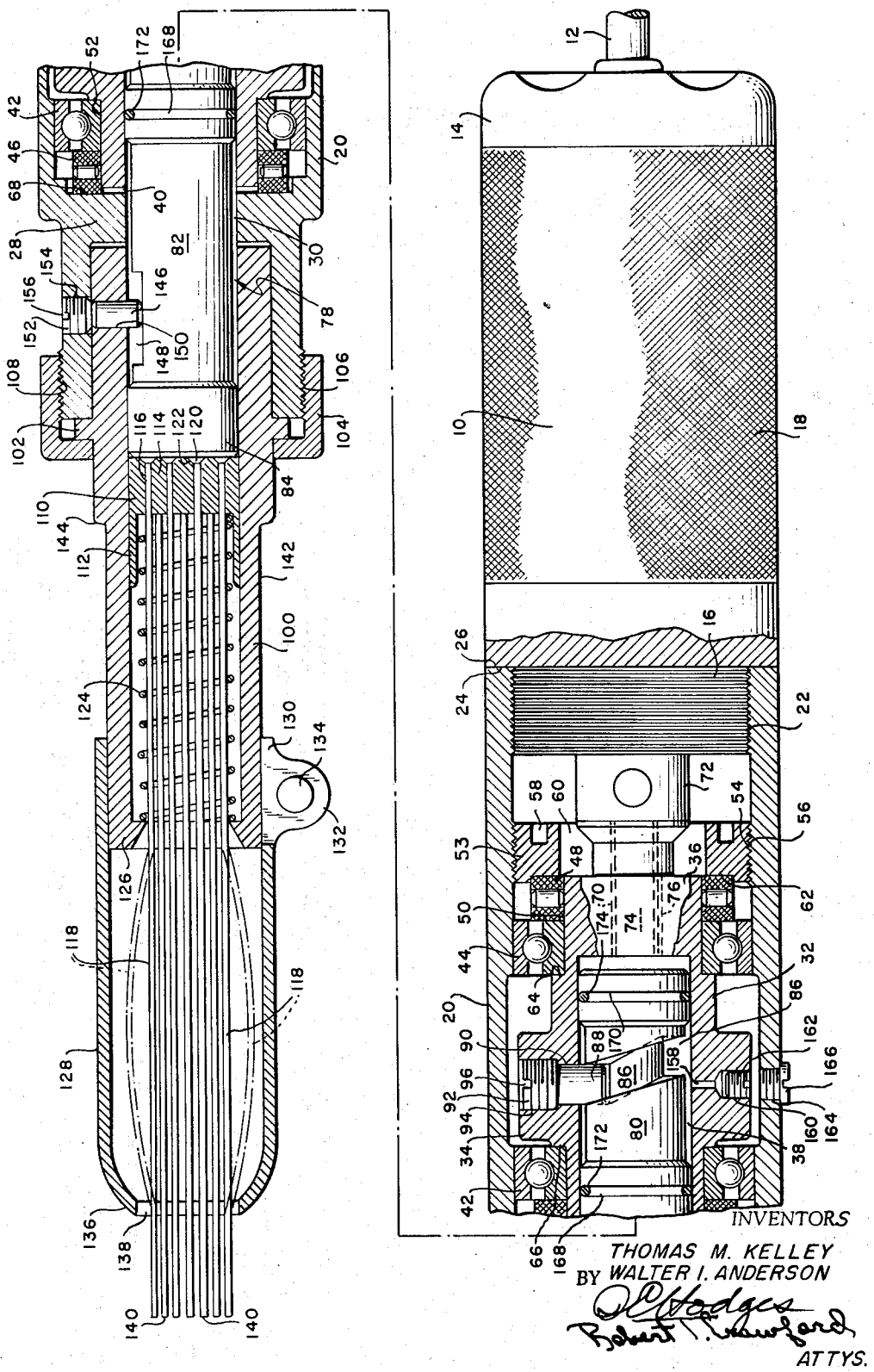
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SCALING TOOL

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SCALING TOOL

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ABSTRACT OF THE DISCLOSURE

A scaling tool driven by a rotating electric motor having a cam drive arrangement which converts rotary to reciprocating motion driving a needle scaling head together with a bundle of needles therein which are therefore impelled into contact with a surface to be scaled and cleaned.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to needle scaling tools and more particularly to an extremely slim and compact electrically-driven needle scaling tool.

