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(54) **ELECTROFUSION TOOL**

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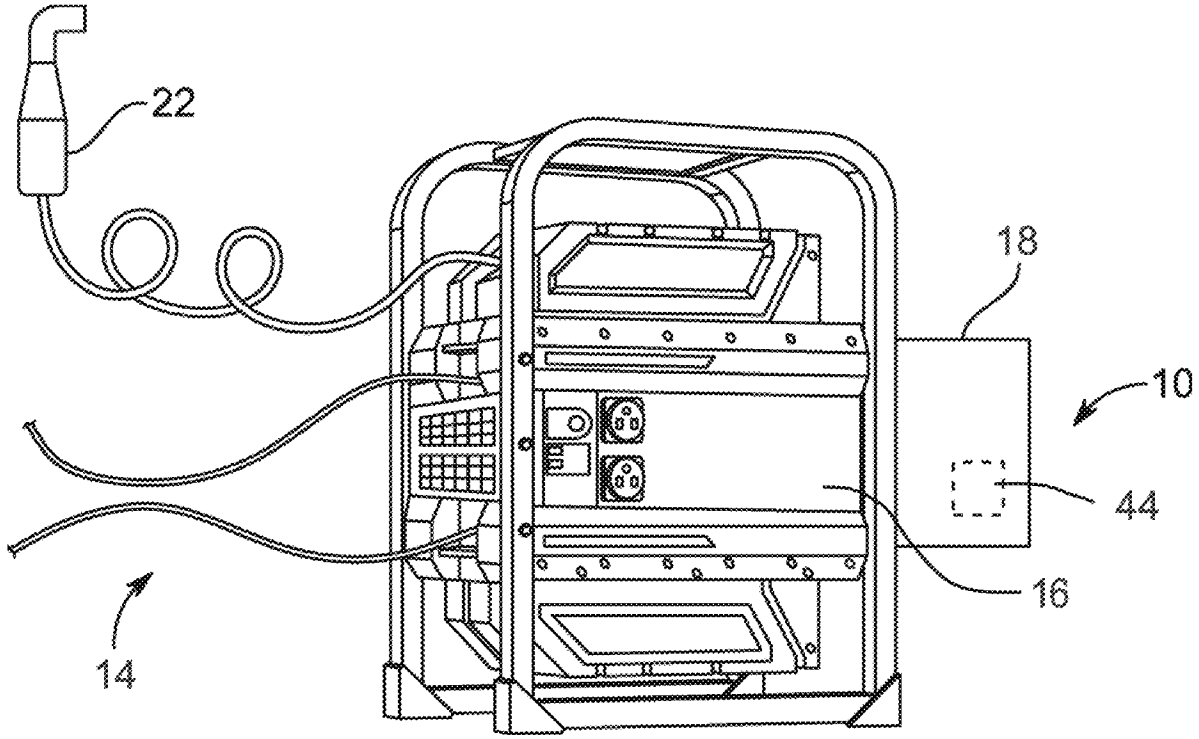
(57) **ABSTRACT**

A universal tip for an electrofusion tool including a main body configured to be electrically connected to an electrical lead of the electrofusion tool, and a contact supported by the main body being capable of transferring a voltage from the electrofusion tool to a pipe fitting. The contact is adjustable between a first configuration, in which the contact is configured to engage a first terminal having a first size, and a second configuration, in which the contact is configured to engage a second terminal having a second size that is different than the first size.



