

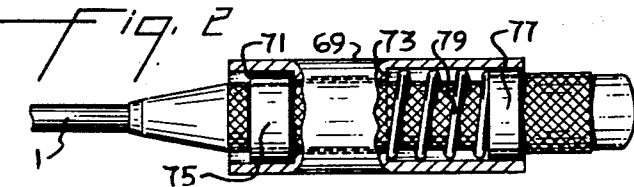
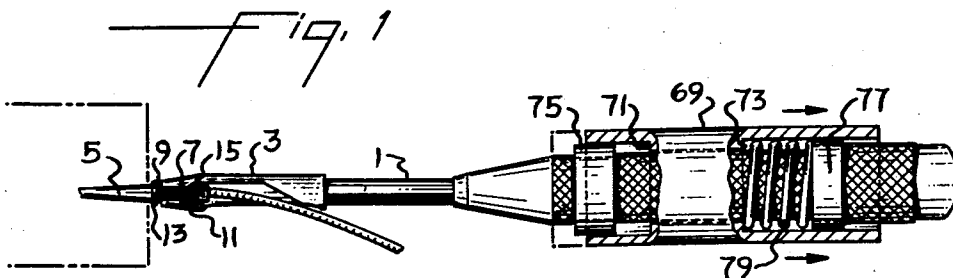
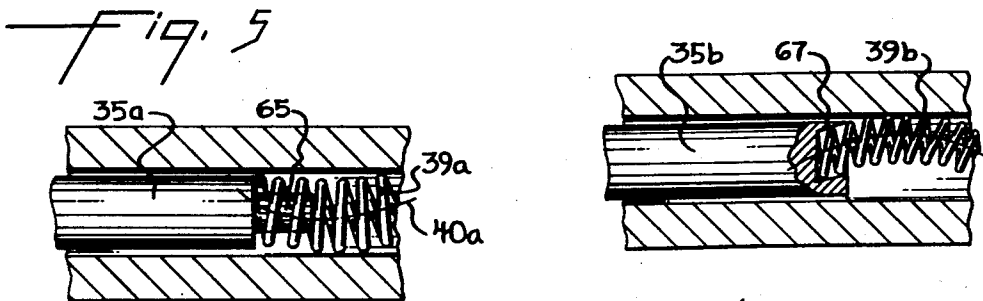
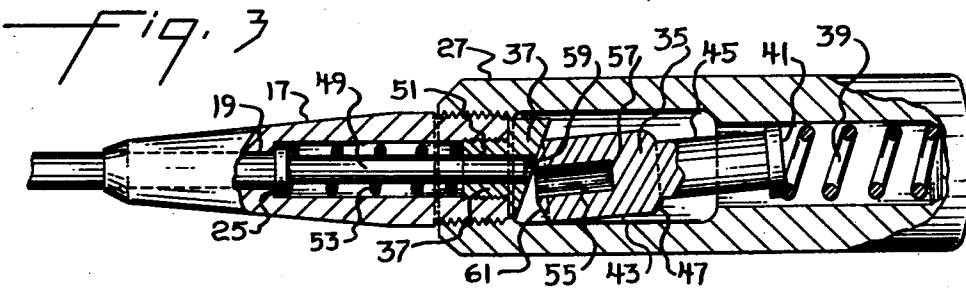
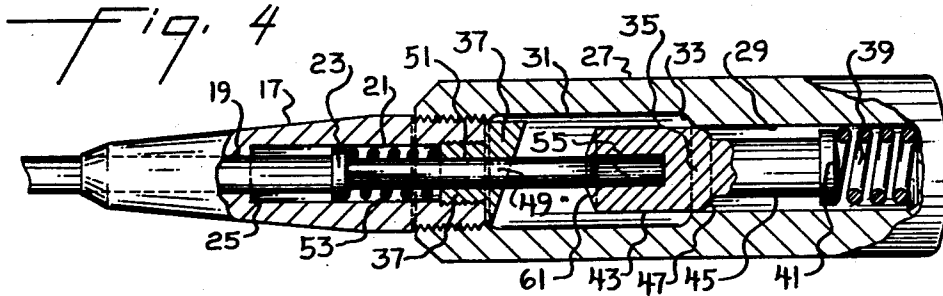
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2,960,864

INSERTION TOOL

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INSERTION TOOL

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This invention relates to a tool for assembling the elements of a solderless electrical connection and more particularly to a tool for driving together and testing the efficacy of the elements of a taper fit electrical connection.

