March 19, 1940. C. A. SCHULZ 2,193,886

SPARK-PLUG TOOL

Filed Feb. 17, 1938

Fig. 1.

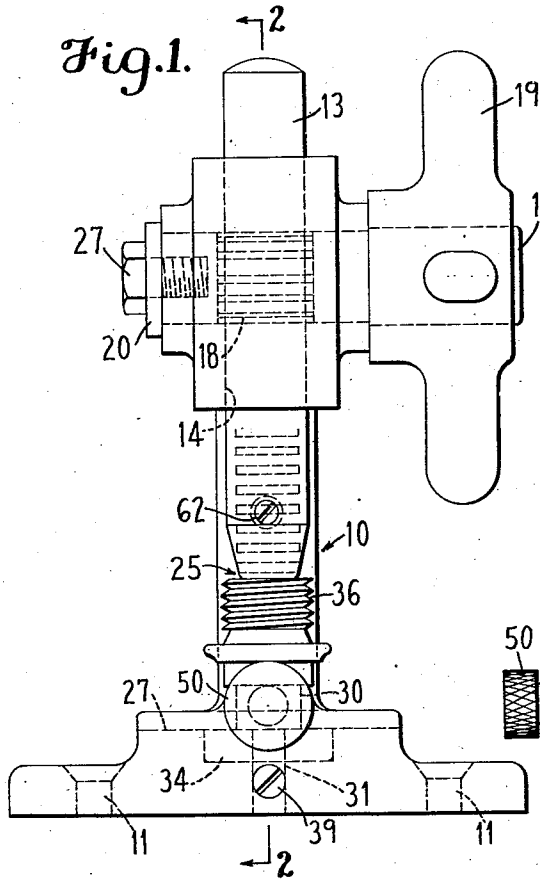


Fig. 2.

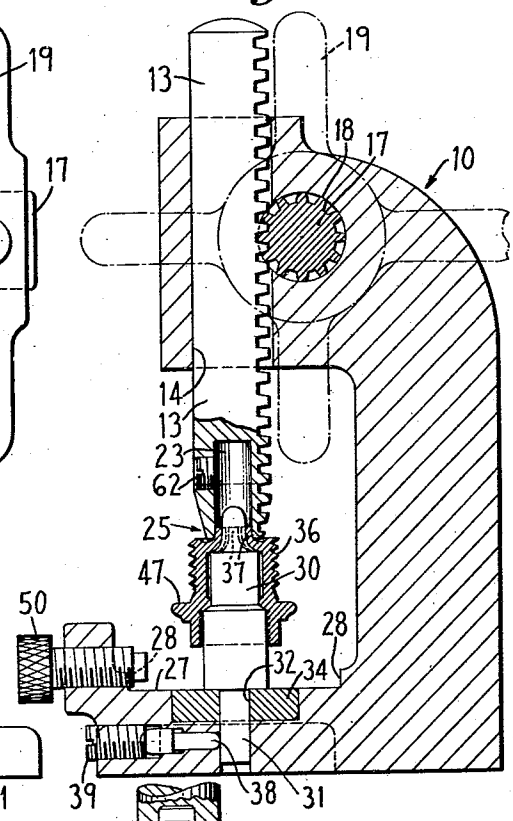


Fig. 3.

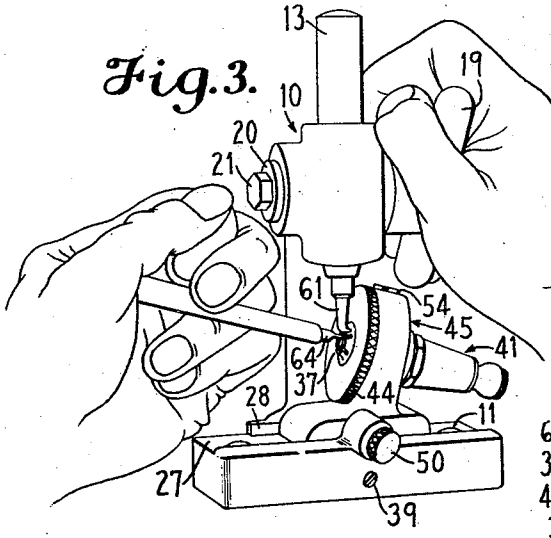


Fig. 4.

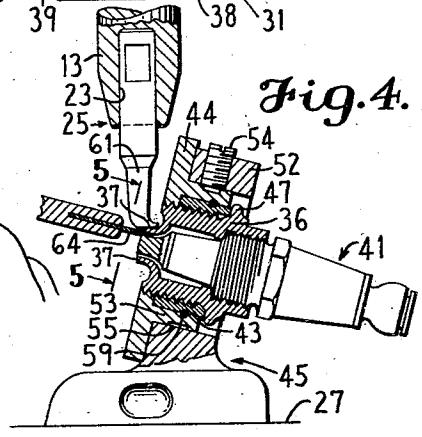
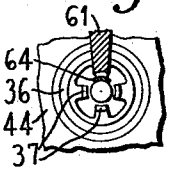


Fig. 5.