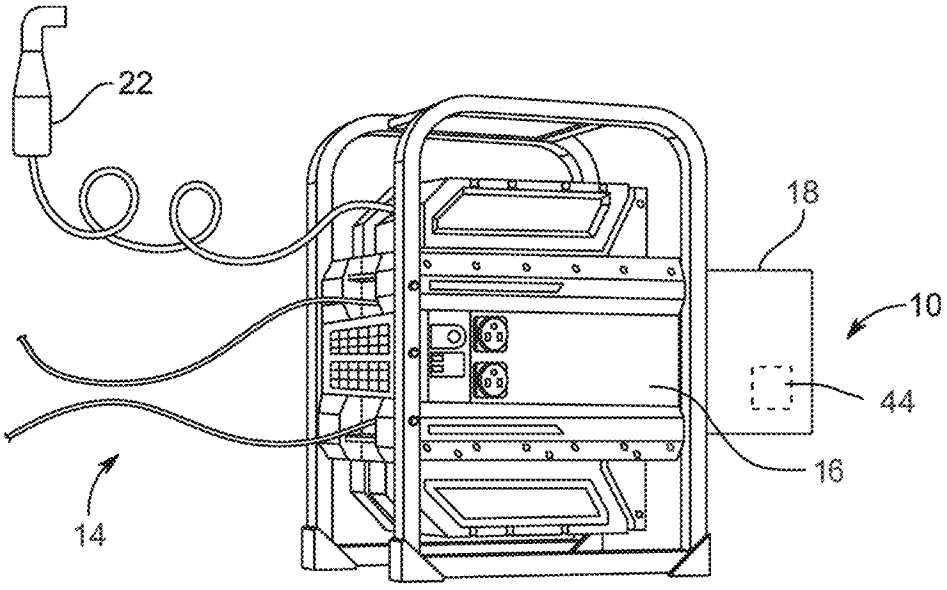


FIG. 1

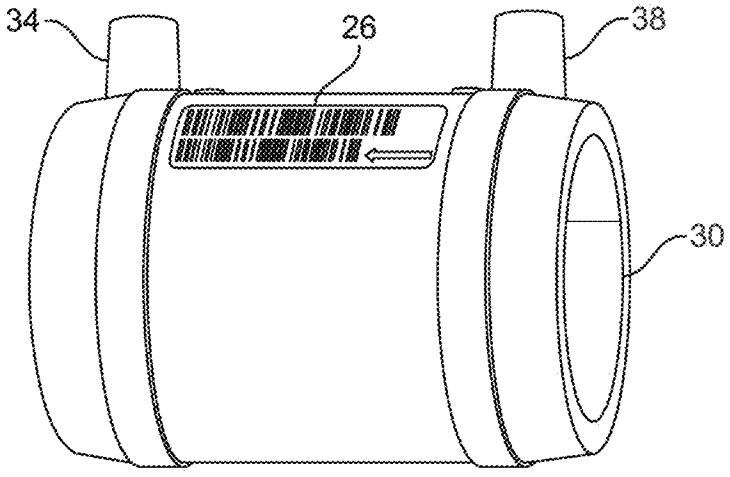


FIG. 2

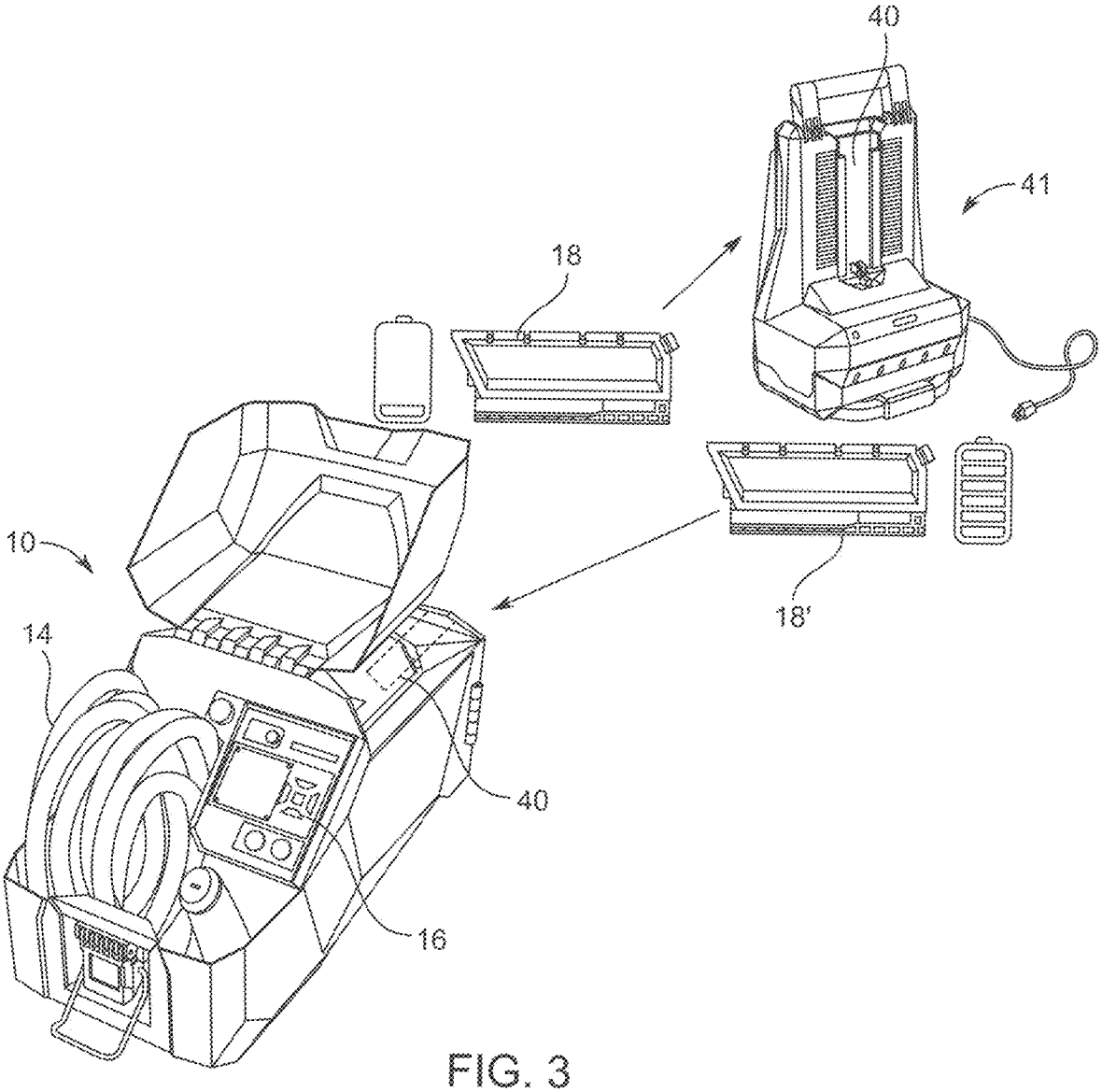


FIG. 3

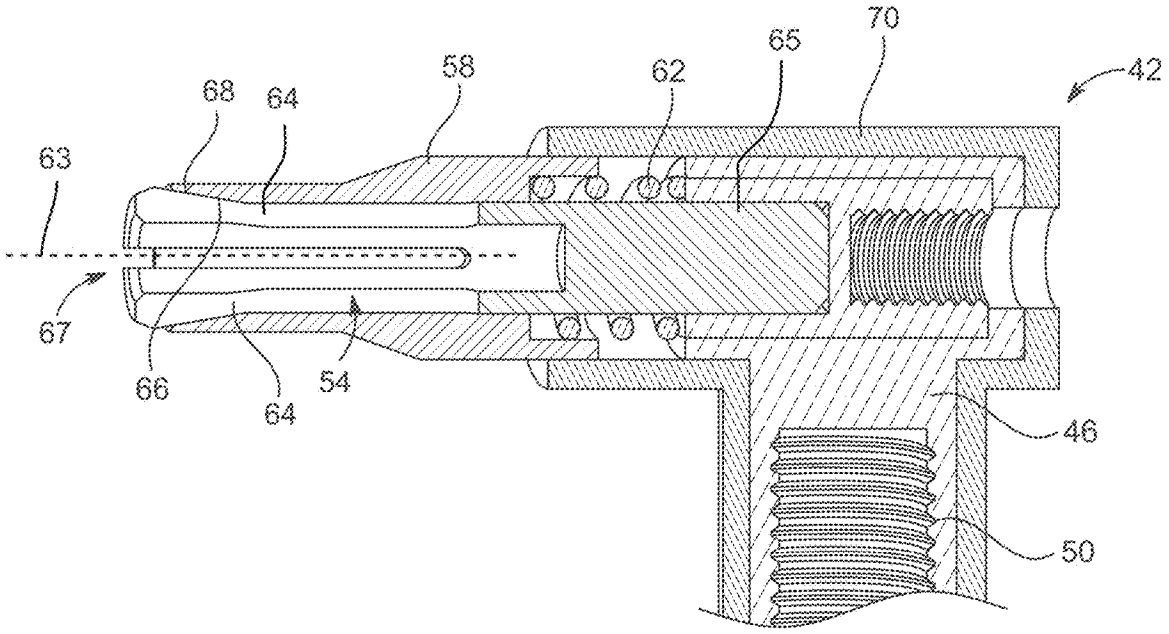

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FIG. 4

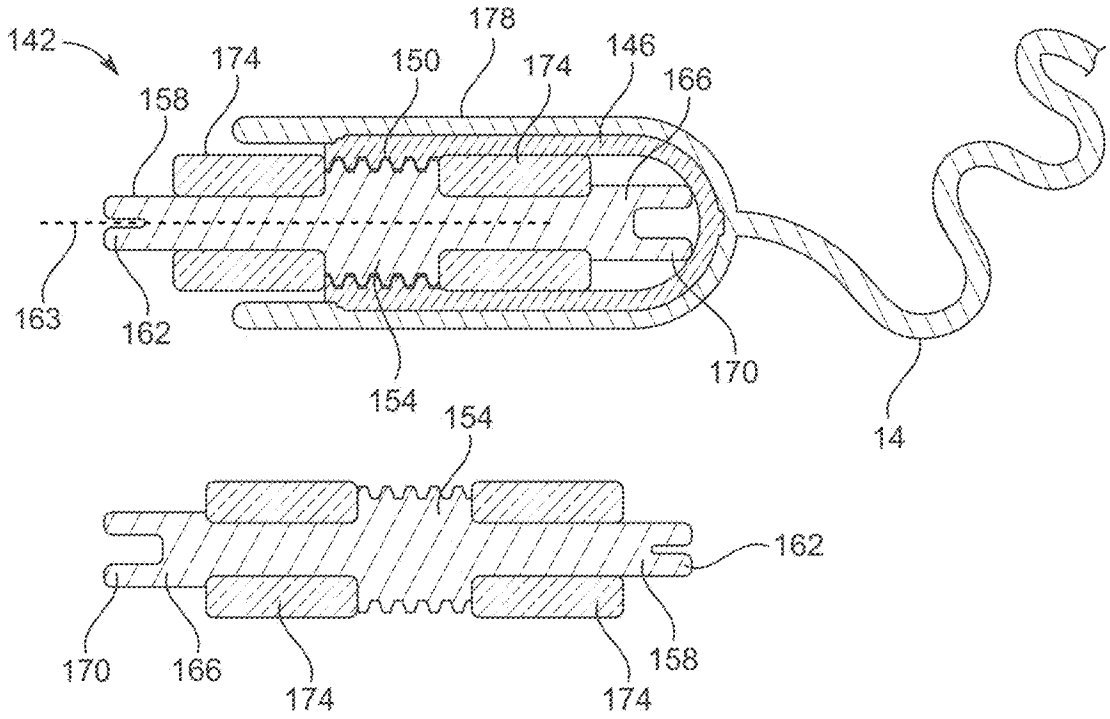
142
178
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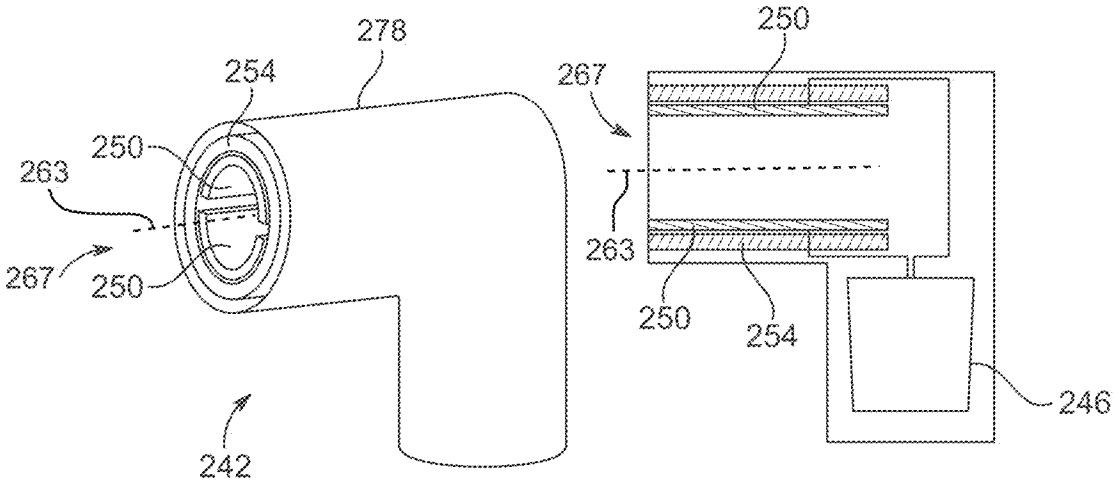
FIG. 5