The well-known taper fit frictional connector is established as a convenient means for coupling electrical leads. In one form the taper fit connector comprises a pin rolled from sheet metal with one portion being tapered to mate with a correspondingly tapered socket and another portion providing the connection with the lead end to be terminated. A circumferential bead intermediate the pin length provides a surface by which the pin may receive an axial driving force for insertion into its associated receptacle. To derive the maximum benefit from the high utility potential inherent in the taper pin as an electrical connector two factors must be carefully controlled. First, the departure from uniformity in the physical characteristics of the pin must be limited to closely held tolerances. Secondly a high degree of uniformity and consistency must be maintained in the procedure for insertion of the pin into their mating associated receptacles.

One means heretofore proposed to assure uniformity in the insertion procedure is disclosed in the co-pending application to Gilbert C. Sitz, Serial No. 408,632, filed February 8, 1954, now Patent No. 2,774,133. In this application there is described a manually operated tool which, upon setting the taper pin in the tool and alignment within the mating receptacle, delivers a predetermined spring generated impact calculated to drive the pin into an optimum force fit within the receptacle. Such tools release the driving impact by automatic operation of a relatively complicated triggering mechanism. In order to obtain uniformity of insertion within acceptable tolerance limits by the use of a spring-generated impact driving force, the trigger mechanism must operate with a high degree of precision inasmuch as slight variations in timing are magnified when translated into effective impact delivered by the tool. The more complicated the triggering mechanism and the more moving parts involved, the greater the irregularity in operation, especially such irregularities as are induced by friction.

In addition it is desired, even in those instances where an optimum driving impact has been generated within the tool, that assurance of effective transmission to the connector elements be had, that is, operator misuse or mishandling is avoided. Furthermore it is desirable that unobserved deficiencies in the connector parts which result in a sub-standard connection be revealed during the insertion procedure.

It is therefore an object of the present invention to provide an improved tool for assembling the component parts of a taper fit frictional connector.

Another object of the present invention is to provide an impact tool for connecting taper pin connectors of improved impact delivering characteristics.

A further object is to provide in an impact tool for

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taper pin connectors a simplified trigger mechanism having a minimum of parts whereby irregularities induced in the operation thereof by friction are lessened or avoided.

5 Still another object of the present invention is to provide a tool for testing taper pin connections for sub-standard tensile characteristics.

A still further object is to provide in an impact tool for taper pin connectors a testing mechanism operable 10 to detect and remove connections of sub-standard tensile characteristics.

Another object is to provide a taper pin tool wherein upon setting of a taper pin therein cyclical operation in continuous forward and backward strokes are effective 15 to drive the pin with an impact of predetermined magnitude and to test the resultant connection for assuring that minimum standards for the connection thus made are met.

To attain these objectives the tool in general includes 20 a shank having on one end a head for receiving and setting the connector to be engaged. Coupled to the shank is an impact delivering mechanism operable through the head to impart a driving force for applying the connector to its mating part, the impact mechanism being of 25 the spring-actuated hammer type triggered automatically after a predetermined forward movement of the tool parts. Transverse shifting of the hammer relative to the plunger, which plunger serves to compress the hammer against the spring in the system is relied upon to align 30 and disalign telescoping parts that effect the triggering action. Also coupled to the head is a test mechanism operable in the backward stroke of the tool to apply to the terminal a predetermined tension in a direction tending to disconnect the elements of the connector, 35 which mechanism includes a drawing sleeve spring-biased against a stop so as to be constrained against movement relative to the connector engaging head with a force determined by the minimum tensile strength desired in the resultant connection.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described an illustrative embodiment of 45 the invention; it is to be understood, however, that this embodiment is not intended to be exhaustive nor limiting of the invention but is given for purposes of illustration in order that others skilled in the art may fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best 50 suited to the conditions of a particular use.

