scraper mounted upon the extension back of the forward end thereof.

7. In a slug for condenser tubes, a rubber slug body, a rubber extension therefrom in advance of the slug and of approximately uniform diameter, and a scraper mounted upon the extension in proximity to the slug body tightly engaging the extension back of its front end and thus adapted to be held to the slug by enlargement of the front end of the extension brought about by striking of the extension against a restraining surface.

8. In a slug, a rubber body having a rearward cylindrical portion, an intermediate externally longitudinally fluted portion and a forward portion of reduced section, walls forming a fluid passage from the rear end of the body into the rear end of one of the flutings and a scraper mounted upon the forward portion.

9. In a rubber slug, a body having spiral passages through the slug from the rear, a forward extension from the body and a metallic scraper mounted thereon adapted to engage the tube in advance of its engagements by the slug.

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