278
254
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263
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246

FIG. 6

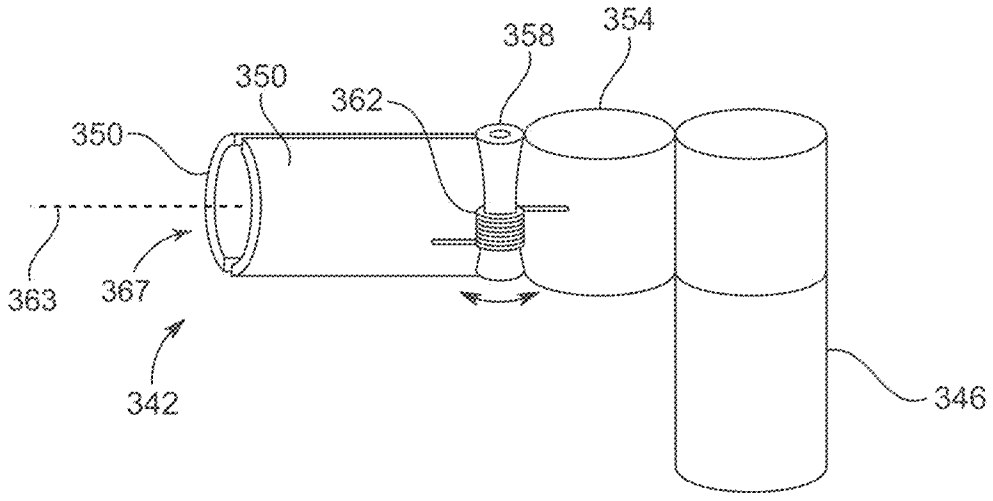
358
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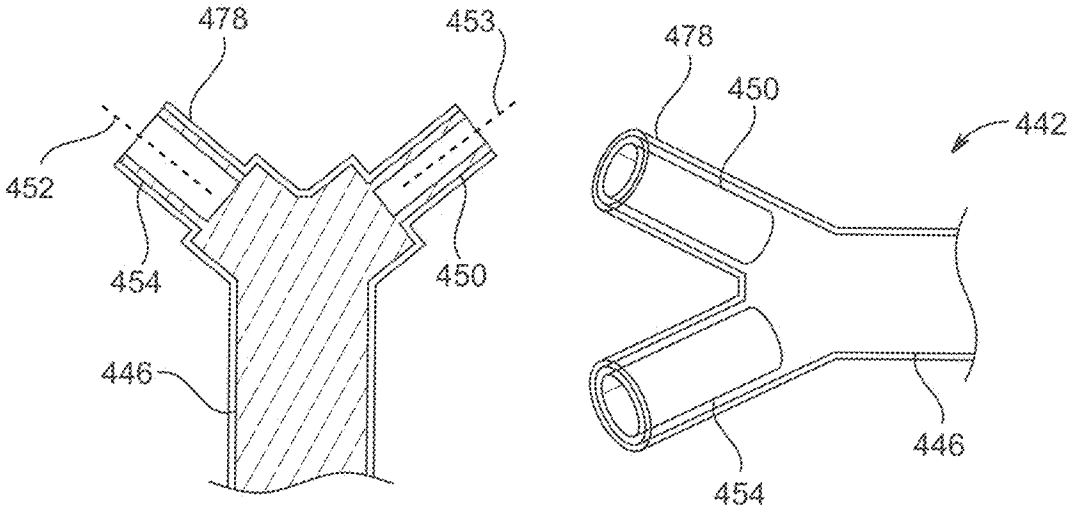
FIG. 7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454

FIG. 8

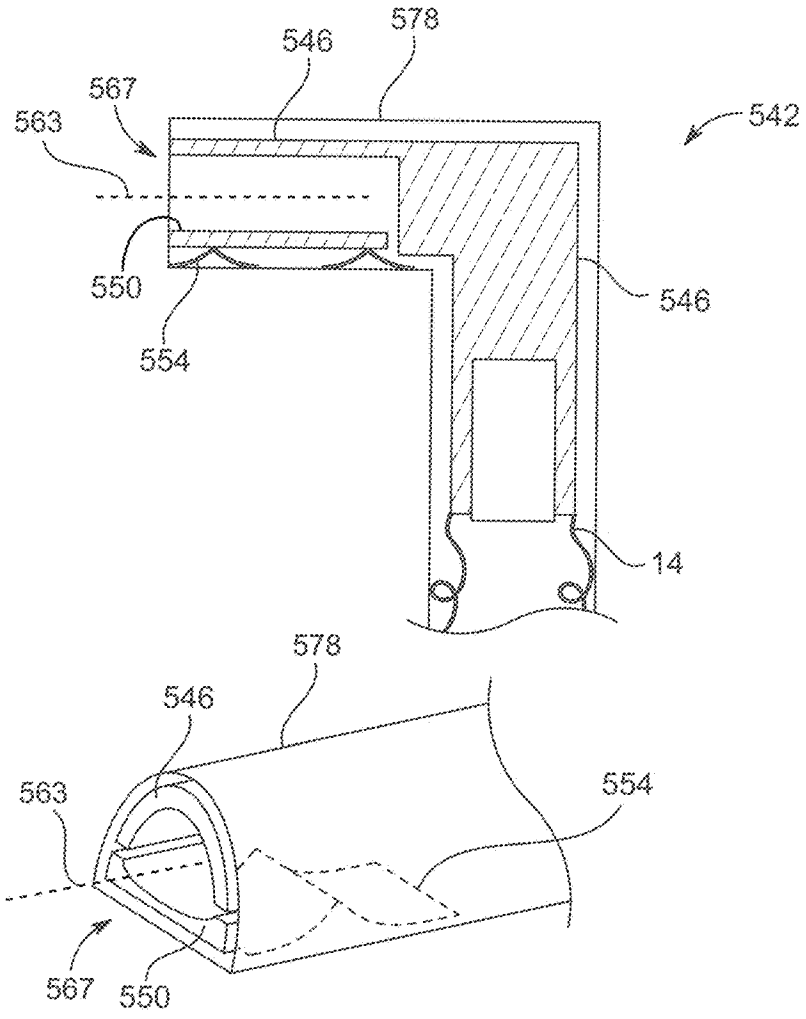
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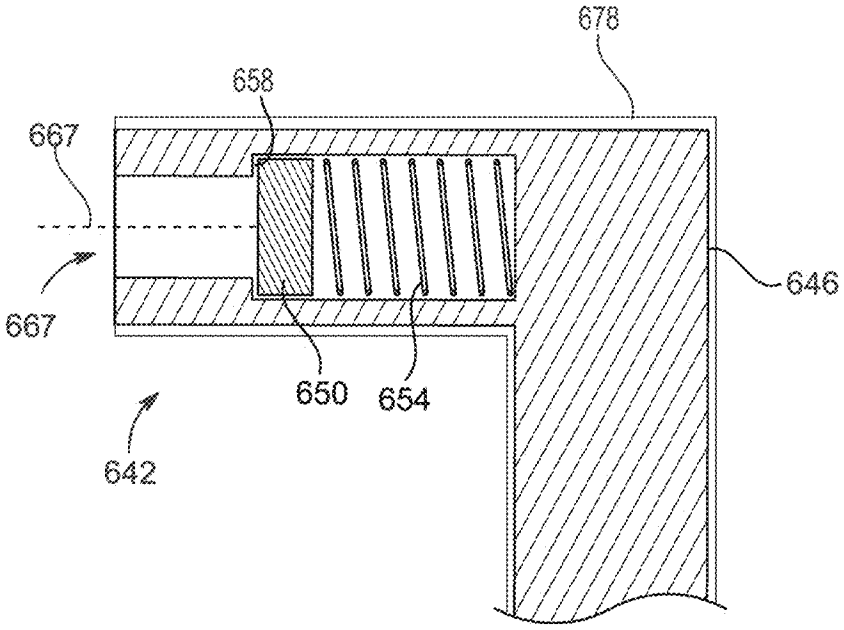
FIG. 9