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SPARK-PLUG TOOL

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Application February 17, 1938, Serial No. 190,953

3 Claims. (Cl. 153—48)

A highly successful type of spark plug widely used in aviation engines includes a center electrode that has a concave surface at its lower end, and a shell surrounding the center electrode with a complementary inner face, preferably in the form of wide prongs, uniformly spaced from the center electrode surface. The spark jumps between the center electrode and the wide prongs, the point of discharge shifting fitfully across the spaced complementary surfaces.

When any points on these discharge surfaces become pitted or worn away, the spark jumps between other points that remain at the correct spacing. An extremely long term of service is required before the large surfaces between which the spark can jump become worn over sufficient area to interfere with the operation of the plug.

Such spark plugs give long and reliable service under severe engine conditions. When it does finally become necessary to adjust the spacing of the electrode surfaces, however, the adjustment must be made with great accuracy and it is important that the part of the shell electrode that has the complementary discharge surface spaced from the center electrode be formed to a truly complementary shape. The reforming of the shell electrode is a part of the adjustment of the spark plug.

It is an object of this invention to provide improved apparatus for forming the electrode surface of the shell and effecting correct spacing of the discharge surfaces in a spark plug of the character indicated. A more specific object of the invention is to provide a single tool with which the different operations of forming and adjusting the electrode surfaces can be efficiently carried out. This invention is used both for manufacturing spark plugs and for reconditioning plugs that have been in service for a long period.

Other objects, features and advantages of the invention will appear or be pointed out as the specification proceeds.

In the accompanying drawing, forming a part hereof:

Fig. 1 is a front elevation of a tool embodying this invention and shown with the plunger against a spark plug shell for forming the electrode surface of the shell.

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a reduced perspective view of the tool, showing the manner in which the tool is used to adjust the spacing of the electrode surfaces of the spark plug.

Fig. 4 is an enlarged sectional view through the carriage, gauge, and adjusting foot of Fig. 3, the parts being shown in the same relation as in Fig. 3.

Fig. 5 is a sectional view on the line 5—5 of Fig. 4.

The embodiment of the invention shown in the drawing has a frame 10 with countersunk screw holes 11 through its base for anchoring the frame to a work bench if a permanent location for the tool is desired.

A circular bar has gear teeth cut in one side to form a rack. This bar will be referred to hereinafter as the rack bar 13. There is a vertical bearing 14 in the frame 10, and the rack bar 13 slides up and down in that bearing. A horizontal shaft 17 turns in bearings in the frame 10 and has gear teeth cut in it to form a pinion 18 that engages the rack 13. The shaft 17 is turned by a hand-wheel 19 that is rigidly secured to one end of the shaft.

The hub of the hand-wheel 19 contacts with a boss on the side of the frame 10, and the shaft 17 is just long enough to extend through its bearing in the frame. A washer 20 is held against the end of the shaft 17 by a screw 21 that threads into the end of the shaft. The washer 20 contacts with a boss on the side of the frame to prevent displacement of the shaft 17 to the right, in Fig. 1, and the hub of the hand-wheel 19 prevents displacement of the shaft 17 toward the left. For the use of left-handed operators, however, the screw 21 and washer 20 can be removed and the shaft 17 pulled out of its bearings and inserted from the left side of the frame.

The rack bar 13 has a tapered lower end in which is a socket 23. The bottom of the rack bar is formed into a die, which is indicated generally by the reference character 25. Thus the bottom end of the rack bar is itself a tool in the illustrated embodiment of the invention, but the die 25 can be a separate piece and attached to the lower end of the rack bar.

On the base of the frame 10 there is a carriage guideway including a supporting surface 27 with guide surfaces 28 extending along both the front and back edges of the surface 27.

A die 30, which is shaped for the particular spark plug sleeve that is to be formed, has a stem 31 that fits into a socket 32 in the base of the frame and in line with the rack bar 13. A hardened insert 34 in the surface 27 at the upper end of the socket 32 prevents the surface from being scratched or nicked by the die 30 or the shoulder of the die that rests on the insert 34.

A spark-plug shell 36 fits over the die 30, and the upper end of the die is substantially the shape desired for the discharge surface of the shell. The actual dimensions of the die 30 are a little oversize so that the prongs 37 at the end of the shell 36 are spaced a few thousandths too far apart and can be bent into exact position as determined by a thickness gauge.

The rack bar is lowered until the die 25 is in contact with the shell 36. The rack bar is then struck on the top with a hammer once or twice

to bend the prongs at the end of the shell to the exact contour of the die. The die **25** at the bottom of the rack bar **13** is shaped so that it has a "drawing" action over the die **30** rather than a true "forming" action as understood in the die art. The operation is referred to herein as the "forming of the shell," however, using the term in its broader sense.