One object of the invention is to provide an electrically-driven needle scaling tool having a slim silhouette or low diameter to length ratio.

Another object of the invention is to provide a compact and light weight electrically-driven needle scaling tool.

Another object of the invention is to provide a new and improved cam driving arrangement for an electrically-driven needle scaling tool.

The needle scaling tool contemplated by the present invention is basically comprised of an electric motor, a reciprocating plunger, a cam drive for converting the rotational output of the motor into the reciprocatory movement of the plunger and a needle scaling head with a bundle of needles therein which are adapted to be impelled by the reciprocating plunger into contact with a surface to be scaled or cleaned. The cam drive is carried within a housing which is attached to and axially aligned with the housing of the motor and includes a bearing-supported barrel member which is rotatably connected to the output shaft of the motor and axially aligned therewith. The barrel member carries a cam pin which rides within a continuous cam groove in the reciprocating plunger which in turn is slidably received within an axially extending bore within the barrel member. A needle scaling head including a needle housing with a spring-biased needle retainer and a cluster of needles therein is detachably connected to the cam drive housing and is adapted to receive one end of the reciprocating plunger. The needle housing carries a detachable guide sleeve for the needles and the sleeve is axially adjustable relative to the housing; the sleeve providing a means for holding the free ends of the needles in a bundle-like assembly.

As the barrel member is rotatably driven by the motor, the cam pin riding within the cam groove imparts reciprocatory movement to the plunger and, for each revolution of the barrel member, drives the plunger through one complete stroke axially inwardly and outwardly of the barrel member. As the plunger is moved outwardly on its power stroke, it strikes the needles and impels them outwardly of the needle housing into contact with a surface to be scaled. When the plunger is driven inwardly by the cam drive on the return half of its stroke, the spring-biased needle retainer urges the needles inwardly of the needle housing into a position where they

will again be struck by the plunger as it moves on its power stroke outwardly of the barrel member.

The aforementioned and other objects of the invention will become readily apparent from the following detailed description of one specific embodiment thereof when taken in connection with the accompanying drawing, wherein like components are designed by like reference numerals and wherein the sole figure thereof is a partial longitudinal section through a needle scaling tool embodying the invention, the partial longitudinal section being divided into two parts with one of the two parts showing a duplication or overlap of some of the components of the other.

Referring more particularly to the drawing, the scaling tool of the present invention is shown as including a motor housing means or motor housing **10** which is adapted to house or carry a suitable electrical drive motor (not shown). The electric drive motor may be one of several conventional types and is connected to a source of energy through the medium of a cord or the like **12** which extends from one end of the motor housing. Motor housing **10** in this particular embodiment of the invention takes the form of an elongated hollow cylinder and is closed at one end by means of a plate or cap **14** and at the opposite end is reduced in diameter and is provided with peripheral threads **16** thereon. Motor housing **10**, intermediate the ends thereof, is provided with knurling on the peripheral surface thereof, this knurled peripheral surface facilitating the use of the scaling tool by an operator as will be discussed more in detail hereinafter.

A cam drive housing means or housing **20** is carried by the motor housing **10** and, in this one embodiment of the invention, takes the form of an elongated hollow cylinder which is opened at both ends. One end of housing **20** is provided with threads **22** on the inner periphery of the housing, and the threads **22** are adapted to be received by the threads **16** on the reduced diameter portion of motor housing **10**, threads **16** and **22** providing a means for holding the two housings **10** and **20** in rigid assembly. The two housings **10** and **20** are threadedly connected in such a manner that the end wall **24** on housing **20** firmly abuts or engages the end wall **26** on housing **10** and the two housings, when so assembled, in effect form one continuous or elongated housing. Both housings **10** and **20** in this one embodiment of the invention are substantially identical in diameter and both are made of a suitable aluminum alloy to provide housings of light weight, the aluminum alloy thus assisting in reducing the overall weight of the scaling tool.

