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- (71) Applicant: LINCOLN GLOBAL, INC. [US/US]; 17721 Railroad St., City of Industry, CA 91748 (US).
- (72) Inventor: ENYEDY, Edward, A.; 36580 Garretts Cove Drive, Eastlake, OH 44095 (US).
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(54) Title: DRIVE ROLL ASSEMBLY

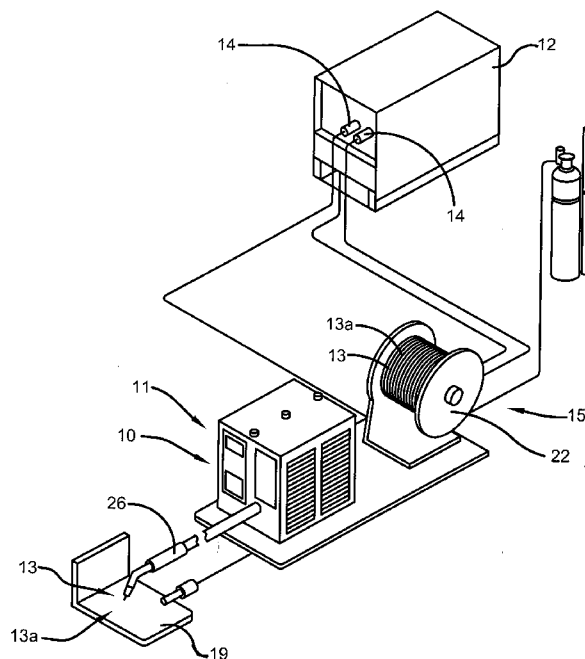


FIG. 1

(57) Abstract: A wire feeder (10,11) includes a wire feeder housing (39a) that may enclose one or more drive rollers rotatably connected with respect to the wire feeder housing (39a) for engaging welding wire (13). The one or more drive rollers may be adjustable and adapted to drive the welding wire (13) to a welding gun (26) connected to the wire feeder (10,11). A drive motor is incorporated for delivering power for rotating the one or more drive rollers. Friction reducing devices, such as bearings (50,64), may be utilized and positioned between one or more driver rollers and the housing (39a), where the bearings (50,64) are electrically non-conducting for preventing the discharge of electrical energy across the bearing surfaces.



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DRIVE ROLL ASSEMBLY

[0001] This application is a continuation-in-part of and claims priority to United States Patent Application Serial No. 12/610,724 filed 02 November 2009, the contents of which are fully incorporated by reference.

Field of the Invention

[0002] The present invention pertains to welding wire feeders, and more particularly, to welding wire feeders having electrically isolated components. In particular the invention is related to a wire feeder according to claim 1, to a push-pull drive system according to claim 7 and to a spool gun drive system according to claim 9.

Technical Background

[0003] Wire feeders, like those used in arc welding applications, convey wire from a continuous feed source to a weld torch. In many instances, the wire is fed from a reel or drum at a rate determined by the operating parameters of the power source. Accordingly, the wire feeder includes a drive motor that delivers the wire at various feed rates. Typically pinch rollers are used to grip the wire pushing, or in certain cases pulling, it toward the work piece. To facilitate smooth operation, bearings may be included that allow the pinch rollers to rotate with reduced friction.

[0004] However, it is known that using aluminum as a welding wire is increasing due to its lightweight attributes and corrosion-resistant properties. However, aluminum can present some real challenges. Equipment must be adapted specifically to handle the softer aluminum wire and machine settings that work well with steel wire may not be appropriate. In fact, aluminum wire can easily be damaged by equipment set up for steel wire.

[0005] One of the recommended changes is the use of a nylon or Teflon[®] liner to reduce friction and wire shaving. It is also recommended to substitute a U-shaped groove in the drive rolls, rather than a more traditional V-shaped groove so that there are no sharp edges to shave off the aluminum wire. Also, the tension on the drive roll should be reduced from typical steel settings to prevent crushing the aluminum wire during feeding. Since aluminum expands more than steel as it heats up, the proper-sized hole in the contact tip is larger for aluminum than for steel. Brake tension on the wire spindle should be set more loosely than it would normally be set for steel so that less force is required to pull the wire off the spool.

