Aug. 6, 1957 B. RANDRUP 2,801,432

ROTARY CLEANING DEVICE

Filed May 13, 1952

Fig. 1

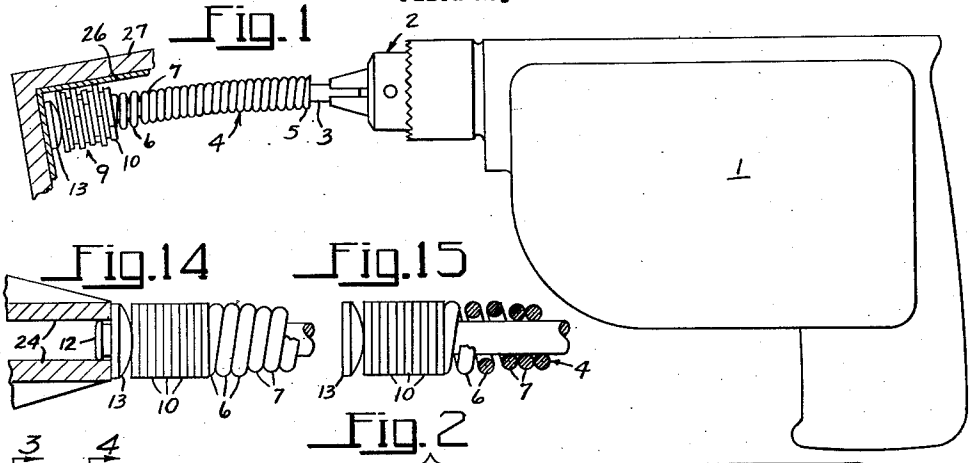


Fig. 14

Fig. 15

Fig. 2

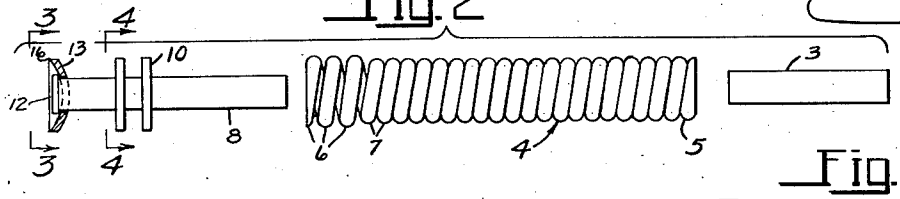


Fig. 3

Fig. 4

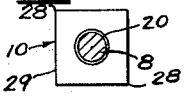


Fig. 5

Fig. 6

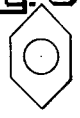


Fig. 7

Fig. 8

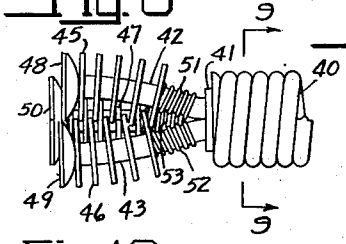


Fig 9

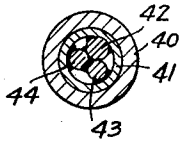


Fig. 12

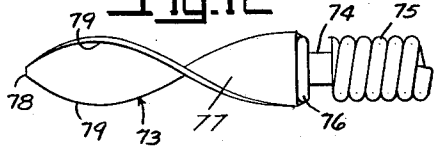


Fig. 13

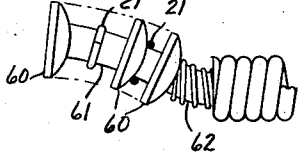


Fig. 10

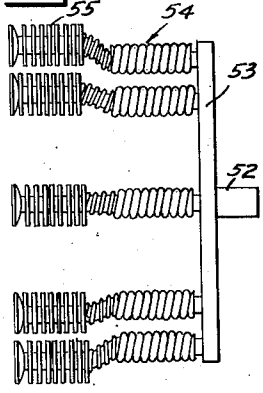
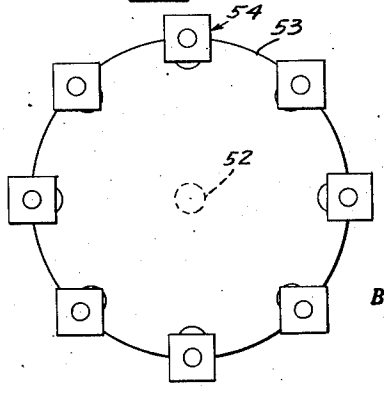


Fig. 11



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ROTARY CLEANING DEVICE

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Application May 13, 1952, Serial No. 287,505

4 Claims. (Cl. 15—104.01)

This invention relates to rotary cleaning tools of the type particularly adapted to remove scale, slag, rust barnacles, moss, paint or other material from surfaces to which such material may be adhered.