Cam drive housing **20** is provided a substantially radially inwardly extending wall **28** therein which in this particular instance is formed integral with the body of the housing. Wall **28** has a preselected thickness and is provided with port or aperture **30** therein which extends substantially axially of the housing. Port **30** is dimensioned or is provided with a diameter such that it will slidably receive the reciprocating plunger of the scaling tool, as will also be discussed more fully hereinafter.

A barrel shaped means or barrel member generally designated by the reference numeral **32** is rotatably supported within housing **20** and extends substantially axially thereof. Barrel member **32** is generally cylindrical in configuration and is provided with an intermediate portion **34** of enlarged diameter and, at one end, terminates in an end wall **36**. Barrel member **32** is also provided with an axially extending bore **38** therein, one end of bore **38** terminating in end wall **36** and the opposite end thereof providing the barrel member with an open end **40**. Barrel member **32** in this particular instance is made of steel rather than an aluminum alloy although it will be apparent

that it also be made of an aluminum alloy or any other suitable material.

Barrel member **32** is rotatably supported within housing **20** on bearing means or bearings and, in this particular instance, the bearings take the form of a pair of anti-friction or ball bearings **42** and **44** in combination with a pair of roller thrust bearings **46** and **48**. The periphery of barrel member **32** adjacent both of its ends is reduced in diameter to provide shaft-like ends **50** and **52** on the barrel member, and these shaft like ends are adapted to be received within the inner periphery of the inner races of bearings **42**, **44**, **46** and **48**. The inner races of the bearings are adapted to snugly fit the periphery of the shaft-like ends **50** and **52** on the barrel member, and the bearings are retained in a predetermined position within casing **20** by the structure or configuration of the barrel member itself in combination with housing wall **28**, the inner periphery of the housing **20** and a lock nut **53**.

Lock nut **53** is substantially cylindrical in configuration and is held or retained in a predetermined position within housing **20** by means of threads **54** on the periphery thereof which are adapted to be received within threads **56** on the inner periphery of the housing. Lock nut **53** in one face thereof is provided with a pair of recesses **58** therein to accommodate the reception of a wrench or the like to facilitate the threading of the lock nut **52** within the housing **20**. Lock nut **52** is provided with an enlarged aperture or port **60** therein and on the opposite face is counterbored at **62**, the counterbore **62** providing a seating surface and shoulder for one race of the thrust bearing **48** and also providing a means for anchoring the thrust bearing **48** in position within the confines of housing **20**. Shaft-like end **50** of the barrel member terminates in an annular shoulder **64** on the barrel member which functions as a seat for one race of the ball bearing **44** and, shaft-like end **52** of the barrel member similarly terminates in an annular shoulder **66** which, likewise, functions as a seat for one race of the ball bearing **42**. The outer peripheries of the outer races of ball bearings **42** and **44** are adapted to snugly fit the inner periphery of casing **20**, and it will be appreciated that casing **20** must be dimensioned so that the ball bearings will snugly fit within the inner periphery thereof. The interior surface **68** of housing wall **28** affords a seat for one face of thrust bearing **46**. It will also be understood that the barrel member **32** and the bearings are held in rigid assembly within housing **20** and so placed in such rigid assembly by tightening nut **53**.

The output or armature shaft **70** of the electric motor carries a spacing collar **72** thereon which is received in port **60** in lock nut **53** and, adjacent its free end, the output shaft **70** is provided with a pair of opposed flat surfaces **74** thereon (only one flat surface **74** shown in the drawing). Shaft **70** with the opposed flat surfaces thereon is adapted to be received in a similarly shaped passage **76** formed in the end wall **36** of barrel member **32**. Passage **76** extends axially of the barrel member **32**, and output shaft **70** is adapted to be slidably received therein. The output shaft **70** with the pair of opposed flat surfaces thereon and the correspondingly shaped passage **76** in the barrel member thus provide an operative and driving connection between the electric motor and the rotatably supported barrel member.