[0006] Because the column strength of aluminum is much less than steel, feeding aluminum wire often requires special feed mechanisms. One way to assist in the feeding of aluminum wire is to use a "push-pull" system which utilizes dual motors: an assist motor that pushes the electrode from the feeder and a primary motor that is located in the gun that pulls the electrode. This type of system offers superior feeding performance of a spool gun with many of the advantages of a compact push system. A push-pull system provides the most uniform feeding and can hold larger spools of wire. The gun can be taken long distances from the power source and does not require the costly 1 lb. spools of the spool gun method and has a comfortable ergonomic gun that fits into tighter places.

Description

[0007] It is an object of the invention to overcome the disadvantages mentioned above and to provide arrangements in order to improve wire feeding. This problem is solved by a wire feeder according to claim 1, by a push-pull drive system according to claim 7 and by a spool gun drive system according to claim 9. Preferred embodiments of the invention are subject of the subclaims. The embodiments of the present invention pertain to a push-pull wire feeder having a wire feeder housing that encloses one or more drive rollers rotatably connected with respect to the wire feeder housing for engaging welding wire and one or more drive rollers positioned within the welding gun. The one or more drive rollers are adjustable and adapted to drive the welding wire to a welding gun connected to the wire feeder. A drive motor is included for delivering power and more specifically torque for rotating the one or more drive rollers. Friction reducing devices, such as bearings, are utilized and positioned between one or more driver rollers and the housing, where the bearings are electrically non-conducting for preventing the discharge of electrical energy across the bearing surfaces.

[0008] In one aspect of the invention, a wire feeder for conveying associated welding wire is described which includes at least the following: a wire feeder having one or more drive rollers, the one or more drive rollers being adapted to push the associated welding wire toward the welding gun; a welding gun operatively connected to the wire feeder for conveying associated welding wire used in arc welding, the welding gun having at least one drive roller within the welding gun to pull the welding wire toward an egress aperture in the welding gun; at least a first driver motor operatively connected to deliver power for rotating the one or more drive rollers in the wire feeder; at least a second driver motor operatively connected to deliver power for rotating the at least one drive roller in the welding gun; and,

one or more bearings positioned between the one or more drive rollers in the wire feeder and the at least one drive roller within the welding gun, said one or more bearings coaxial with each of said one or more drive rollers, wherein each of the one or more bearings is electrically non-conducting for preventing the discharge of electrical energy across the one or more bearings.

[0009] The one or more bearings are constructed from a dielectric material, often ceramic, and an electrically non-conducting material. The drive rollers further include: a plurality of adjacent spherical bearing balls, and, wherein the bearing balls are constructed from ceramic. Often the drive motors are variable speed drive motors for conveying the associated welding wire at varying speeds.

[0010] In another aspect of the invention, a push-pull drive system for a welding wire feeder conveying associated electrically charged wire, is described which includes at least: a first wire feeding means positioned external to a welding wire gun, the first wire feeding means comprising: a generally rigid apertured first feed plate having one or more recesses; at least one first pair of drive rollers rotatably connected with respect to the first feed plate, wherein the drive rollers are spaced apart to propel the associated electrically charged wire, the first pair of drive rollers having a first pair of opposed rollers which matingly engage with each of the drive rollers; a first means for reducing rolling friction operatively positioned between each of the first rollers and the first feed plate, the first means for reducing rolling friction being coaxially positioned with the first rollers, and wherein the first means for reducing rolling friction is electrically non-conducting for substantially preventing the discharge of electrical energy between the first feed plate and the first rollers; and a second wire feeding means positioned within the welding wire gun, the second wire feeding means comprising: a second apertured welding wire feed plate positioned within the welding gun, one side of the second feed plate connected to a gun gooseneck; at least one second pair of drive rollers rotatably connected with respect to the second feed plate, wherein the second pair of drive rollers are spaced apart to propel the associated electrically charged wire, the second drive rollers having a pair of second opposed rollers which matingly engage with each of the second drive rollers; and a second means for reducing rolling friction operatively positioned between each of the second rollers and the second feed plate, the second means for reducing rolling friction being coaxially positioned with the second rollers, and wherein the second means for reducing rolling friction is electrically non-conducting for substantially preventing the discharge of electrical energy between the second feed plate and the second roller.

[0011] Each of the means for reducing rolling friction comprises one or more rolling elements constructed from ceramic, although it is possible that each of the one or more rolling elements are constructed from metal and wherein the one or more rolling elements are coated with ceramic thereby completely covering the one or more metal rolling elements. Optionally, each of said means for reducing rolling friction comprises one or more rolling elements constructed from non-conducting polymeric material.