The die **30** is held in position by a die lock pin **38** clamped against the stem **31** by a set-screw **39** threading through the forward wall of the base.

After the forming of the shell **36** in the manner described above, the shell **36** is screwed onto the rest of the plug **41**, as shown in Fig. 4, and the assembled spark plug is inserted through a bushing **43** and threaded into a face plate **44** of a carriage **45** until the shoulder **47** of the plug comes against the end of the bushing **43**.

The carriage **45** rests on the supporting surface **27** and has a width substantially equal to the distance between the guide surfaces **28**, best shown in Fig. 2. When the carriage has been moved into position to locate the electrode end of the plug in the proper relation to the path of movement of the rack bar **13**, a set-screw **50**, threaded into the front of the frame **10**, is tightened against the carriage **45** to lock it in position.

The carriage **45** includes a body portion **52**, a part of which extends upward at a substantial acute angle to the vertical as shown in Fig. 4. The face plate **44** has a sleeve **53** extending from its back face. This sleeve **53** fits into the upstanding part of the carriage body **52**, and is held in the carriage body by a set-screw **54**, that extends into a circumferential groove **55** in the sleeve **53** and leaves the sleeve and the face plate **44** free to rotate.

The bushing **43** surrounds the tops of the outside threads of the shell **36** and limits the extent to which the spark plug can be screwed into the face plate **44** by providing an abutment against which the shoulder of the spark plug strikes. The bushing **43** has a circumferential groove registering with a groove on the inside surface of the sleeve **53**, and a spring **59** confined in these grooves holds the bushing against displacement from the sleeve. The spring **59** yields, however, to permit the bushing to be forced from the sleeve when a longer bushing is to be inserted for a different model of spark plug.

An electrode adjusting foot **61** has an enlarged upper end that fits snugly into the socket **23** in the bottom of the rack bar **13**. The adjusting foot **61** is held fast in the socket by a set-screw **62** (Figs. 1 and 2), and the rack and pinion mechanism is operated to bring the adjusting foot down against the uppermost prong **37** of the spark-plug shell **36**. A thickness gauge **64** is inserted between the center electrode of the spark plug and the uppermost prong **37** of the shell; the hand-wheel is then operated, and the prong is pressed against the thickness gauge with sufficient force to reduce the clearance between the electrode surfaces to the dimension of the thickness gauge.

The face plate **44** is turned to bring each of the four prongs on the end of the shell **36** successively into position under the adjusting foot **61**. Fig. 3 illustrates the manner in which an operator holds the thickness gauge **64** in one hand and turns the hand-wheel **19** with the other hand. The hand-wheel is of such a size in proportion to the size of the pinion and other parts that no injury to the plug will be caused with any reasonable force that is applied to the hand-wheel.

The preferred embodiment of the invention has been illustrated and described, but modifications can be made and some features of the invention may be used without others.

I claim:

1. A tool for spark plugs that have a center electrode with a curved surface, and a sleeve portion having one or more other electrodes each with a complementary surface that is uniformly spaced from the center electrode surface over a substantial area when the spark plug is assembled, said tool comprising a frame with means for engaging and holding said sleeve portion of a spark plug in a fixed position, a rack bar movable in a bearing in a portion of said frame toward and from an electrode of a sleeve portion so held, and a die which is located at the end of the rack bar and which is so curved that it forms the electrode of the sleeve portion on the engaging and holding means to said complementary surface when said die on the rack bar is pressed against the electrode with a deforming pressure.

2. A spark-plug tool for making the surface of an electrode on a spark-plug shell correspond to the curve of a complementary center electrode of the spark plug, said tool including a frame having a base on which is a supporting surface, an upper frame portion with a bearing, a rack bar slidable in the bearing toward and from the supporting surface on the base, a handle and pinion for causing the rack to move up and down, a socket in said supporting surface, die means comprising a member with a stem at the lower end that fits into the socket, an upper portion shaped to receive a spark-plug shell and a top surface that forms a die with a surface of substantially the desired shape of the surface of the electrode on the spark-plug shell, a second die that cooperates with the die means on which the electrode shell is supported, said second die being formed at and integral with the lower end of the rack bar and being of a curved shape to cooperate with the die on the shell-supporting die means to form the shell electrode surface to the desired shape.

3. A tool for spark plugs of the type which have a shell with electrode prongs that converge inward from the end of the shell and toward the axis of the spark plug, said tool including a first die having a portion that engages and holds the spark-plug shell in a definite position and having another portion with a tapering surface of substantially the desired shape of one side of the converging electrode prongs, a second die having a tapering surface complementary to the tapering surface of the first die and constructed and arranged to compress the electrode prongs against the die that receives the spark-plug shell, supporting means associated with the die that receives the spark-plug shell for holding that die and said shell in a definite position in the path of said second die, and means connected in definite relation to the die supporting means for forcing one of the dies against the other to compress the electrode prongs between said dies.

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