A plunger means or plunger **78** is carried within the bore **38** in barrel member **32** and is dimensioned to be slidably received therein. Plunger **78** is cylindrical in shape or configuration and is reduced in diameter at points **80** and **82** along its length primarily to reduce the weight thereof. Plunger **78** in this particular instance is made of forged steel although it will be apparent that it could also be made of any other suitable material such as an aluminum alloy. Plunger **78** terminates at one end thereof in a head portion or head **84** and, along reduced diameter portion **80**, is provided with a cam groove means or cam groove **86** therein. Cam groove **86** has a preselected depth and a preselected pitch and takes the form of an endless or continuous groove formed in the body of the plunger.

Barrel member **32** carries a cam follower means or cam follower which is adapted to ride or be received within the continuous cam groove **86**. The cam follower in this one specific embodiment of the invention takes the form of a cam pin **88** which is carried in a passage **90** in the intermediate portion **34** of barrel **32**. Cam pin **88** is provided with a threaded head **92** thereon and the head **92** is adapted to be received within a counterbore **94** within barrel passage **90**. The threads on head **92** are adapted to be received within threads (not shown) in counterbore **94**, and this threaded connection firmly retains the cam pin **88** within barrel passage **90**. Cam pin **88** is also provided with a slot **96** in the head **92** thereof to accommodate the use of a screwdriver or the like when the cam pin is being threadedly connected to the barrel member.

Cam pin **88** riding within the continuous cam groove **86** provides a means for converting the rotary motion of the electric motor into the reciprocating movement of the plunger **78**. It will be understood that each revolution of the barrel member **32** will produce one complete stroke of the plunger **78** with the plunger moving axially outwardly and inwardly of bore **38** in the barrel member. It will also be understood that cam pin **88** will continuously drive the plunger **78** through its reciprocating movement and will thus move the plunger both axially inwardly of bore **38** (to the right as shown in the drawing) and axially outwardly of bore **38** (to the left as shown in the drawing). In the drawing, the plunger **78** is shown at the extreme inner end of its stroke and is thus in a fully retracted position. Upon rotation of the barrel member **32**, however, the plunger will be moved axially to the left as shown in the drawing and, when the barrel member rotates through one half of a revolution, the plunger will have moved to its extreme extended position and will have thus moved through its power stroke. When the plunger **78** reaches its fully extended position, the continued rotation of the barrel member **32** through the other half of the revolution will again move the plunger **78** back to its fully retracted position. Thus, as the barrel member **32** rotates, the plunger **78** will be constantly and continuously reciprocated axially outwardly and inwardly of the barrel member between fully extended and fully retracted positions. The length of stroke of the plunger **78** will, of course, be determined by the pitch of the cam groove **86**. The cam groove **86** in this one specific embodiment of the invention has a pitch such that one complete revolution of the barrel member **32** produces a length of stroke of the plunger of one quarter of an inch.

Cam drive housing **20** carries a needle scaling head generally indicated by the reference number **98**. Needle scaling head is comprised of a housing means or housing **100** which in this one specific embodiment of the invention assumes the form of an elongated hollow cylinder which is opened at both ends. Housing **100** is provided with a peripheral flange **102** thereon adjacent one end thereof (the right end as shown in the drawing), and this end of the housing **100** is adapted to be slidably received within the open end of cam drive housing **20**. Housing **100** is rigidly connected to housing **20** by means of a collar **104**, the collar **104** being provided with internal threads **106** thereon which are adapted to be received within threads **108** on the periphery of housing **20**. Collar **104** provides a rigid connection between cam drive housing **20** and needle housing **100**, and, when the two housings are in assembly, flange **102** is adapted to abut the end wall of cam drive housing **20**. Peripheral flange **102** is carried in a predetermined position on needle housing **100** and, in being so positioned, limits the depth of insertion of housing **100** into the open end of cam drive housing **20**. It will also be noted in the drawing that peripheral flange **102** is formed integrally with the body

of needle housing **100** in this particular instance. Needle housing **100** in this one specific embodiment of the invention is made of steel, as is the collar **104**, although it will be appreciated that both of these components could just as readily be made of any other suitable material such as an aluminum alloy.

