SPRING SLUG FOR CONDENSER TUBES

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My invention relates to slugs for cleaning condenser tubes and the like, to be driven through the tubes by compressed air, steam or water.

5 A purpose of my invention is to mount a metal scraper circumferentially upon a resilient support.

A further purpose is to resiliently press a circumferentially extending scraper outwardly during the passage of the slug by a resilient backing material, the driving fluid or by both.

A further purpose is to have the scraper preferably comprise a helical metal spring having its helical axis wound around the slug, and preferably twice around the slug. A further purpose is to press a metal scraper outwardly by wedge action between the scraper and a slug during passage of the slug.

A further purpose is to press the scraper outwardly by its own resilience when radially compressed.

A further purpose is to apply a spring to scraping duty by resiliently supporting it from a rubber slug.

A further purpose is to scrape by the diagonal strands of a spiral spring, using the spacing between the turns of the spring as clearance for better breaking up of the material removed.

A further purpose is to secure all of the advantages of such a rubber slug as shown in my application for method and apparatus for cleaning condenser tubes, Serial Number 572,570, filed July 3, 1922, with the additional advantage of a metal scraper carried by the reduced external surface of the slug removed.

A further purpose is to provide desirable modified forms of scraper.

A further purpose is to rifle the bore of a slug in order to make its action more effective.

My invention relates to the methods involved as well as to the structure shown by which the methods may be carried out.

Further purposes will appear in the specification and in the claims.

I have preferred to illustrate my invention by one main form only, with minor modifications, selected because the form is practical, efficient, inexpensive and simple in manufacture and at the same time well illustrates the principles involved.

Figure 1 is a fragmentary longitudinal section of a tube and a slug in the tube.

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

Figure 2 is a view similar to Figure 2 but showing modified form of scraper.

Figure 3 is a side elevation of a slug carrying two scraping springs fastened together.

Figure 4 is a section of Figure 3 taken above the point 4-4 thereof with the fastening in elevation.

Figure 5 is a side elevation and Figure 6 is a section upon line 6-6 thereof showing a slug carrying a modified form of scraping spring.

Figure 7 is a side elevation and Figure 8 is a section upon line 8-8 thereof showing a different form of connecting means for the ends of the spring from that shown in Figures 4-1.

Figure 9 is an enlarged longitudinal section of a part of Figure 8.

Figure 9 is a section corresponding in position to 8-8 of Figure 7 to an enlarged scale and showing a different form of connecting means for the ends of the spring.

Figure 10 is a longitudinal section of a slug provided with a modified form of spring scraper.

Figure 11 is a fragmentary side elevation showing a convenient tool for feeding a spring ring on to a slug, and showing the rifling of the slug's bore.

Figure 12 shows the spring used in Figure 10 extended.

In the drawings similar numerals indicate like parts.

Describing in illustration and not in limitation and referring to the drawings—

In order to illustrate the applicability of my invention to slugs of my application above mentioned—in addition to other types of slugs with which it is obviously capable of use—I have shown the body 15 as of the same general character as that shown in my prior application. This body, usually rubber or other elastic material, comprises a nearly cylindrical portion 16 of less diameter than the tube 17 to be cleaned, carrying a flange or flanges at both ends. In the illustration I show forward and rear flanges, 18 and 19 respectively.

The rear flange is hollowed from the rear at 20 to admit fluid pressure into its interior to swell the slug during its passage through the tube, and the hollow 20 as shown in the illustration preferably extends forwardly to longitudinally perforate the slug to permit
limited passage of the driving fluid for cleansing purposes. When made tubular it is desirable also to forwardly taper the passage 20, as shown, which prevents material fall in fluid pressure until near the forward end of the slug. It is desirable to provide, i.e., spirally flute (rib or groove) the interior of the slug, as illustrated in Figures 1, 2, 7, 8, and 11.

10 The exterior wall 21 of the intermediate portion 16 rearwardly flares at 22 into the rear flange 10 so that a spring ring 23 encircling the intermediate portion of the body is expanded during passage of the slug by wedge engagement with the flare portion 22, tightening the spring ring against the interior 24 of the tube.

The scraper used is preferably a spiral spring ring, as shown at 25 wrapped around the slug with ends fastened together. This ring may make a single turn as shown in Figure 2 but more desirable is wound twice around the slug as seen in Figures 1 and 2, or it is a composite spring formed by fastening together two or more single springs, as illustrated in Figures 3 and 11. The individual spirals of the spring are somewhat diagonal to the direction of movement of the slug, so that each spring ring comprises circumferentially spaced diagonal scraping members carried by the slug.

In Figure 5 a metal ring 23', preferably wound twice around the slug, is shown having open ends at 25 and capable of serving the general purpose of the spiral spring ring 23. The open ring 25 may be of size initially to scrape any predetermined portion of the full interior circumference of the tube, and need not be of spring material though spring material offers an advantage in permitting the ring to yieldingly press outwardly by its own resilience. The ring being open can accommodate itself to interior pressure, being resiliently swelled into contact with the tube walls by wedge engagement with the flare 22 or by swelling of the slug by interior fluid pressure.