678
658
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646
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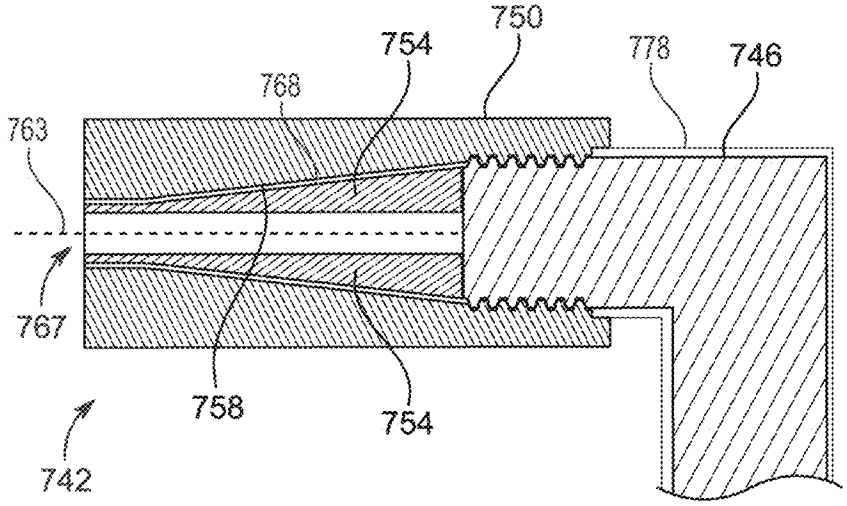
654
642

FIG. 10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754
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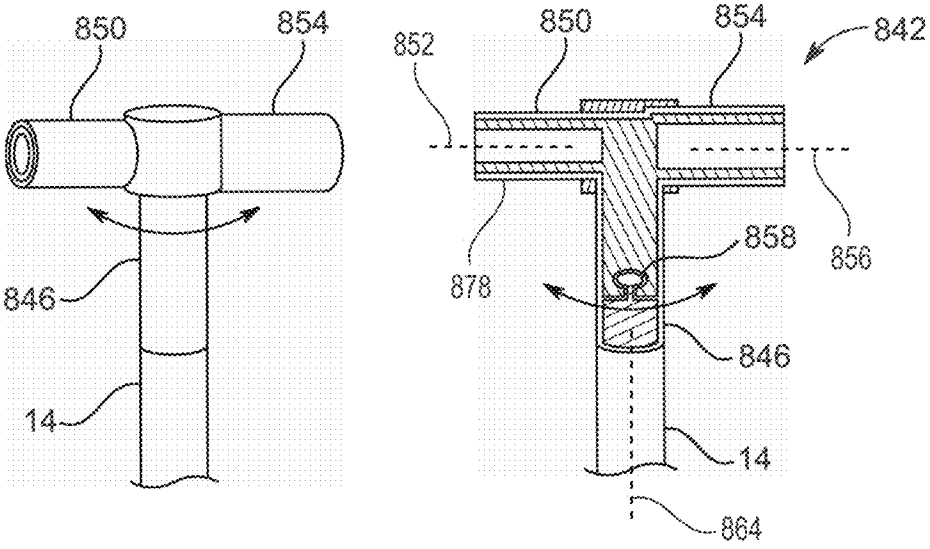
FIG. 11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878
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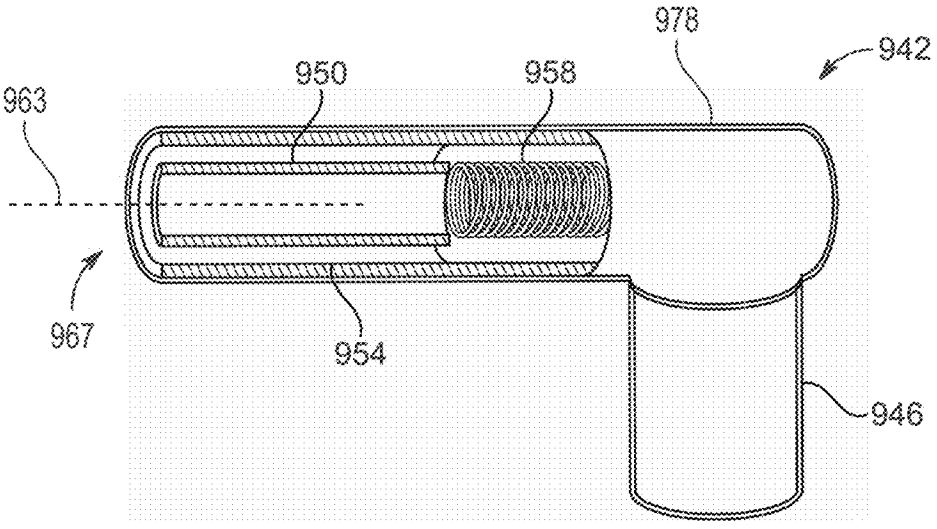
FIG. 12


978
942
950
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963
967
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FIG. 13

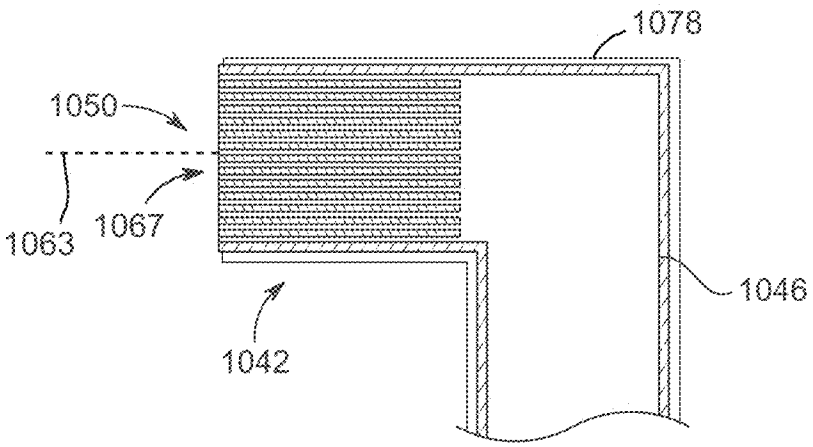
1078
1050
1063
1067
1046
1042

FIG. 14

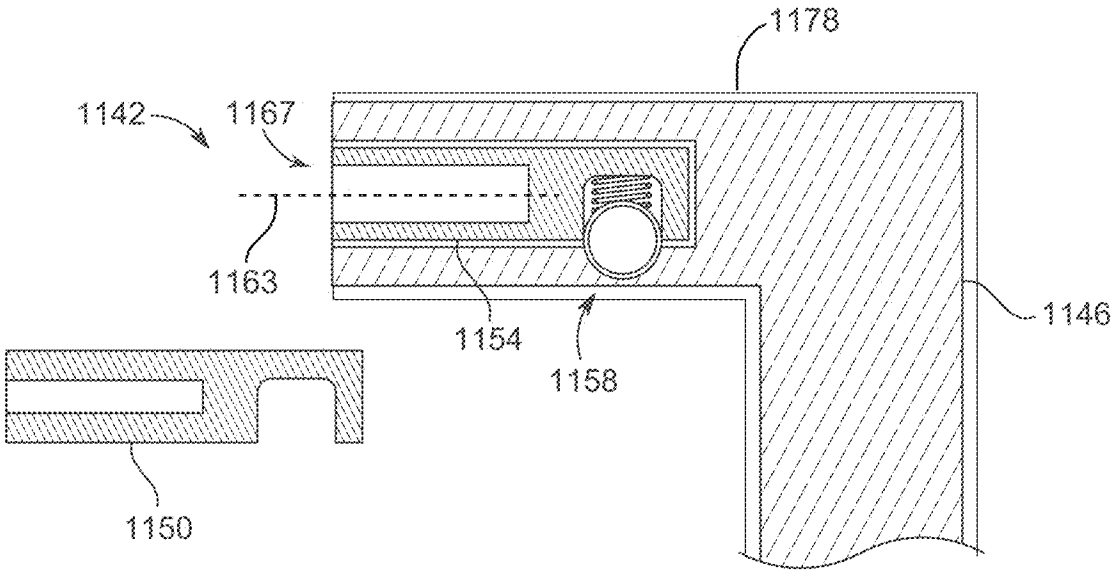
1178
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FIG. 15