A needle retainer means or needle retainer **110** is slidably carried within needle housing **100** and in this particular instance assumes the form of an annular, substantially cup-shaped member having a side wall **112** and a bottom wall **114**. Bottom wall **114** is provided with a plurality of spaced, axially extending passages **116** therein, and each passage **116** is adapted to slidably receive and retain therein a needle means or needle **118**. Each needle **118** is provided with a substantially frusto-conically shaped head **120** thereon and each such head is adapted to be received or seated within a similarly shaped recess **122** in one face of needle retainer bottom wall **114**, each recess **122** of course being axially aligned or symmetrically positioned with respect to one of the passages **116** in the needle retainer bottom wall. Needles **118** are made of a hard and flexible steel and, in use, must be capable of flexing or bending without being subject to breakage.

Needle housing **100** carries a resilient means therein and, in this particular embodiment of the invention, such resilient means assumes the form of a compression spring **124**. One end of compression spring **124** is received within side wall **112** of needle retainer **110** and is adapted to seat on the bottom wall **114** of the needle retainer. The opposite end of spring **124** is adapted to seat on an inturned flange **126** on the end of the needle housing **100**. It will be noted in the drawing that spring **124** has a diameter such that the needles **118**, extending axially of and beyond the needle housing **100**, are carried or positioned within the spring. It will also be noted in the drawing that spring **124** will constantly urge the needle retainer **110** and the plurality of needles **118** carried thereby toward engagement with the head **84** on plunger **78**. In the fully retracted position of the plunger **78** as shown in the drawing, the spring **124** will of course bias the needle retainer axially of housing **100** into engagement with plunger head **84**.

A guide means or guide **128** is carried by housing **100** and, in this particular instance, takes the form of an elongated substantially cylindrical sleeve. The end of sleeve **128** that is positioned on housing **100** is "split" or is provided with a longitudinally extending slot **130** therein and, on both sides of slot **130**, carries or is provided with a pair of upstanding ears or tabs **132** (only one shown). Each ear **132** is provided with a hole or port **134** therein, the two holes **134** providing a passageway for a bolt or the like (not shown). The bolt is adapted to carry a nut (not shown) which when tightened on the bolt provides a means for rigidly connecting or clamping the guide sleeve **128** to the casing **100**. The opposite end of guide sleeve **128** is converged or turned inwardly at **136** to provide a constricted open end **138** on the guide sleeve, the constricted open end **138** in this particular instance assuming a substantially rectangular shape or configuration (not shown). Open end **138** is constricted into the substantially rectangularly shape in order that the ends **140** of the needles projecting beyond the end of the guide sleeve may be retained in a bundle-like or cluster-like assembly so that they may be effectively directed at a surface to be scaled or cleaned. Since guide sleeve **128** is clamped on housing **100**, the position thereof on housing **100** may be selectively varied. The guide sleeve is preferably clamped on the housing in such a position that the end **138** thereof is positioned approximately an inch and a half from the free or working ends **140** of the needles. Guide sleeve **128** is carried on a reduced diameter portion **142** of housing **100** and, when moved to its extreme retracted position on housing **100**, is adapted to abut a shoulder **144** formed on the periphery of housing **100**, the shoulder **144** thus serving as a stop to limit the axial movement of the guide sleeve on the housing.

Rotation of plunger **78** within the bore **38** of the barrel member is prevented by means of a pin means or pin **146** which is slidably carried within a longitudinally extending peripheral groove or recess **148** formed in the periphery of the plunger. Pin **146** is carried within a passage **150** in the wall of housing **100** and is retained within housing passage **150** by means of a set screw or the like **152**. Set screw **152** is in turn carried within a threaded passage **154** in cam drive housing **20**, the two housing passages **150** and **154** of course being aligned. Set screw **152** is provided with the usual slot **156** therein to accommodate the reception of a tool such as a screw driver or the like.