The problem of removing scale and other coatings from a surface to be cleaned is one which has not heretofore been solved satisfactorily. The use of rotating wire brushes has been attempted in the past for removing paint, rust and barnacles from ships' hulls and decks and for removing scale from boiler tubes and fittings, but such brushes are not satisfactory. The same problem, which has not heretofore been solved, exists in cleaning the heads, blocks and valve ports of internal combustion engines wherein carbon adheres to the same in a hard scale. When rotary brushes are employed the effect is to smooth out the scale or paint instead of removing it. The cleaning process then becomes one of wearing the scale away by repeated scraping by the bristles of the brush. Various attempts have been made in the past to employ air actuated chisels or hammers, but the results have not heretofore been worth the additional expense involved and at best such devices involve greater danger to the surface of the work.

The main object of the present invention is therefore the provision of a cleaning tool for removing scale from an article to be cleaned and which tool overcomes the disadvantages of prior art devices of like nature.

Another object of the invention is the provision of a cleaning tool which is extremely inexpensive to make and to operate and which may be power driven by a conventional electric hand drill.

Still another object of the invention is the provision of a cleaning tool for removing scale, which tool incorporates a unique cleaning head and drive arrangement resulting in a chipping action designed to remove the scale by impact as distinguished from wearing the scale off by friction.

Yet another object of the invention is the provision of a unique cleaning head which combines the functions of chipping and scraping and which head completes the cleaning operation without the use of additional finishing devices such as wire brushes.

Another object of the invention is the provision of a cleaning tool including means for securing the same to the chuck of a drill or the like efficiently and speedily without the use of fastening devices or tools.

Another object of the invention is the provision of a tool including a flexible coupling permitting the cleaning head to engage the surface to be cleaned without danger of injuring the surface during the scale removing process.

Another object of the invention is the provision of a cleaning tool having an extremely simple and inexpensive cleaning head including cleaning elements which may be readily replaced when worn.

Other objects and advantages will be apparent from the following specification and from the drawings.

Fig. 1 is a side elevational view of the preferred form

of the invention showing the same attached to a conventional electric hand drill with the cleaning head illustrated in engagement with the work to be cleaned.

Fig. 2 is an enlarged exploded view of the tool of Fig. 1 showing the various parts of the tool separated for clarity but in their proper relative position.

Fig. 3 is an end elevational view of the end scraping element of the cleaning head as taken along lines 3—3 of Fig. 2.

Fig. 4 is a typical cross-sectional view through the cleaning head showing the driven shaft and a chipping element mounted thereon.

Figs. 5, 6 and 7 illustrate modified forms of the chipping element of Fig. 4.

Fig. 8 is a modified form of cleaning head showing three driven shafts each having a row of chipping elements mounted thereon.

Fig. 9 is a cross-sectional view through the cleaning head of Fig. 8 showing the means for securing the head to the flexible coupling.

Fig. 10 is a side elevational view of a modified form of cleaning head and

Fig. 11 is an end elevational view of the cleaning head of Fig. 10.

Fig. 12 is a side elevational view of a scraping head adapted to be employed with the present invention.

Fig. 13 is an enlarged side elevational view of a cleaning head similar to that shown in Fig. 1 but illustrating a modified form of the invention.

Fig. 14 is a semi-schematic side elevational view of the cleaning head of Fig. 1 showing the method of assembling the same on a vise.

Fig. 15 is a side elevational view of the cleaning head of Fig. 14 removed from the vise.

In detail, the invention is adapted to be mounted on and actuated by a conventional electric hand drill generally designated **1** (Fig. 1) and which drill includes a conventional chuck **2**.

The present invention includes a shank or driving shaft **3** (Figs. 1, 2) which is adapted to be removably but fixedly secured in chuck **2**. Shaft **3** is a plain cylindrical member requiring no holes or other fastening means as will be subsequently described.

Secured to the end of shaft **3** opposite the end adapted to be clamped in chuck **2** is one end of a closely coiled helical left-hand spring **4** having an inside diameter slightly less than the diameter of shaft **3**. The end **5** of spring **4** is adapted to receive therein the end of shaft **3** as shown in Fig. 1 with the coils of spring **4** which are adjacent said shaft surrounding the latter and in gripping relation therewith. The method of effecting this connection will be subsequently described in greater detail.