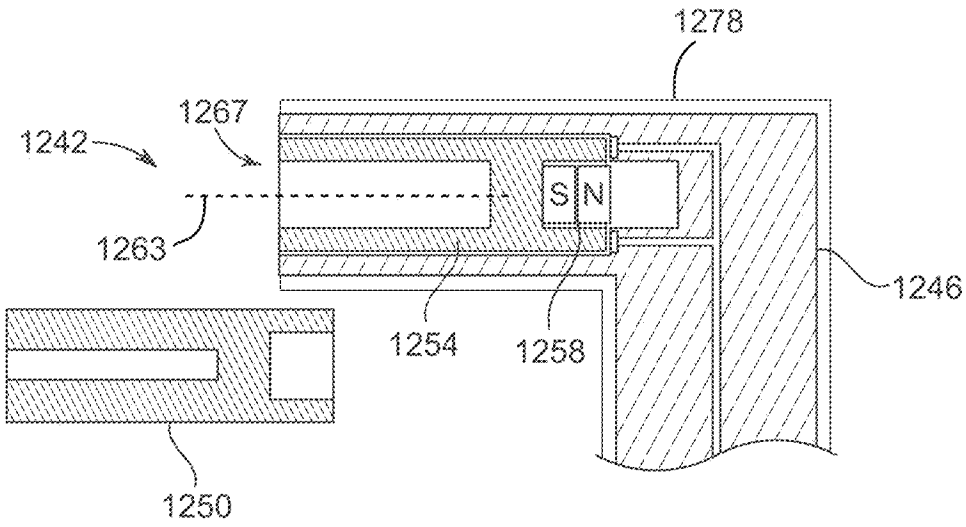

FIG. 16

ELECTROFUSION TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 63/461,717, filed on Apr. 25, 2023, and U.S. Provisional Patent Application No. 63/464,336, filed on May 5, 2023, the entire contents of both of which are incorporated by reference herein.

FIELD OF THE INVENTION

[0002] The present invention relates to power tools, and more specifically, an electrofusion power tool.

BACKGROUND OF THE INVENTION

[0003] Pipe fusion uses heat to join two segments of polyethylene pipe together permanently. In electrofusion, the two pipes to be connected are inserted into a one-time fitting. Then, a predetermined voltage is applied to the terminals of the fitting to heat the inside of the fitting. This melts the pipes to make a type of weld connection.

SUMMARY OF THE INVENTION

[0004] In one aspect, the invention provides a universal tip for an electrofusion tool including a main body configured to be electrically connected to an electrical lead of the electrofusion tool, and a contact supported by the main body being capable of transferring a voltage from the electrofusion tool to a pipe fitting. The contact is adjustable between a first configuration, in which the contact is configured to engage a first terminal having a first size, and a second configuration, in which the contact is configured to engage a second terminal having a second size that is different than the first size.

[0005] Other aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a perspective view of an electrofusion tool in accordance with an embodiment of the invention, illustrating electrical leads electrically connectable to a pipe fitting.

[0007] FIG. **2** is a perspective view of the pipe fitting that may receive two separate PVC pipes, illustrating electrical terminals that electrically connect to the electrical leads of the electrofusion tool.

[0008] FIG. **3** is a perspective view of the electrofusion tool of FIG. **1**, illustrating a depleted battery pack being removed from the electrofusion tool and a new, fully charged battery pack from a battery charger being installed in the electrofusion tool.

[0009] FIG. **4** is a universal tip of the electrical leads in accordance with an embodiment of the invention.

[0010] FIG. **5** is a universal tip of the electrical leads in accordance with another embodiment of the invention.

[0011] FIG. **6** is a universal tip of the electrical leads in accordance with yet another embodiment of the invention.

[0012] FIG. **7** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0013] FIG. **8** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0014] FIG. **9** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0015] FIG. **10** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0016] FIG. **11** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0017] FIG. **12** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0018] FIG. **13** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0019] FIG. **14** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0020] FIG. **15** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0021] FIG. **16** is a universal tip of the electrical leads in accordance with still yet another embodiment of the invention.

[0022] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

DETAILED DESCRIPTION

[0023] FIG. **1** illustrates a battery-operated electrofusion tool **10**. The electrofusion tool **10** includes a pair of electrical leads **14** extending from the electrofusion tool **10** and a battery pack **18** that is selectively coupled to a power module **16** of the electrofusion tool **10**. The battery pack **18** provides power to the electrofusion tool **10** and voltage across the electrical leads **14** through the power module **16**. In other embodiments, the electrofusion tool **10** may be powered from a wall outlet or other suitable power source. A scanner **22** is connected to the electrofusion tool **10** for scanning a barcode **26** containing the pipe fitting characteristics (e.g., voltage required, voltage time, curing time, etc.) of the pipe fitting **30**.

[0024] With reference to FIGS. **1** and **2**, during a fusion process, a user peels the outer layer of plastic from the PVC pipe to make a clean connection. Next, the PVC pipes are inserted into the pipe fitting **30** and clamped to stabilize the PVC pipes. Subsequently, the electrofusion tool **10** is turned on and the electrical leads **14** (e.g., red positive lead to positive terminal **34** on the pipe fitting **30**, black negative lead to negative terminal **38** on the pipe fitting **30**) are connected to the pipe fitting **30**. Using the scanner **22**, the user scans the barcode **26** on the pipe fitting **30** where the power module **16** of the electrofusion tool **10** collects the pipe fitting characteristics. At this point, the power module **16** begins supplying voltage to the electrical leads **14** from the battery **18** in accordance with the pipe fitting characteristics. The voltage traveling through the terminals **34**, **38** of

the pipe fitting **30** heat a heat conductive coil within the pipe fitting **30**, which melts at least portions of the pipe fitting **30** and/or the PVC pipes to couple the components together. Finally, the electrical leads **14** are removed from the pipe fitting **30** and the PVC joints are permanently joined together.

[0025] As previously mentioned, the electrofusion tool **10** may selectively receive the battery pack **18**. With reference to FIG. **3**, the battery pack **18** may be a power tool battery pack generally used to power a power tool, such as drills, electric saws, and the like (e.g., an 18-volt, 24-volt, 36-volt, 72-volt rechargeable battery pack, etc.). Specifically, the illustrated battery pack **18** is a high power battery pack having a nominal voltage of up to about 80V. The battery pack **18** may include lithium ion (Li-ion) cells that are operable to output a sustained operating discharge current of between about 40 A and about 60 A. In alternate embodiments, the battery pack **18** may be of a different chemistry (e.g., nickel-cadmium (NiCa or NiCad), nickel-hydride, and the like).

[0026] The battery pack **18** may further include terminals (not shown) to connect to a battery connector **40** of the power module **16** or a battery charger **41**. The terminals for the battery pack **18** include a positive terminal and a negative terminal to provide power to and from the battery pack **18**. In some embodiments, the battery pack **18** further includes a temperature terminal to monitor the temperature of the battery pack **18**, the power module **16**, or the battery charger **41**. In some embodiments, the battery pack **18** also includes data terminals to communicate with the electrofusion tool **10**. For example, in alternate embodiments, the battery pack **18** may include a microcontroller **44** that monitors characteristics of the battery pack **18**, such as the state of charge of the battery pack **18**, the temperature of the battery pack **18**, or other characteristics relevant to the battery pack **18**. The microcontroller **44** may send signals to the power module **16** indicating various characteristics of the battery pack **18**, at which point the power module **16** may regulate the electrofusion tool **10** accordingly. In alternate embodiments, the microcontroller **44** may also control aspects of charging and/or discharging of the battery pack **18**. In some embodiments, the battery connector **40** may include the data terminals for communicating with the battery pack **18**.

[0027] As shown in FIG. **3**, when the charge of the battery pack **18** is depleted, the battery pack **18** can be removed and placed on the battery charger **41** to charge while a new battery pack **18'** that is fully charged is installed in the electrofusion tool **10**. That is, the electrofusion tool **10** may receive the battery packs **18**, **18'** interchangeably.