An advantageous form of spring is that illustrated in Figures 10 and 12. Here a spiral portion, sufficiently long to make one turn about the slug, lies between straight portions which hook together after making the second turn.

The form having a single turn is preferably provided with more steep approach 29' to the flange 10, than need be the case with the other forms.

The metal scraper, whether a spiral spring or an open ring, is resiliently supported upon the material of the slug and to a reasonable extent can bite in to accommodate an obstruction in the tube or to pass through a tube of relatively small diameter.

Normally wedge engagement between the scraper and the body of the slug and radial expansion of the body portion increase the compression of the scraper against the interior wall of the tube. The radial expansion of the body portion during passage through the tube arises not only from admission of the driving fluid into the slug interior but also from longitudinal driving compression of the slug.

The rear flange of the slug desirably operates both to limit rearward motion of the slug and as a wiper, the pressure of the driving fluid when it is made large enough for use as a wiper forcing it into tight engagement with the interior of the tube. Obviously the latter function may be alternatively dispensed with to afford a passage of driving fluid past the scraper to sweep loosening dirt forward about the circumference of the slug, through the spring and out of the way of the plug.

The desirability of having the rear flange serve as a wiper or of having it sufficiently small to permit sweeping passage of the driving fluid through a spiral spring scraper will depend upon the character and quantity of dirt present; and in certain cases it may be advantageous to have the wiper form follow the other for final cleaning. Normally however tubes are satisfactorily cleaned after a slug has passed through only once.

The forward flange 18 may advantageously form a forward wiper as seen in Figure 1. It serves an important function in retaining the rings on the plug. Where these functions are not desired or are attained in other ways it may be omitted.

A plurality of rings may be carried by a single slug to secure the advantage of additional scraping, as seen in Figure 3. Preferably these are fastened together as shown. Where the scraper ring is formed from a spiral spring, the ends of the spring have to be fastened together and I show several ways for doing this. In Figures 1–4 the ends of the spiral coil are fastened together by threads, cord or wire, the turns of which pass in and out from one end to the other to unite them.

In the form shown in Figures 7 and 8, a double coupling member 28 extends oppositely from the joint into each of the ends to engage its hook terminals 29 between portions of the wire. The hooks are held in position by pressure radially through the engagement of the back 30 of the coupling with the interior wall 31 of the spiral spring opposite to that portion 32 of the spring in which the hooks are engaged. These couplings can be sprung into position by forcing the hooks past the individual turns of the coil over each of which the hook will latch because of the pressure of the coupling at 30 against the interior surface 31 of the spiral spring. It will be noted that the curva-
ture of the complete joint may be made to conform substantially to the curvature most desirable for the coil, agreeing nearly with the interior contour of the tubes to be cleaned.

In Figure 9 a double-threaded plug 33 is shown, having tapered threads 34 and 35 to be screwed into the ends of the spiral spring. In placing this plug, it is screwed into one end and the plug and the opposite end of the spiral are then turned in a direction opposite to that for screwing them together, enough to thread the spring to the plug at its other end during spring retraction.

Because of the taper of the plug the outer contour of the spiral spring at the joint circumferentially of the length of the ring may be made to agree very nearly with that of the interior of the tube to be cleaned.

The spiral springs may be fed to place as seen by the use of a tool seen in Figure 11 where the tapered plug end 36 provided with a pin 41 is placed against the end of the slug with the pin 37 within the opening 20. The spiral 23 may be slid up the sloping surface 38 of this plug and over the front end of the slug.

In view of my disclosure herein other forms of practicing my invention will obviously occur to those skilled in the art, either better suited to the particular use intended by the designer or suiting merely his whim or preference, or for the purpose of appropriating my invention unfairly, and it is my purpose to include herein all such variations of my invention, whether securing the advantage of the invention entirely or not, as come within the spirit and scope of my invention.

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

1. A rubber slug having a rear flange and increasing in diameter from a point near the rear to the flange to form the flange, and a contractile and expansible scraping ring on the smaller part of the slug in front of the flange.

2. A rubber slug hollow at the rear, a rear flange thereon, and a contractile and expansible spring scraping ring circumferentially mounted on the slug in front of the flange.

3. A slug of resilient non-metallic material having a flange and hollowed in said end, the hollow extending to and beyond said flange and a contractile and expansible scraper ring of spiral spring material on the slug in front of the flange adapted to be expanded by the flange and by the expansion of the slug about the extended hollowed portion.

4. A slug of resilient material flaring at one end and hollowed from the rear, and a spiral spring ring expansible scraper on the flare and surrounding the slug.

5. A slug having a rear flange and a forwardly facing slope between the flange and the smaller part of the slug and a spiral spring ring scraper surrounding the smaller part of the slug and adapted to be expanded by wedge action of the slope.

6. A spiral spring ring for condenser tube scraping in combination with uniting means for the adjoining ends of the rings comprising a double latch adapted to snap into both ends of the spring and rest on the side opposite to the latching portions against the interior walls of the spiral spring.

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