[0012] In a preferred aspect of the invention, each of the at least one pair of drive rollers includes first and second drive rollers, and, wherein the position of the first drive roller is adjustable with respect to the second drive roller for driving differently sized associated wire. The system may further include wire support guides having a wire passage for channeling the associated electrically charged wire.

[0013] In another aspect of the invention, the first and second feed plates are constructed from electrically non-conducting material. Typically, each of said means for reducing rolling friction comprises: a bushing constructed from a dielectric material, e.g., ceramic, and often one implementation is where the ceramic is glass.

[0014] Each of said means for reducing rolling friction comprises: at least one bearing race and a plurality of rolling elements, wherein the at least one bearing race is received into the one or more recesses of each of said feed plates; and wherein the at least one bearing race or the plurality of rolling elements is coated or constructed from a non-conductive dielectric material.

[0015] In yet another aspect of the invention, a spool gun drive system for a welding wire feeder conveying associated electrically charged wire, is described which includes at least: a wire feeding means positioned within the welding wire gun, the wire feeding means comprising: an apertured welding wire feed plate positioned within the welding gun, one side of the feed plate connected to a gun gooseneck; at least one pair of drive rollers rotatably connected with respect to the feed plate, wherein the pair of drive rollers are spaced apart to propel the associated electrically charged wire, the drive rollers having a pair of opposed rollers which matingly engage with each of the drive rollers; and a means for reducing rolling friction operatively positioned between each of said rollers and the feed plate, the means for reducing rolling friction being coaxially positioned with the rollers, and wherein the means for reducing rolling friction is electrically non-conducting for substantially preventing the discharge of electrical energy between the feed plate and the roller.

[0016] In a further aspect of the invention, the means for reducing rolling friction comprises one or more rolling elements constructed from ceramic or alternatively, the one or more rolling elements are constructed from metal and wherein the one or more rolling elements are coated with ceramic thereby completely covering the one or more metal rolling elements. Optionally, the means for reducing rolling friction comprises one or more rolling elements constructed from non-conducting polymeric material.

[0017] The at least one pair of drive rollers includes first and second drive rollers, and, wherein the position of the first drive roller is adjustable with respect to the second drive roller for driving differently sized associated wire.

[0018] The spool gun drive system optionally has wire support guides having a wire passage for channeling the associated electrically charged wire and wherein the feed plate is constructed from electrically non-conducting material.

[0019] The means for reducing rolling friction comprises: a bushing constructed from a dielectric material, often a ceramic material, e.g., glass.

Brief Description of the Drawings

[0020] *Fig. 1* is a perspective view of a wire feeder used in a welding application;

[0021] *Fig. 2* is a side view of an wire feeder and wire feed source;

[0022] *Fig. 3* is a close up side view of drive rollers feeding wire;

[0023] *Fig. 4* is an expanded perspective view of a feed plate and accompanying drive rollers;

[0024] *Fig. 5* is cutaway side view of a non-conductive friction reducing device;

[0025] *Fig. 6* is a top elevational view of a wire feeder contained within the housing of a welding gun; and

[0026] *Fig. 7* is an assembly view of the wire feeder of *Fig. 6*.

Detailed Description

[0027] Referring now to the drawings wherein the showings are for purposes of illustrating embodiments of the invention only and not for purposes of limiting the same, *Fig. 1* shows a wire feeder depicted generally at **10**. The wire feeder **10** comprises a device for conveying wire **13** from a feed source **15**, i.e. wire supply **15**, for use in a particular application. For illustrative purposes, the wire feeder **10** will be described in the context of arc welding. However, other applications will become apparent to those skilled in the art, all of which should be construed as falling within the scope of coverage of the embodiments of the subject invention. In one embodiment, wire **13** may comprise a welding electrode **13a**, also referred to herein as welding wire **13a**, and wire feeder **10** may comprise welding wire feeder **11**. Wire **13**, **13a** may be drawn continuously from a reel **22**, box or drum, and delivered to a work piece **19**, which in the current embodiment is a weldment. Accordingly, the wire feeder **10**, or welding wire feeder **11**, may include a drive assembly that utilizes power from one or more locomotive devices that drive the wire **13**, **13a** to the application work site or work piece **19**.