In the drawings:

Figure 1 is a side view of a tool embodying the 55 present invention with a taper pin connector in position in the tool head, and with parts of the tool being broken away to illustrate details in the test mechanism;

Figure 2 is a fragmentary side view similar to Figure 1 to illustrate the details of the test mechanism in rest 60 position;

Figure 3 is an enlarged fragmentary side view with portions in side section to illustrate the impact delivering mechanisms of the tool in rest position;

Figure 4 is a view similar to Figure 3 with the impact 65 delivering mechanism in the position taken just prior to delivery of the impact;

Figure 5 is a fragmentary sectional side view of a modified form of certain of the elements in the impact generating mechanism of the tool; and

Figure 6 is a fragmentary sectional side view illustrating another form that the elements of the impact generating mechanism shown in Figure 5 may take.

In the embodiment illustrated in Figure 1 the tool of the present invention includes a shank or shaft 1 having at its acting end a head 3 in which one element 5 of a pair of frictional interlocking connector parts is set in a manner such that forces in both directions along the axis of shank 1 may be transmitted thereto through head 3. Where connector 5 takes the form of the well-known sheet metal taper pin, which is adapted to be driven into a frictional force fit with a mating part (not shown), the terminal engaging portion of head 3 may include a longitudinal slot 7 for receiving the taper pin neck, and forward and rearward faces 9 and 11 adapted to engage driving bead 13 or lateral shoulder portion 15 respectively of pin 5 depending upon the direction of axial movement of shank 1, all is described in detail in the aforesaid co-pending application Serial No. 408,632, now Patent No. 2,774,133. It is to be understood, however, that the particular form of the terminal engaging portion of head 3 is subject to variation according to the characteristics of the terminal element to be applied.

Referring now to Figures 3 and 4, shank 1 is slidably mounted in shank holder guide 17 having a small bore 19 fitted to the diameter of the shank and a counterbore 21 of enlarged diameter for accommodating collar 23 fixed to the end of shank 1 which thereby is retained in the holder guide 17 by virtue of the cooperation of collar 23 with shoulder 25 at the transition between bores 19 and 21. Shank holder guide 17 is threadably received at one end of a housing 27 which provides a bore or well 29 and a cylindrical cavity 31 of enlarged diameter to define at the transition section a camming shoulder 33 to be referred in more detail hereinafter. An elongated hammer 35, generally of cylindrical configuration, is received in cavity 31 and bore 29, and in normal position rests against a plug 37 which is threaded to shank holder guide 17. Hammer 35 is spring biased to its rest position by a spring 39, preferably a compression coil spring, which is received in well 29 so as to bear against the closed end of housing 27 and the butt-end 41 of hammer 35. The forward portion 43, approximating half the length of hammer 35, is significantly less in diameter than cavity 31, but fitted to the diameter of well 29, while the rear portion 45 is significantly less in diameter compared to well 29 whereby the hammer in its rest position may be canted relative to the longitudinal axis of the tool as indicated in Figure 3. The transition section 47 between portions 43 and 45 of the hammer defines an annular cam shoulder 47 for cooperation with shoulder 33 in a manner to be explained.

Extending from the end of shank 19 is a plunger or stem 49 which is slidably guided by an axial bore 51 in plug 37, the plunger being of a length so as to project axially within cavity 31 upon rearward movement of shank 19, but to be completely withdrawn therefrom when collar 23 is moved to its forward limit as defined by shoulder 25 as illustrated in Figure 3. A small coil spring 53, disposed about plunger 49, is preferably employed to bias the end of the plunger out of cavity 31 and collar 23 against stop 25, the coil spring bearing at one end against the forward face of plug 35 and at the other end against collar 23.

A blind bore 55 formed axially in hammer portion 43 and terminating in a striking surface 57 is adapted to receive and guide the end of plunger 49 upon bringing the hammer into axial alignment with the plunger. Due to the initial canted position of hammer 35, however, the butt end of plunger 49, defining an anvil surface 59, is adapted to engage the forward face 61 of hammer 35 in an offset relationship relative to bore 55 until such time as the mechanism is triggered, that is, the hammer and bore 55 are brought into coaxial alignment within the housing 27. Upon such alignment the plunger, then may be telescoped within bore 55 to permit the hammer, under compulsion from compression spring 39, to be driven forwardly within the tool, and at striking surface 57 to

deliver a sharp blow to anvil surface 59, thus to impart an impact along plunger 49 and shank 19 in a manner now to be described.