Spring **4** is preferably formed solid with an initial tension; that is, with its adjacent coils in tightly engaging relationship so that an effort is required to separate the same. However, at the end opposite end **5**, spring **4** is provided with one or more coils **6** which are in normally spaced relationship for a purpose to be described (Figs. 2, 15). These end coils **6** are also formed to a somewhat larger diameter than the remainder of the spring **4**.

A driven shaft **8**, preferably of the same diameter as driving shaft **3**, is adapted to be received in the end of spring **4** opposite end **5** with the closed coils **7** of spring **4** that are adjacent the expanded coils **6** surrounding and in gripping relationship with said driven shaft (Figs. 1, 2, 14, 15).

Mounted on driven shaft **8** is a row of chipping elements **10** which are preferably thin square planar sections of relatively hard sheet material such as tool steel (Figs. 1, 2, 4).

The end of driven shaft **8** opposite spring **4** is upset to form a head **12** against which a scraping element **13** is adapted to abut. This scraping element **13** is slightly dished, and is centrally apertured to receive shaft **8**. Scraping element **13** is formed around its periphery to provide a sharp scraping edge **16**. The amount that element **13** is dished should be such that the head **12** on shaft **8** is entirely contained within the dish-shaped space of element **13**. The scraping element **13** may be made circular if desired but certain advantages are gained by using a square-shaped cutting edge and these advantages will subsequently be described.

Referring again to chipping elements **10** and as best seen in Fig. 4, said elements are each provided with a central hole **20** for receiving shaft **8**. This hole **20** is somewhat larger in diameter than the shaft **8** so as to permit relative rotation of the shaft and chipping element. For purpose of illustration a ⅝" square chipping element mounted on a ¼" diameter shaft would be provided with a central aperture of about 9/32" diameter.

When the device is assembled as shown in Fig. 1 the expanded coils **6** serve to yieldably urge the chipping elements **10** toward upset head **12** of shaft **8** and at the same time cause each element **10** to tightly engage adjacent elements. The friction between adjacent elements may be adjusted by changing the distance which driven shaft **8** is inserted into the end of spring **4**. It will be noted in this connection that the expanded coils **6** of spring **4** have an inside diameter larger than the diameter of shaft **8** and therefore these end coils do not engage shaft **8** but merely act as a compression spring for urging chipping elements **10** together (Fig. 15).

In operation, and when the driving shaft **3** is clamped in chuck **2** of drill **1** and the latter started, the chipping elements **10** may be held against the work to be cleaned as seen in Fig. 1 wherein scale **26** on work **27** is indicated. With reference to Fig. 4 it should be noted that the sharp cutting edges **28** which are formed by the intersection of adjacent sidewalls **29** of elements **10** will strike the scale **26** with considerable impact upon rotation of shaft **8**. It will further be apparent that the magnitude of such impact will be proportional to the weight of the elements **10** and the compression in coils **6** of spring **4** as well as the speed of rotation of shaft **8**. The fact that each element **10** is free on shaft **8** provides a desirable yieldability during use inasmuch as the energy received by head **9** is partially dissipated by rotation of elements **10** in a direction opposite to that in which they strike the scale. The rotation of one element **10** tends to cause rotation of the adjacent elements thus resulting in the cutting edges **28** of the various elements being indiscriminately arranged relative to each other. The final result is that upon rotation of the cleaning head at about 2500 R. P. M. the scale **26** will be subjected to a series of relatively sharp impacts which result in the scale being loosened and broken away from the work **27**.

The fact that each element **10** may rotate rearwardly away from the work after striking the latter prevents undesirable scoring of the surface of the work which would result if the elements **10** were fixedly secured to shaft **8**. However, the presence of compression coils **6** on spring **4** causes the elements **10** to be tightly engaged by each other thus establishing a frictional resistance to rotation of the chipping elements **10** and which resistance is sufficient to cause the desired amount of impact. It will be obvious that the compressive force of coils **6** may be readily adjusted as above described.

The end scraper **13**, being at the free end of driven shaft **8** may be positioned substantially flat against the surface to be scraped. Although excellent results are obtained by using a circular cutting edge instead of a square one on scraping element **13**, the shape shown in Fig. 3 results in additional impact on the surface of the work which is desirable when the scale is particularly tough. It will be understood of course that the end scraping element **13** may also be employed for chipping in like manner as chipping elements **10** with the plane of its cutting edge substantially at right angles to the surface of the scale.