[0028] With continued reference to *Fig. 1*, the welding wire feeder **11** may be used in conjunction with a welding power source **12** as manufactured by, for example, the Lincoln Electric company in Cleveland, Ohio. The welding power source **12** may receive electrical input power, from an outside source, that is directed to an onboard transformer, not depicted in the figures. Output from the transformer may subsequently be connected to welding output terminals **14**, or studs **14** of the welding power source **12**. Additionally, the welding power source **12** may include a regulated power supply for delivering electrical power to one or more welding accessories, which may include the welding wire feeder **11**. A welding gun, designated generally at **26**, and wire conduit may be electrically connected to the welding power source **12** through the welding wire feeder **11** for delivering welding current in a manner known in the art. It follows that welding wire **13a** is fed through a weld gun **26** and metered out, i.e. dispensed, at the discretion of the application and/or end user in any manner suitable for conducting the welding process. It is noted that the electrode, i.e. welding wire **13**, conducts electricity for establishing a welding arc, wherein the electrode is conveyed to the work piece **19** having a voltage potential equal to or approximately equal to the output voltage of the welding power source **12**, which may be substantially greater than ground.

[0029] Different modes of conveying welding wire **13a** are known in the art, an example of which includes pushing the welding wire **13a** to the weld gun **26** via power or torque provided by the locomotive device. Other modes of conveying welding wire **13a** include push/pull modes that utilize multiple locomotive devices. In any instance, welding wire **13a** is delivered to a weld gun **26**, which may have a trigger or other activation mechanism for dispensing the wire **13** at the users discretion. At times, it may be necessary to deliver welding wire **13a** at varying rates of feed. Therefore, the locomotive device, which may comprise or include a drive motor **18**, has an output that is adjustable for varying the rate which welding wire **13a** is discharged from the wire feeder **10**. In particular, the drive motor **18** itself may be a variable speed drive motor **18**.

[0030] It is noted here that the wire feeder **11** and/or drive motor(s) **18** may draw operating power from the regulated power supply onboard the welding power source **12**. Alternatively, the welding wire feeder **11** may draw power from the open circuit voltage of the welding power source **12**, or an altogether separate power source. Still any manner of providing power to operate the welding wire feeder **11** and/or the drive motors **18** may be chosen with sound engineering judgment as is appropriate for use with the embodiments of the present invention.

[0031] With continued reference to *Fig. 1* and now also to *Figs. 2* and *3*, the welding wire feeder **11** may include a drive assembly, or drive roll assembly. As mentioned above, the drive motor **18**, also called a wire feeder motor **18**, delivers power, i.e. torque, to convey the welding wire **13a** to the weld gun **26** and subsequently to the work piece **19**. Drive rollers **36** are included that grip the welding wire **13a** for pushing or pulling the welding wire **13a** in the appropriate direction, i.e. toward the work piece. The drive rollers **36** are rotatably connected with respect to a frame member or other portion of the wire feeder **11**. In one particular embodiment, the drive rollers **36** are rotatably connected to a feed plate **39** or possibly the wire feeder housing. A friction reducing device may be disposed between the drive rollers **36** and the feed plate **39** facilitating smooth and consistent operation of the welding wire feeder **11**. In an exemplary manner, bearings **50**, shown in *Fig. 4*, may be incorporated between the drive rollers **36** and the feed plate **39**, although other friction reducing devices including, but not limited to, bushings may also be utilized. Still, any type of device that reduces rolling friction may be used to facilitate sustained operation of the driver rollers **36** as is appropriate for use with the embodiments of the present invention.

[0032] With reference to *Fig. 3*, the drive roll assembly may include a plurality of electrically conductive wire support guides **21** spaced along a wire trajectory. The wire support guides **21** may each incorporate a wire passage, or through-hole, for guiding the wire **13**, **13a**. The wire support guides **21** may be oriented such that the wire passages are axially aligned and thereby define the wire trajectory in the region between the driver rollers **36**, which may comprise adjacently positioned pairs of drive rollers **36**. The plurality of wire support guides **21** may include first and second end guides **21a**, **21b**. Additionally, a center guide **21c** may be disposed between pairs of drive rollers **36**. Still, it will be appreciated that any configuration and quantity of wire support guides **21** and drive rollers **36** may be included as chosen with sound judgment.