[0028] With reference to FIG. **2**, the pipe fitting **30** comes in different sizes to accommodate different size pipe ends of the PVC pipes. As such, different pipe fittings often include different voltage platforms, which often change the size and shape of the positive and negative terminals **34**, **38** of the pipe fitting **30**. Specifically, the terminals **34**, **38** can vary in size from 4.0 millimeters to 4.7 millimeters in diameter. Therefore, a universal tip **42** (FIG. **4**) is coupled to each end of the electrical leads **14** to accommodate different sized terminals **34**, **38**, as explained in further detail below.

[0029] With reference to FIG. **4**, the universal tip **42** includes a main body **46** having a threaded aperture **50** to threadably and electrically connect to one of the electrical leads **14**. A similar universal tip may also be coupled to the other electrical lead **14**. The universal tip **42** further includes a contact **54** in electrical communication with the main body **46**, a collar **58** disposed around the contact **54**, and a spring **62**. The collar **58** is movable along an axis **63** between an extended position (as shown in FIG. **4**), in which the collar **58** exerts a force on the contact **54**, and a retracted position, in which the collar **58** no longer exerts a force on the contact **54**. The spring **62** biases the collar **58** toward the extended position. When in the extended position, the collar **58** exerts a compression force on the contact **54** to elastically deform the contact **54** radially inward toward the terminals **34**, **38**. Specifically, the contact **54** includes a series of fingers **64** extending from a base **65**. The series of fingers **64** are generally parallel to the axis **63** when no force is being exerted on the series of fingers **64** and skew radially inward when the collar **58** compresses the series of fingers **64**. That is, the series of fingers **64** move radially inward toward the axis **63**, such that the series of fingers **64** angularly skew relative to the axis **63**, causing an opening **67** of the contact **54** to diametrically change sizes between a first size and a second size that is larger than the first size. When the opening **67** is the first size, a user may pull the collar **58** along the axis **63** toward the retracted position against the bias of the spring **62**, allowing the contact **54** to rebound radially outward and increasing the opening **67** to the second size. The collar **58** includes a cam surface **66** that is responsible for moving the contact **54** radially inward and outward. Specifically, the cam surface **66** slides against a corresponding cam surface **68** of the contact **54**, causing radial movement of the series of fingers **64** simultaneously. The collar **58** is preferably composed of an electrically insulative material to avoid inadvertent electrocution. Similarly, the universal tip **42** also includes an outer coating **78** that is composed of an electrically insulative material and encases the main body **46**. In the illustrated embodiment, the contact **54** is composed of brass, while in other embodiments, the contact **54** may alternatively be composed of other suitable electrically conductive materials.

[0030] FIG. **5** illustrates another universal tip **142** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **142** includes a main body **146** that is electrically connected to one of the electrical leads **14**. A similar universal tip may also be coupled to the other electrical lead **14**. The main body **146** includes a threaded aperture **150** to which a contact **154** is threadably and electrically connected along an axis **163**. The contact **154** includes a first end **158** having a first contact portion **162** and a second end **166** opposite the first end **158** and having a second contact portion **170**. The first contact portion **162** is smaller than the second contact portion **170**. Specifically, the first contact portion **162** is capable of receiving the 4.0 millimeter terminals **34**, **38**, while the second contact portion **170** is capable of receiving the 4.7 millimeter terminals **34**, **38**. A user may unthread the contact **154** from the main body **146** and rethread the contact **154** to the main body **146** along the axis **163** with either contact portion **162**, **170** being external to the main body **146**. That is, either the first contact portion **162** or the second contact portion **170** faces outward to engage the terminals **34**, **38**. For example, when the first contact portion **162** faces outward, the universal tip **142** is ready to receive the 4.0 millimeter terminals **34**, **38**. In this position, the second contact portion **170** is not accessible and disposed within the main body **146**. When the second contact portion **170** faces

outward, the universal tip **142** is ready to receive the 4.7 millimeter terminals **34**, **38**. In this position, the first contact portion **162** is not accessible and disposed within the main body **146**. An insulative material **174** may wrap around the contact **154** for a user to grip when screwing and unscrewing the contact **154** from the main body **146**. Similarly, the universal tip **142** also includes an outer coating **178** that is composed of an electrically insulative material and encases the main body **146**. The contact **154** is composed of brass, while in other embodiments, the contact **54** may alternatively be composed of other suitable electrically conductive materials.

[0031] FIG. **6** illustrates another universal tip **242** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **242** includes a main body **246** that is electrically connected to one of the electrical leads **14**, a series of arcuate plates **250** coupled to the main body **246**, an axis **263** about which the arcuate plates **250** are disposed, an opening **267** between the series of arcuate plates **250**, and a, elastomeric sleeve **254** disposed around the series of plates **250**. A similar universal tip may also be coupled to the other electrical lead **14**. The series of arcuate plates **250** is electrically connected to the main body **246** and biased radially inward toward the axis **263** by the elastomeric sleeve **254**, such that the opening **267** is a first size. When a user engages the universal tip **242** with the terminals **34**, **38**, the terminals **34**, **38** mechanically interfere with the arcuate plates **250** and exert a force on the arcuate plates **250**, causing the plates **250** to move radially outward relative to the axis **263** against the bias of the elastomeric sleeve **254**. As such, the opening **267** changes to a second size larger than the first size. In the illustrated embodiment, the series of arcuate plates **250** includes two plates. In other embodiments, the series of arcuate plates **250** may include two or more individual plates. The universal tip **242** also includes an outer coating **278** that is composed of an electrically insulative material and encases the main body **146**. The series of arcuate plates **250** are composed of brass, while in other embodiments, the series of plates **250** may alternatively be composed of other suitable electrically conductive materials.

[0032] FIG. **7** illustrates another universal tip **342** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **342** includes a main body **346** that is electrically connected to one of the electrical leads **14**, a series of arcuate plates **350**, an axis **363** about which the arcuate plates **350** are disposed, an opening **367** between the series of arcuate plates **350**, a handle portion **354**, and a pivot **358** disposed between the arcuate plates **350** and the handle portion **354**. A similar universal tip may also be coupled to the other electrical lead **14**. The pivot **358** includes a torsion spring **362** that biases the arcuate plates **350** toward each other, such that the opening **367** is a first size. A user may squeeze (i.e., pinch) the handle portion **354** against the bias of the spring **362** to move the arcuate plates **350** away from each other, such that the opening **367** is a second size larger than the first size. As such, a user pinches the handle portion **354** to move the arcuate plates **350** away from the axis **363**, at which point the arcuate plates **350** may clamp down on the terminals **34**, **38** of different sizes when a user releases the handle portion **354**. The universal tip **342** also includes an outer coating **378** that is composed of an electrically insulative material and encases the handle portion **354** and at least an outer periphery of the arcuate plates **350**. The series of arcuate plates **350** are composed of brass, while in other embodiments, the series of plates **350** may alternatively be composed of other suitable electrically conductive materials.

[0033] FIG. **8** illustrates another universal tip **442** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **442** includes a main body **446** that is electrically connected to one of the electrical leads **14**, a first contact **450** connected to the main body **446**, and a second contact **454** connected to the main body **446**. A similar universal tip may also be coupled to the other electrical lead **14**. The main body **446** splits to form the first contact **450** that is separate from the second contact **454**. The first contact **450** extends in a first direction along a first axis **452**, while the second contact **454** extends in a second direction along a second axis **453** that is different from the first direction. In the illustrated embodiment, the first axis **452** and the second axis **453** are angled approximately 90 degrees relative to each other. In other embodiments, the first axis **452** and the second axis **453** may be angled more than 90 degrees relative to each other or less than 90 degrees relative to each other. For example, the first axis **452** and the second axis **453** may be angled between 30 degrees and 180 degrees relative to each other. The first contact **450** accommodates the 4.0 millimeter terminals **34**, **38**, while the second contact **454** accommodates the 4.7 millimeter terminals **34**, **38**. There may be another contact in some embodiments that extends in another direction different from the first and second directions. The universal tip **442** also includes an outer coating **478** that is composed of an electrically insulative material and encases the main body **446**. The contacts **450**, **454** are composed of brass, while in other embodiments, the contacts **450**, **454** may alternatively be composed of other suitable electrically conductive materials.