An important feature of the invention is the flexibility achieved by the spring coupling **4**. As illustrated in Fig. 1 when the cleaning head is pressed against the work to be cleaned, the spring coupling **4** is deflected laterally of its length so that a yieldable pressure is applied to hold the cleaning head against the scale to be removed. This prevents undue loading of the head **9** and the driven shaft and at the same time the coils of spring **4** absorb the impacts transmitted to the cleaning head from the work. Stalling of the motor in drill **1** is completely obviated because each element is free to rotate on shaft **8** thus acting as a clutch to prevent overloading of said motor.

The spring coupling **4** also constitutes a simple means for power connecting the driving shaft **3** and driven shaft **8**. As above noted when the spring **4** is not assembled on said shafts the inside diameter is slightly less than the diameter of the shafts so that the end coils may firmly grip the shafts which they surround. The method of assembling the spring and shafts is as follows:

After the scraping and chipping elements which constitute cleaning head **9** have been mounted on shaft **8** the upset head **12** of shaft **8** may be gripped between the jaws **24** of a vise as shown in Fig. 14. By placing the shaft **8** with the jaws of the vise extending a short distance past the upset head **12** the jaws of the vise may serve as a stop to limit movement of scraping element **13** along driven shaft **8** (Fig. 14).

Spring **4** may then be gripped by pliers or by any other convenient means and positioned coaxial with the shaft and then rotated onto shaft **8** in a direction opposite to that in which the coils of the spring are wound. It should be noted in this connection that spring **4** is left hand. That is, it must be rotated in a counter-clockwise direction looking at the free end of driven shaft **8**. When thus rotated, the friction between the closed coils **7** of spring **4** will tend to cause said coils to open up or expand radially outwardly to permit the end of shaft **8** to be received therein.

By pushing spring **4** toward shaft **8** while said spring is being rotated it is apparent that the expanded coils **6** may be compressed until the same are solid as shown in Fig. 14. At this point rotation of spring **4** may be stopped so that the coils **7** grip shaft **8** and the device may then be removed from the vise jaws **1**. The compressed end coils **6** will then expand to urge scraping element **13** against head **12** and to urge chipping elements **10** into tight frictional engaging relationship as shown in Fig. 15.

In the above manner, by properly positioning driven shaft **8** with reference to vise jaws **24** a predetermined compressive force may be impressed on elements **10** by the coils **6** of spring **4**. This force may be adjusted at any time by relatively rotating spring **4** and shaft **8**.

When the number of tools to be assembled is very large and power means is available for assembling spring **4** on shafts **3** and **8** the latter may be simply press-fitted into spring coupling **4** without rotating spring **4** and the shafts **3** and **8** relative to each other. In such a case the end result is the same and the coils of the spring will surround the shafts in gripping relationship therewith.

The opposite end **5** of spring **4** may also be secured to driving shaft **3** in the above described manner.

Depending upon the nature of the work the end scraping element **13** may be eliminated in which case the assembly procedure is the same except that the jaws **24** of the vise will engage the adjacent chipping element **10**.

When the tool is assembled as above described, with four or five solid coils gripping the shafts **3** and **8**, the driving shaft **3** may then be clamped in chuck **2** of drill **1** and the latter started. It should be understood that the invention has herein been described assuming that the same is employed with a conventional "right hand" drill.

The term "right hand" as applied to drill 1 (Fig. 1) conventionally means that the chuck 2 rotates in a clockwise direction looking from the body of drill 1 toward said chuck. Thus the entire tool hereinbefore described will be rotated clockwise looking toward the head. Right hand rotation of shaft 3 will obviously make the coils at the end 5 of spring 4 grip said shaft more tightly and no slippage between said shaft and spring will occur. In like manner right hand rotation of spring 4 will tighten the grip of the coils 7 of said spring on the driven shaft 8. When it is desired to disassemble the tool reversal of the normal direction of rotation will permit spring 4 to be removed from shafts 3 and 8.

It is obvious that if the rotation of drill 1 were left hand then spring 4 would be conventional or right hand.

The shape of chipping element 10 is not critical insofar as use is concerned, it being apparent that a triangular element such as indicated at 31 in Fig. 5 may be employed; or a hexagonal element 32 (Fig. 6).

The chipping elements may also be formed from lengths of wire as shown in Fig. 7 but this form has the disadvantage of providing a relatively small amount of inertia as compared with a planar blank and is therefore suitable for only light work.