Means is provided to permit the introduction of a lubricant into cam groove **86** and, in this one embodiment of the invention, this means takes the form of a passage **158** in barrel member intermediate portion **34**. Passage **158** communicates with a counterbore **160** in barrel member intermediate portion **34** and counterbore **160** is threaded (not shown) and is adapted to be sealed by a threaded plug **162**. Barrel member passage **158** and counterbore **160** are adapted to communicate with a port **164** in cam drive housing **20**, which port is likewise threaded (not shown) and is adapted to be sealed by a threaded plug **166**. Threaded plugs **162** and **166** are both provided with the usual slots in the heads thereof to permit a suitable tool such as a screw driver to be applied thereto.

Adjacent to cam groove **86**, plunger **78** is provided with a pair of peripheral recesses or grooves **168** and **170** therein and the grooves are adapted to seat a pair of O-ring seals **172** and **174**, respectively. The O-ring seals **172** and **174** in function serve to retain the lubricant in barrel member bore **38** in close proximity to the cam groove **86** and cam pin **88** and thus insure that the groove and pin will be constantly lubricated.

To assemble the scaling tool of the present invention, plunger **78** with the two O-ring seals **172** and **174** thereon is first inserted into axial bore **38** in barrel member **32**. Cam pin **88** is then threadedly connected to barrel member **32** in such a manner that the pin is received in cam groove **86**. The bearings **42**, **44**, **46** and **48** are then placed upon the shaft-like ends **50** and **52** of the barrel member, and then the assembly comprised of the barrel member, the plunger and the bearings is inserted as a unit into cam drive housing **20**. Lock nut **53** is then threaded into cam drive housing **20** and tightened therein into a position until all of the components of the assembly are rigidly retained within the cam drive housing. The cam drive housing is then threaded or turned onto the motor housing **10** with the flattened armature shaft **74** of the motor being received within the axially extending passage **76** in the end wall **36** of the barrel member. Needle housing **100** with the needle retainer, needles and spring therein is then inserted into the open end of cam drive housing **20** and pin **146** is then inserted into needle housing passage **150** to prevent the rotation of barrel member **78**. Threaded plug **152** is then inserted into cam drive housing passage **154**. Collar **104** is then applied to the threaded portion **108** of cam drive housing **20** to rigidly connect the needle scaling head to the cam drive housing. With the guide sleeve **128** being clamped on housing **100** in a pre-selected position the needle scaling tool is now ready for use or operation.

In using the scaling tool, the operator first grasps the knurled portion **18** of the motor housing with one hand and the periphery of needle retainer housing **100** with the other. As power is supplied to the electric motor of the tool, the barrel member **32** will rotate and, through the medium of the cam pin **88** and cam groove **86**, will impart reciprocatory movement to the plunger **78**. As barrel member **32** moves through one half of a revolution, the cam pin **88** and cam groove **86** will move the plunger axially outwardly of the barrel member and will thus move the plunger through the power half of its stroke. As the barrel rotates the remaining half of the revolution, the cam pin and groove will move the plunger axially

inwardly of the barrel member and will thus move the plunger through the retraction half of its stroke. The plunger **78** will thus be constantly and continuously driven by the motor and in both directions of travel.

On the power half of each stroke, the head **84** of the plunger will strike the needle retainer **110** and the needle heads **120** a sharp blow and will drive the needle retainer and needles axially outwardly of the housing **100** into contact with a surface to be scaled. On the return half of each stroke, the spring **124** will urge the retainer and needles axially inwardly of the housing **100** and will move them into a position where they can again be struck by the plunger head **84** on the next power half of the stroke of the plunger. Thus, acting under the influence of the plunger **78** and the spring **124**, the needles **118** will be cyclically and repeatedly impelled and moved axially outwardly and inwardly of the housing **100** into contact with a surface to be scaled.

The free or working ends **140** of the needles will repeatedly strike the surface to be cleaned with a series of sharp blows. These sharp blows will loosen or dislodge the material from such surface, and the needles will at the same time undergo a lateral whipping action which will remove the material from such surface. When pressure is applied to the needles by the operator of the tool or, in other words, when the needles are pushed into engagement with a surface to be scaled, the needles will flex or bow upon striking such surface, as illustrated in dotted lines in the drawing within the guide sleeve **128**.