[0034] FIG. **9** illustrates another universal tip **542** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **542** includes a main body **546** that is electrically connected to one of the electrical leads **14**, a plate **550** moveable relative to the main body **546**, and a spring **554** (e.g., leaf spring, etc.) for biasing the plate **550** toward the main body **546**. A similar universal tip may also be coupled to the other electrical lead **14**. The universal tip **542** further includes an opening **567** between the plate **550** and the main body **546**, and an axis **563** defined along the opening **567**. The opening **567** is moveable between a first size and a second size that is larger than the first size. The spring **554** biases the plate **550**, and therefore, the opening **567** to the first size. When a user places the universal tip **542** onto the terminals **34**, **38**, the terminals **34**, **38** mechanically interfere with the plate **550** and exert a force on the plate **550**, causing the plate **550** to move away from the main body **546** to the second size against the bias of the spring **554**. As such, the plate **550** also moves away from the axis **563**. The universal tip **542** also includes an outer coating **578** that is composed of an electrically insulative material and encases the main body **546**. The main body **546** and the plate **550** are composed of brass, while in other embodiments, the main body **546** and the plate **550** may alternatively be composed of other suitable electrically conductive materials.

[0035] FIG. **10** illustrates another universal tip **642** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip

642 includes a main body 646 that is electrically connected to one of the electrical leads 14, a plate 650 moveable relative to the main body 646, and a spring 654 (e.g., compression spring, etc.) for biasing the plate 650 toward the terminals 34, 38. A similar universal tip may also be coupled to the other electrical lead 14. The universal tip 642 further includes an opening 667 through which the terminals 34, 48 may pass. The opening 667 defines an axis 663, along which the plate 650 moves. A shoulder 658 formed on an inner surface of the main body 646 inhibits the plate 650 from falling out of the opening 667. When a user places the universal tip 642 onto the terminals 34, 38, the terminals 34, 38 interface with and exert a force on the plate 650, causing the plate 650 to retract into the main body 646 along the axis 663 against the bias of the spring 654. The universal tip 642 remains on the terminals 34, 38 via a snug fit (e.g., press fit, etc.) between the universal tip 642 and the terminals 34, 38. The plate 650 is constantly biased toward the terminals 34, 38, such that the plate 650 remains in contact with the terminals 34, 38. The universal tip 642 also includes an outer coating 678 that is composed of an electrically insulative material and encases the main body 646. The plate 650 is composed of brass, while in other embodiments, the plate 650 may alternatively be composed of other suitable electrically conductive materials.

[0036] FIG. 11 illustrates another universal tip 742 that can be coupled to each of the electrical leads 14 to accommodate different sized terminals 34, 38. The universal tip 742 includes a main body 746 that is electrically connected to one of the electrical leads 14, a collar 750 threadably coupled to the main body 746, and contacts 754 disposed within the collar 750. A similar universal tip may also be coupled to the other electrical lead 14. The universal tip 742 further includes an opening 767 through which the terminals 34, 48 may pass. The opening 767 defines an axis 763, along which the collar 750 moves when rotated. The collar 750 includes a cam member 758 that interacts with a corresponding cam member 768 of the contacts 754 to move the contacts 754 radially inward and radially outward relative to the axis 763. A user may rotate the collar 750 relative to the main body 746, for example, clockwise to move the contactors 754 radially inward towards the terminals 34, 38 to change the opening 767 to a first size. Similarly, a user may rotate the collar 750 relative to the main body 746, for example, counterclockwise to move the contacts 754 radially outward away from the terminals 34, 38 to change the opening 767 to a second size that is larger than the first size. The universal tip 742 also includes an outer coating 778 that is composed of an electrically insulative material and encases the main body 746. The contacts 754 are composed of brass, while in other embodiments, the contacts 754 may alternatively be composed of other suitable electrically conductive materials.

[0037] FIG. 12 illustrates another universal tip 842 that can be coupled to each of the electrical leads 14 to accommodate different sized terminals 34, 38. The universal tip 842 includes a main body 846 that is electrically connected to one of the electrical leads 14, a first contact 850 defining a first axis 852 and connected to the main body 846, and a second contact 854 defining a second axis 856 and connected to the main body 846. A similar universal tip may also be coupled to the other electrical lead 14. The first contact 850 extends in a first direction, while the second contact 854 extends in a second direction that is different from the first direction. Specifically, the first axis 852 of the first contact 850 is angularly spaced 180 degrees from the second axis 856 of the second contact 854. The first contact 850 accommodates the 4.0 millimeter terminals 34, 38, while the second contact 854 accommodates the 4.7 millimeter terminals 34, 38. The universal tip 842 remains on the terminals 34, 38 via a snug fit (e.g., press fit, etc.) between the universal tip 842 and the terminals 34, 38. A pivot joint 858 is disposed between the electrical leads 14 and the main body 846, such that the main body 846 may rotate relative to the electrical leads 14. Specifically, the main body 846 may rotate about a pivot axis 864 that is perpendicular to the first and second axis 852, 856. There may be another contact in some embodiments that extends in another direction different from the first and second directions. The universal tip 842 also includes an outer coating 878 that is composed of an electrically insulative material and encases the main body 846. The contacts 850, 854 is composed of brass, while in other embodiments, the contacts 850, 854 may alternatively be composed of other suitable electrically conductive materials.

[0038] FIG. 13 illustrates another universal tip 942 that can be coupled to each of the electrical leads 14 to accommodate different sized terminals 34, 38. The universal tip 942 includes a main body 946 that is electrically connected to one of the electrical leads 14, a first barrel 950 disposed within the main housing 946, and a second barrel 954 disposed within the main housing 946. A similar universal tip may also be coupled to the other electrical lead 14. The first barrel 950 is disposed within the second barrel 954. The universal tip 942 also includes an opening 967 that receives the terminals 34, 38. The opening 967 defines an axis 963, along which the first barrel 950 moves. A spring 958 is disposed within the second barrel 954 and biases the first barrel 950. The first barrel 950 accommodates the 4.0 millimeter terminals 34, 38, while the second barrel 954 accommodates the 4.7 millimeter terminals 34, 38. A user may engage the universal tip 942 with the 4.0 millimeter terminals 34, 38, causing the first barrel 950 to receive the 4.0 millimeter terminals 34, 38. When a user engages the universal tip 942 with the 4.7 millimeter terminals 34, 38, the terminals 34, 38 mechanically interfere with and exert a force on the first barrel 950, causing the first barrel 950 to move against the bias of the spring 958, at which point the second barrel 954 engages the 4.7 millimeter terminals 34, 38. Thus, the first barrel 950 moves rearward along the axis 963, which changes the opening 967 from a first size to a second size that is larger than the first size. The first barrel 950 is constantly biased toward the terminals 34, 38, such that the plate 950 remains in contact with the terminals 34, 38. The universal tip 942 also includes an outer coating 978 that is composed of an electrically insulative material and encases the main body 946. The first and second barrels 950, 954 are composed of brass, while in other embodiments, the first and second barrels 950, 954 may alternatively be composed of other suitable electrically conductive materials.

[0039] FIG. 14 illustrates another universal tip 1042 that can be coupled to each of the electrical leads 14 to accommodate different sized terminals 34, 38. The universal tip 1042 includes a main body 1046 that is electrically connected to one of the electrical leads 14 and a plurality of pins 1050 that are biased outward. A similar universal tip may also be coupled to the other electrical lead 14. The plurality of pins 1050 move axially inward and outward relative to

each other along or parallel to an axis **1063**. As the plurality of pins **1050** move inward along the axis **1063** via the terminals **34**, **38** exerting a force on the pins **1050**, an opening **1067** is created that accommodates the terminals **34**, **38**. The number of pins **1050** moving at one time depends on the size of the electrical terminals **34**, **38**. For example, a greater number of pins **1050** move axially inward along the axis **1063** when the 4.7 millimeter terminals **34**, **38** are received within the main body **1046**. Conversely, a fewer number of pins **1050** moves axially inward along the axis **1063** when the 4.0 millimeter terminals **34**, **38** are received within the main body **1046**. The universal tip **1042** also includes an outer coating **1078** that is composed of an electrically insulative material and encases the main body **1046**. The plurality of pins **1050** are composed of brass, while in other embodiments, the plurality of pins **1050** may alternatively be composed of other suitable electrically conductive materials.