Referring again to the operation of the device of Figs. 1, 2 it will be apparent that a certain amount of scraping action on the work is effected by the elements 10. Thus while certain elements are striking the work with an impact, others will tend to scrape the work because of the staggered relationship of the elements.

To enhance the chipping action of the elements 10, and to secure certain other advantages, the driven shaft 8 may be bowed to provide a portion offset from the axis of rotation of said shaft. Thus referring to Fig. 13 the shaft 62 is provided with a bowed portion 61 adjacent its free end and which bowed portion diverges outwardly of the axis of shaft 62 at all points along its length. Inasmuch as the chipping action of the elements 60 is enhanced by revolution of said elements about the axis of rotation of shaft 62 as well as rotation therewith the number of chipping elements 60 may be considerably reduced. To this end I provide a spacer 21 between each pair of chipping elements 60. Spacers 21 may be made by forming a circular loop of wire having an inside diameter slightly greater than the diameter of shaft 62. In all other respects the assembly of the cleaning head of Fig. 13 is the same as above described in connection with Figs. 1, 2.

In Fig. 13 the chipping elements 60 are dished in like manner as the end scraping element 13 of Figs. 1 and 2 although they may be identical to elements 10. By dishing all of the elements on shaft 62 an advantage in uniformity is achieved and at the same time a scraping action may be obtained by using the end element as above described. It will also be apparent that the spacers 21 may be eliminated if desired so that dished elements 60 are in tight frictional engaging relationship on shaft 62, or dished elements such as 60 may be employed on straight shaft 8 of Figs. 1, 2.

In the operation of the device of Fig. 13 the chipping elements 10 swing laterally of the axis of rotation of shaft 62 resulting in a greater impact when they strike the work. In addition the scraping element at the free end of the shaft achieves a more thorough scraping action inasmuch as it follows a circular path of travel in addition to rotating on its axis.

A triple gang head is illustrated in Figs. 8 and 9 wherein a spring coupling 40 is secured at one end to a driving shaft (not shown) in like manner as spring 4 (Fig. 1). The other end of spring 40 is adapted to receive therein a sleeve 41 in the same manner as spring 4 receives shaft 8.

Secured within sleeve 41 by welding or the like are three driven shafts 42, 43, 44 which are provided with offset bowed portions in like manner as shaft 62 of Fig. 13. A row of chipping elements 45 similar to elements 10 are mounted on shaft 42 and rows of similar elements 46, 47 are respectively mounted on shafts 43, 44. The elements of each row or gang are staggered relative to adjacent rows so that the elements themselves act as spacers. Scraper elements 48, 49, 50 may be respectively secured to the free end of shafts 42, 43, 44 like element 13 of Fig. 2. Light compression springs 51, 52, and 53 serve to urge the chipping elements against each other at all times and in this respect perform the same function as expanded coils 6 of Fig. 15.

The modified form of the invention of Figs. 8, 9 is adapted for heavier work than the form shown in Fig. 13 and has the advantage of not requiring spacers between adjacent chipping elements.

In the case of extremely heavy work and where the required amount of power is available, the form of the invention shown in Figs. 10, 11 may be employed. In this case a shank 52 is adapted to be received at one end thereof in the chuck of a drill or the like and at its opposite end is rigidly connected as by welding to one side of a circular plate 53 at a point centrally of the latter.

Secured around the periphery of plate 53, on the opposite side from shaft 52 and extending axially therefrom is a row of cleaning tools 54 which are secured as by welding to said plate (Fig. 10). Each of the tools 54 is substantially similar to the tool illustrated in Fig. 13 except that the offset portion 55 thereof may be straight but spaced radially outwardly from the periphery of plate 53 so that the chipping elements thereon are free for engagement with the work. The form shown in Figs. 10, 11 is particularly suitable for cleaning the inner surface of cylindrical walls such as large pipe.

Now referring again to Fig. 13 additional advantages gained by bowing the offset portion of the driven shaft may be seen. When the chipping elements 10 (Fig. 13) strike the scale to be removed it will be apparent that each element will be tilted relative to the portion of the shaft which supports it because, as pointed out above, each element is free on said shaft. When a chipping element is thus tilted the shaft will grip said element tighter thus facilitating turning of the element by the shaft.

For the above reason it is preferable that the bowed portion of the driven shaft diverge relative to the axis of the shaft at all points along its length. Thus in Fig. 13 the rate of divergence of bowed portion 61 of shaft 62 is greatest at the juncture of said portion with the straight end portion and said rate of divergence is reduced toward the free end of said shaft. By this structure it will be apparent that the inner end of the cleaning head may be employed for more rugged work and the outer free end may be used for finer work because the frictional grip between the shaft and the chipping elements is greatest on the portion which diverges most, relative to the axis of rotation.