With a taper pin connector assembled in the tool head with the connecting part inserted within the mating connector, initial forward movement of housing 27, to the left in Figures 1 and 3, produces a relative movement of the plunger 49 into cavity 31 and causes anvil surface 59 to engage the forward face 61 of hammer 35. Further relative movement of the plunger causes the hammer to move rearwardly which serves to compress and store energy within spring 39 until the point is reached where the cam shoulder 47 strikes the camming shoulder or constriction 33 of the housing. The camming shoulders are cooperatively arranged to effect a centering and coaxial alignment of the hammer within the housing. Accordingly, as the larger portion 43 of the hammer begins to slide into well 29, there occurs a relative sliding of the plunger end 59 across hammer face 61 ultimately to reach the point where blind bore 55 is registered axially with plunger 49 as shown in Figure 4. Upon this occurrence the tool has been triggered and the hammer is released from the restraint imposed by plunger 49 and is free to move quickly forwardly under the impulsion of spring 39 ultimately to deliver a sharp blow upon striking surface 57 coming into contact with anvil surface 59. This sharp blow is transmitted through plunger 49, shank 19 and the forward face 9 of the tool head to the taper pin at driving bead 13 resulting in the taper pin being driven into a force fit within its mating receptacle.

The magnitude of the blow struck by hammer 35 is determined by the mass of the hammer and its velocity at impact which depends upon the characteristics of spring 39. According to the purposes for which the tool is designed, the impact delivered is subject to control by preselecting the relative weight of the aforesaid factors. For example, in this illustrative use it is desired that the resultant taper pin connection have a predetermined minimum pull-out or tensile strength. Suitable weight and design of the hammer and impelling spring will assure a blow of sufficient magnitude to drive pins of least minimum quality into a frictional force fit in excess of minimum tensile requirements. On the other hand the impact delivered should not be so great as to cause damage to the parts.

Release of the forward pressure of housing 27 permits all the parts to return to their rest position, Figure 3, in readiness for the next blow.

During the rearward travel of the hammer under pressure from plunger 49, prior to triggering of the mechanism, there is a tendency due to the eccentric or offset loading for the plunger end face 59 to slide across the forward surface 61 of the hammer. Any such movement would tend to cause undesirable irregularity in the magnitude of impact delivered by the tool from blow-to-blow and nonuniformity in the tensile strength of the resultant connection made by the tool. To counteract this tendency, the end surface 61 is preferably cone-shaped or beveled, as indicated in Figures 3 and 4, the bevel angle being such that when the hammer is in its rest and canted position, the plane of surface 61 is inclined toward the plunger axis to result in a point of engagement as near as possible to the central axis of the plunger and coil spring 39 thereby reducing the tendency to slide to a minimum.

To insure that the hammer in its rest position is canted or tilted within cavity 31 to disalign bore 55 and plunger 49, the end surface of plug 37 against which the hammer abuts is inclined relative to the transverse axis of the tool. During return of the hammer to its rest position under pressure from spring 39, the forward end of the hammer is effectively cammed or shifted to one side as shown in Figure 3.

In another embodiment of the invention, Figure 5, the canting action on the hammer may be effected by

prestressing the compression spring to a predetermined curvature thereby to load the hammer eccentrically and to cause a lateral throw or shift. In this embodiment the coil spring 39a is pre-stressed to have a curvature indicated by the dotted center line 40a and is disposed at one end about an integral stud 65 projecting from the butt end of hammer 35a. Alternatively, the end of pre-curved spring 39b may be received in a blind bore or well 67 drilled in the end of hammer 35b at an angle inclined with respect to the longitudinal axis of the tool as shown in Figure 6.

As alluded to above, the application of taper pins is a relatively critical operation and due to misuse of the tool by unskilled or misattentive operators, misfiring of the tool, or imperfection in the connector parts, the connection made may be less than the optimum, that is, the tensile strength may be inadequate. Advantageously, operation of the tool should insure a connection meeting at least the minimum requirements established in the art. To this end the tool includes mechanism operative in each reverse stroke of the tool, to the right in Figure 1, following the forward connecting stroke of the tool, to apply a test in tension to each connection which results either in an indication that the connection exceeds minimum requirements or a removal of those connections falling below the predetermined minimum established in the test. As shown in Figures 1 and 2, disposed in slideable relationship about housing 27 is a sleeve 69, the internal diameter of which is enlarged from either end to provide internal forward and rearward shoulders 71 and 73, respectively. A forward collar 75 rigidly affixed to housing 27 cooperates with shoulder 71 to define the forward limit in movement of sleeve 69 relative to housing 27. A rear collar 77 on housing 27 serves as a bearing surface for one end of a coil spring 79 disposed about housing 71, the coil spring being arranged to bear against shoulder 73 so as to bias the sleeve to its forward position against stop collar 75, Figure 2.