[0040] FIG. **15** illustrates another universal tip **1142** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **1142** includes a main body **1146** that is electrically connected to one of the electrical leads **14**, a first contact **1150** removably coupled to the main body **1146**, and a second contact **1154** removably coupled to the main body **1146**. A similar universal tip may also be coupled to the other electrical lead **14**. The universal tip **1142** further includes an opening **1167** that receives the terminals **34**, **38**. The opening **1167** defines an axis **1163**, along which the terminals **34**, **38** pass. The opening **1167** is also configured to receive the first contact **1150** and the second contact **1154**. The opening **1167** is a first size when the first contact **1150** is received within the opening **1167** and changes to a second size that is larger than the first size when the second contact **1154** is received within the opening **1167**. The first contact **1150** accommodates the 4.0 millimeter terminals **34**, **38**, while the second contact **1154** accommodates the 4.7 millimeter terminals **34**, **38**. A detent mechanism **1158** (e.g., spring and ball catch) enables a quick-disconnect between the contacts **1150**, **1154** and the main body **1146**. The contacts **1150**, **1154** are configured to slide in or out of the main body **1146** along the axis **1163**. When a user desires the first contact **1150**, the second contact **1154** is pulled from the main body **1146** along the axis **1163** so the first contact **1150** can be inserted into the main body **1146** along the axis **1163**, and vice versa for the second contact **1154**. The universal tip **1142** also includes an outer coating **1178** that is composed of an electrically insulative material and encases the main body **1146**. The first and second contacts **1150**, **1154** are composed of brass, while in other embodiments, the first and second contacts **1150**, **1154** may alternatively be composed of other suitable electrically conductive materials.

[0041] FIG. **16** illustrates another universal tip **1242** that can be coupled to each of the electrical leads **14** to accommodate different sized terminals **34**, **38**. The universal tip **1242** includes a main body **1246** that is electrically connected to one of the electrical leads **14**, a first contact **1250** removably coupled to the main body **1246**, and a second contact **1254** removably coupled to the main body **1246**. A similar universal tip may also be coupled to the other electrical lead **14**. The universal tip **1242** further includes an opening **1267** that receives the terminals **34**, **38**. The opening **1267** defines an axis **1263**, along which the terminals **34**, **38** pass. The opening **1267** is also configured to receive the first contact **1250** and the second contact **1254**. The opening **1267** is a first size when the first contact **1250** is received within the opening **1267** and changes to a second size that is larger than the first size when the second contact **1254** is received within the opening **1267**. The first contact **1250** accommodates the 4.0 millimeter terminals **34**, **38**, while the second contactor **1254** accommodates the 4.7 millimeter terminals **34**, **38**. A magnet **1258** (e.g., earth magnet, electromagnet, etc.) enables a quick-disconnect between the contacts **1250**, **1254** and the main body **1246**. The contacts **1250**, **1254** are configured to slide in or out of the main body **1246** along the axis **1263**. When a user desires the first contact **1250**, the second contact **1254** is pulled from the main body **1246** along the axis **1263** so the first contact **1250** can be inserted into the main body **1246** along the axis **1263**, and vice versa for the second contact **1254**. The universal tip **1242** also includes an outer coating **1278** that is composed of an electrically insulative material and encases the main body **1246**. The first and second contacts **1250**, **1254** are composed of brass, while in other embodiments, the first and second contacts **1250**, **1254** may alternatively be composed of other suitable electrically conductive materials.

[0042] Various aspects of the invention are set forth in the following claims.

What is claimed is:

1. A universal tip for an electrofusion tool, the universal tip comprising:

a main body configured to be electrically connected to an electrical lead of the electrofusion tool; and

a contact supported by the main body and capable of transferring a voltage from the electrofusion tool to a pipe fitting, the contact being adjustable between a first configuration, in which the contact is configured to engage a first terminal having a first size, and a second configuration, in which the contact is configured to engage a second terminal having a second size that is different than the first size.

2. The universal tip of claim **1**, wherein the contact defines an opening, wherein in the first configuration, the opening has a first size, and wherein in the second configuration, the opening has a second size that is larger than the first size.

3. The universal tip of claim **2**, wherein the opening defines an axis along which the first terminal or the second terminal is received into the opening.

4. The universal tip of claim **3**, further comprising a collar disposed around the contact and movable along the axis between an extended position, in which the collar exerts a force on the contact to move the contact radially inward toward the axis to the first size, and a retracted position, in which the contact rebounds radially outward away from the axis to the second size.

5. The universal tip of claim **4**, wherein collar includes a cam surface that interfaces with a corresponding cam surface of the contact to move the contact radially inward and radially outward in response to the cam surface of the collar sliding against the cam surface of the contact between the extended position and the retracted position.

6. The universal tip of claim **4**, further comprising a spring that biases the collar toward the extended position.

7. The universal tip of claim **3**, further comprising an elastomeric sleeve that is disposed around the contact, wherein the elastomeric sleeve exerts a force on the contact to move the contact radially inward toward the axis to the first size.

8. The universal tip of claim **7**, wherein the contact includes a series of arcuate plates that are biased radially inward via the elastomeric sleeve.

9. The universal tip of claim **3**, wherein the contact includes a series of arcuate plates that are biased radially inward toward the axis to the first size via a torsional spring, wherein the universal tip further comprises a handle portion that is manipulated to move the series of arcuate plates radially outward away from the axis to the second size against bias of the torsional spring.

10. The universal tip of claim **3**, further comprising a leaf spring that biases a portion of the contact toward the axis to the first size.

11. The universal tip of claim **3**, wherein the contact includes a first barrel and a second barrel, and wherein the first barrel is movable relative to the second barrel along the axis between an extended position, in which the first barrel engages the first terminal, and a retracted position, in which the second barrel engages the second terminal.

12. The universal tip of claim **11**, wherein the first barrel is biased to the extended position via a spring, and wherein the first barrel is moved to the retracted position against the bias of the spring via the second terminal moving along the axis to engage the second barrel.

13. The universal tip of claim **3**, wherein the contact includes a plurality of pins that are disposed throughout the opening, wherein a first amount of the plurality of pins is moved inward relative to the main body along the axis when the opening receives the first terminal and a second amount of the plurality of pins is moved inward relative to the main body along the axis when the opening receives the second terminal, and wherein the second amount is greater than the first amount.

14. The universal tip of claim **1**, wherein the contact includes a first contact portion and a second contact portion, wherein in the first configuration, the first contact portion is positioned to engage the first terminal, and wherein in the second configuration, the second contact portion is configured to engage the second terminal.

15. The universal tip of claim **14**, wherein the main body includes a threaded aperture to which the contact is threadably connected, wherein the second contact portion is disposed within the main body when the contact is in the first configuration, and wherein the first contact portion is disposed within the main body when the contact is in the second configuration.

16. The universal tip of claim **14**, wherein at least a portion of the main body is rotatable relative to the electrical lead via a pivot joint, such that the first contact portion is rotated to align with the first terminal in the first configuration and the second contact portion is rotated to align with the second terminal in the second configuration.

17. The universal tip of claim **1**, wherein the contact is one of a set of contacts including a first contact and a second contact, wherein in the first configuration, the first contact is supported by the main body and configured to engage the first terminal, and wherein in the second configuration, the second contact is supported by the main body and configured to engage the second terminal.

18. The universal tip of claim **17**, wherein the first contact and the second contact are separately maintained in the main body via a detent mechanism.

19. The universal tip of claim **17**, wherein the first contact and the second contact are separately maintained in the main body via a magnet.

20. The universal tip of claim **1**, wherein the contact is composed of brass.

21. An electrofusion tool comprising:

a power module;

a pair of electrical leads electrically coupled to the power module; and

the universal tip of claim **1** coupled to one of the pair of electrical leads.

22. The electrofusion tool of claim **21**, wherein the power module includes a battery connector configured to receive a battery pack.

23. The electrofusion tool of claim **22**, further comprising the battery pack, wherein the battery pack includes a microcontroller that monitors a state of charge, a temperature, or both of the battery pack.

24. The electrofusion tool of claim **21**, further comprising a scanner configured to scan a barcode on the pipe fitting.

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