In cases where the surface of the work may be cleaned without resorting to chipping, a scraping head generally designated 73 (Fig. 12) may be employed. This scraping head is provided with a rigid shank 74 which is adapted to be gripped in one end of a spring coupling 75 similar to spring 4 hereinbefore described. A circular flange 76 is provided on shank 74 to which is rigidly secured one end of an elongated helically formed scraper blade 77 which is tapered at its free end to a point 78. The opposite side edges of blade 77 are sharpened to form cutting edges 79 for engaging the work to be cleaned. In operation, the head 73 is rotated and applied to the work with edges 79 lying against and in scraping relation with the scale to be removed. It will be understood that the length of spring coupling 75 is sufficient to permit deflection of the same as the scraping head is urged against the work thus resulting in a smooth cleaning action. In the event that the scale to be removed is in a recess of relatively small cross section it is apparent that the size of a blade 77 may be varied as desired. If the length of

such recess is considerable the length of blade 77 may be increased as desired so long as the same is sufficiently reinforced or stiffened as required.

The invention herein described has been employed with excellent results to remove paint from steel and carbon scale from cylinder heads. The device is also useful for cleaning welds and castings.

Safe operation of the chipping device is insured because the chipping elements are not fixedly secured to their supporting shaft and therefore the resistance offered by the work is not sufficient to jerk the tool from the hands of the user.

The spring coupling for assembling the shafts is fool proof and no additional fastening devices are required which would slow down assembly and disassembly of the tool.

It should also be noted that the spring coupling not only makes for effortless operation of the chipping device but absorbs shocks which might otherwise have a detrimental effect on the drill.

I claim:

1. A rotary tool comprising; a helical coil of spring wire, a driving shaft and a driven shaft spaced therefrom in end to end relation with their adjacent ends secured within opposite ends of said coil against rotation relative to said coil when said driving shaft is rotated in one direction, a work engaging head on the end of said driven shaft that is opposite the end within said coil, the adjacent coils of the portion of said coil that is between said shafts being in tight yieldable engagement under the tension of said coil in a direction axially of the coil, said work engaging head including a plurality of coaxial elements on said driven shaft and a stop at the outer end of said driven shaft for holding said elements on said head and spring means between the said elements and the said portion reacting between said portion and said elements for yieldably holding said elements together and against said stop.

2. A rotary tool comprising; a helical coil of spring wire, a driving shaft and a driven shaft spaced therefrom in end to end relation with their adjacent ends secured within opposite ends of said coil against rotation relative to said coil when said driving shaft is rotated in one direction, a portion of said coil that is around said driven shaft being axially extended providing an axially compressible spring section, a plurality of elements rotatable on said driven shaft outwardly of said portion relative to said coil, a stop on said driven shaft outwardly of said elements relative to said coil for preventing movement of said elements past said stop, said section being free from securement to said driven shaft to enable axial expansion and contraction thereof and said elements being held against said stop and against each other under the expansion tension of said section.

3. In a rotary cleaning device including a cleaning head having a row of work engaging elements supported on a driven shaft and free for movement thereon and including a driving shaft for supplying torque to said driven shaft, a flexible coupling for coaxially connecting said shafts comprising an elongated helical spring having opposite driving and driven ends adapted to receive therein said driving and driven shafts respectively with certain coils of said spring surrounding said shafts and in gripping relation therewith, said driven end of said spring being provided with axially spaced coils free from securement to said driven shaft for yieldably urging said row of elements toward each other and the remainder of said spring being provided with closely adjoining coils for transmitting said torque.

4. In a rotary cleaning device including a cleaning head having a row of work engaging elements supported on a driven shaft and free for movement thereon and including a driving shaft for supplying torque to said driven shaft, a flexible coupling for coaxially connecting said shafts comprising an elongated helical spring having opposite driving and driven ends adapted to receive therein said driving and driven shafts respectively with certain coils of said spring surrounding said shafts and in gripping relation therewith, said driven end of said spring being provided with axially spaced coils for yieldably urging said row of elements toward each other and the remainder of said spring being provided with closely adjoining coils for transmitting said torque, said axially spaced coils having a larger inside diameter than the adjacent closely adjoining coils whereby said spaced coils are free from engagement with said driven shaft when the latter is secured in said driven end.

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