As the needles **118** become shortened or worn away in use, the position of the guide sleeve **128** on housing **100** can be selectively varied to maintain the desired spacing between the ends **138** of the guide sleeve and the working ends of the needles. When the needles **118** become too short for use, they of course must be replaced and this can readily be done by merely removing the housing **100** from the cam drive housing **20** which provides ready access to the interior of needle retainer housing **100**.

The present invention provides a compact and light weight scaling tool and one having a slim silhouette, all of which is mainly due to the fewer number of components employed in the tool as compared to prior art devices and the axial arrangement of substantially all of the components thereof. The axial arrangement of the components, especially those within the cam drive housing **20**, permits the components to be made as small as possible and thus enables the components to be carried or packaged within housings having small diameters compared to their lengths. Scaling tools incorporating the present invention have been constructed and successfully used wherein one inch ball bearings have been employed to rotatably support the barrel member thereof. Needless to say the tool could be even further miniaturized without any difficulty and without interfering in any way with the successful operation thereof.

Having thus described one specific embodiment of the invention, it will be appreciated and understood that numerous other structural modifications and adaptations may be resorted to without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A needle scaling tool comprising:
electric motor means;
first housing means connected to said electric motor means and extending axially thereof;
barrel means rotatably supported within said housing means in axial alignment therewith and being driven by said motor means;
plunger means slidably and axially received within said barrel means and having cam groove means therein;
cam follower means carried by said barrel means and being receivable within said cam groove means in said plunger means;
second housing means detachably connected to said first housing means and extending axially thereof;
one end of said plunger means being slidably received within said second housing means;
needle retainer means slidably carried within said second housing means;
needle means slidably carried by said needle retainer means and extending axially outwardly of said second housing means; and
resilient means carried within said second housing means constantly urging said retainer means and said needle means toward engagement with said one end of said plunger means;
said cam follower means being operable upon rotation of said barrel means to impart reciprocatory movement to said plunger means to thereby cyclically and repeatedly impel said needle means outwardly of said second housing means into contact with a surface to be scaled;
wherein said needle retainer means is substantially cup-shaped in configuration and is provided with a plurality of passages in the bottom wall thereof;
said needle means takes the form of a plurality of elongated and flexible needles, one of which is slidably received in each passage in said bottom wall of said retainer means;
said needles having heads thereon adapted to seat in countersunk portions in one face of said bottom wall of said needle retainer means;
said resilient means carried within said second housing means takes the form of a compression spring;
one end of said compression spring being seated on the opposite face of said bottom wall of said cup-shaped needle retainer means and the opposite end of said compression spring being seated on an inturned flange on the opposite end of said second housing means.

2. A needle scaling tool comprising:
electric motor means;
first housing means connected to said electric motor means and extending axially thereof;
barrel means rotatably supported within said housing means in axial alignment therewith and being driven by said motor means;
plunger means slidably and axially received within said barrel means and having cam groove means therein;
cam follower means carried by said barrel means and being receivable within said cam groove means in said plunger means;
second housing means detachably connected to said first housing means and extending axially thereof;
one end of said plunger means being slidably received within said second housing means;
needle retainer means slidably carried within said second housing means;
needle means slidably carried by said needle retainer means and extending axially outwardly of said second housing means; and
resilient means carried within said second housing means constantly urging said retainer means and said needle means toward engagement with said one end of said plunger means;
said cam follower means being operable upon rotation of said barrel means to impart reciprocatory movement to said plunger means to thereby cyclically and repeatedly impel said needle means outwardly of said second housing means into contact with a surface to be scaled;
wherein said plunger means carries peripheral lubricant seals therein on opposite sides of said cam groove means; and
wherein said barrel means and said first housing means have sealable lubricant passages therein for the introduction of a lubricant into said cam groove means.

3. A needle scaling tool as claimed in claim **2** wherein said motor means includes an output shaft the end portion of which has a pair of opposed flat surfaces thereon;

the end portion of said output shaft being slidably received within a correspondingly shaped axially extending passage in one end wall of said barrel means; said pair of opposed flat surfaces on said end portion of said output shaft and said correspondingly shaped passage in said end wall of said barrel means providing a driving connection between said motor means and said barrel means.

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