In rest position of the parts, spring 79 is in a partially compressed or loaded condition so that a precalculated amount of force is required to unseat shoulder 71 from stop collar 75 by movement or sliding of sleeve 69 relative to housing 27, to the right as indicated by the arrows in Figure 1. Sleeve 69 is thus yieldably biased to a relatively fixed position in the tool, which bias must be overcome in the rearward stroke of the tool before relative movement of sleeve 69 can occur.

In operation to test the connections made in the forward stroke of the tool through actuation of the impact mechanism, sleeve 69 is employed to impart a rearwardly directed force through spring 79, housing 27, shank 1, head 3 and rear face 11 to the connector at projection 15 in a direction tending to disconnect the connection. If the connection exceeds minimum requirements spring 79 ultimately will yield with the resultant relative movement of the sleeve on housing 27 servicing to indicate a satisfactory connection. If the connection is inadequate in tensile characteristics, the driven connector will be disengaged from its mating connector element before relative sliding movement of the sleeve occurs.

Obviously, in the assembly of the tool the degree to which spring 79 is compressed, and consequently the force required to unseat the sleeve, is less than the effective force of the impact delivered by hammer 35, the magnitude of the force differential being subject to variation in accordance with the results desired. For example, if in a taper pin connection it is desired that an optimum connection have a pull-out or tensile strength of the order of 20 pounds and a minimum of 15 pounds, the impact mechanism is designed to seat standard quality connector parts upon proper firing of the tool to the prescribed force fit while the precompression of spring 79 in the test

mechanism is set at the 15-pound established minimum.

Conveniently the tool of this invention may be adapted for manual operation and embodied in a single screw-driver-like form. As thus constructed, an operator by manipulation of sleeve 69 may impart the forward and rearward thrusts required in operation of the tool mechanisms.

I claim:

1. A pull-test device adapted for assembly and co-operation, in the installation of a taper fit electrical connector, with a connector driving tool having a shank with a connector engaging head and a tubular housing for receiving and transmitting forward and reverse axial loads on an end portion of the shank, said device including a pair of collars for longitudinally spaced fixed disposition on said housing, a sleeve slidably mounted on said collars and having an internally reduced section projecting between said collars, said reduced section providing a forward shoulder for engaging a side face of the collar nearest said head, and a compression spring for disposition around said housing and bearing with a predetermined pressure at its ends against a side face of the other of said collars and a rear shoulder provided by said reduced section.

2. A tool for installing in a mating part a taper fit frictional connector having lateral abutments providing pushing and pulling surfaces, comprising a shank having at one end a connector supporting head having pushing and pulling faces engageable with said pushing and pulling surfaces respectively, a sleeve receiving the other end of said shank and mounted for manual movement from a rest position relatively toward and away from the head end of said shank, and a coupling between said sleeve and said shank for transmitting pushing and pulling forces to said connector surfaces, said coupling including means for biasing said sleeve in said rest position, and further including an impact delivering mechanism operative upon predetermined movement of said sleeve toward said head end to impart an impact force to said shank, and further including a yieldable connection releasing said sleeve for limited movement relative to said rest position away from said head end upon a predetermined pulling force being exerted between the sleeve and shank.

3. A tool for installing in a mating part a taper fit frictional connector having lateral abutments providing pushing and pulling surfaces, comprising a shank having at one end a connector supporting head having pushing and pulling faces engageable with said pushing and pulling surfaces respectively, a tool body telescopically receiving the other end of said shank, an impact delivering mechanism in said tool body for imparting an impact force through said pushing face upon predetermined inward telescoping movement of said shank in said body, said tool body including a sleeve mounted for coaxial movement relative to said shank, a stop limiting relative movement of said sleeve in the direction of pushing movement of said tool, and a yieldable connection between said sleeve and said shank releasing said sleeve for movement relative to said shank upon a predetermined pulling force being exerted therebetween.

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