[0033] Each drive roller **36**, in accordance with one embodiment of the subject invention, may include an outer circumference **37** for contacting the welding wire **13a** and a hub **54** for rotation about a central axis. In an exemplary manner, the drive rollers **36** may be cylindrical in configuration, or more specifically disk-shaped, although the particular configuration should not be construed as limiting. The surface, i.e. the outer circumference **37**, of the driver roller **36** may be comprised of a sufficiently hardened material, like steel, that is durable and suitable for gripping the wire **13**, **13a**. In one embodiment, drive rollers **36** may be disposed in pairs along the wire trajectory with each drive roller pair being supported on opposing sides thereof such that respective outer circumferences **37** contact opposite sides of the wire **13**, **13a**. It is noted that the central axes of respective drive rollers **36** extend substantially parallel with one another and generally transverse to the trajectory of the wire **13**, **13a**. In one particular embodiment, the relative position of the drive rollers **36** in one set, or pair, may be adjustable for use with wires of different diameters. Stated differently, the outer circumference of one drive roller **36** may be adjustable with respect to the outer circumference of an adjacent driver roller **36** for changing the distance therebetween thus accommodating different sizes of wire **13**, **13a**. In this manner, the driver roller pairs may be selectively positioned for gripping the welding wire **13**, **13a** with the appropriate amount of gripping force.

[0034] The hubs **54** of the drive rollers **36** may be rotatably supported by the feed plate **39** or other portion of the housing **39a**, as previously mentioned. In one embodiment, the hubs **54** are supported by bearing(s) **50** incorporating a plurality of rolling elements, or alternatively by bushings. However, any means for facilitating sustained rotational operation of the driver rollers **36** may be chosen as is appropriate for use with the embodiments of the subject invention. Shafts **55** may be included that extend from the hub **54** and into en-

gagement with a bearing race. In one exemplary manner, the drive rollers **36** may be mounted on corresponding shafts **55** for rotation therewith by a key and keyway arrangement, although any suitable arrangement for engaging the drive rollers **36** may be incorporated. Additionally, shafts **55** for each set or pair of drive rollers **36** may be driveably engaged with the drive motor **18** and with one another such that the shafts **55** rotate together for conveying the wire **13**, **13a** in a desired direction. The shafts **55** may be driveably engaged via gears or pulleys and belts, not shown, retained on the shafts **55** by any suitable mechanism, like for example a set screw or other fastener. It will be understood that the gears or pulleys may have sufficient clearance between the extents thereof to accommodate relative radial movement of the outer circumferences **37** of the drive rollers **36** in a manner consistent with that described above. It is noted here that the shafts **55** and corresponding driver rollers **36** rotate in opposing directions for advancing the wire **13**, **13a** in a designated direction. In other words, the driver roller **36** on one side of the wire **13**, **13a** may rotate clockwise while the drive roller **36** on the opposing side of the wire **13**, **13a** rotates counterclockwise, as illustrated by the arrows in *Fig. 3*.

[0035] Still referencing *Fig. 2* and now also *Fig. 4*, the feed plate **39** may comprise a generally rigid piece of material suitably strong for supporting the drive roll assembly. In one embodiment, the feed plate **39** may be separate from the housing of the wire feeder **11** and affixed to the housing via fasteners or other means. Accordingly, feed plate **39** is mounted onto or within the wire feeder housing. The feed plate **39** may be comprised of aluminum. However, the feed plate **39** may be comprised of other materials including steel in any of various alloys or other non-metallic materials having sufficient strength and rigidity for supporting the drive assembly. It should be noted that during operation of the wire feeder **11**, the feed plate **39** may be subject elevated temperature. Accordingly, the feed plate **39** will have the requisite rigidity and the ability to withstand high temperatures without failure. In one particular embodiment, the feed plate **39** may be constructed from an electrically non-conducting material for preventing arcing or sparking resulting from differences in voltage potential between components of the drive roll assembly, examples of which may include ceramic based materials. Alternatively, feed plate **39** may be constructed from polymeric material. Still, any suitable material may be used to construct the feed plate **39** as chosen with sound engineering judgment. The feed plate **39** may have a thickness in the range of ¼ inch to 1 ½ inches thick. However, any thickness of material, or length and width of material, may be chosen with sound engineering judgment. It is noteworthy to mention that alternate embodiments of the subject invention are contemplated wherein the drive roll as-

sembly is connected directly to the housing of the wire feeder **11**, and not to the feed plate **39**. In this instance, the housing **39a** itself may be sufficiently rigid and strong to support the drive roll assembly functioning effectively as the feed plate **39**. Still it is to be construed that any manner of supporting the drive roll assembly may be chosen without departing from the intended scope of coverage of the embodiments of the subject invention.

[0036] *Fig. 4* shows an exemplary embodiment of one configuration of feed plate **39** and drive rollers **36**. In this configuration, bearings **50** may be installed into the feed plate **39**, which may have recesses that receive the outer bearing race. In particular, four (4) bearings are shown, although the number of bearings **50** may vary without departing from the intended scope of coverage of the embodiments of the subject invention. Shafts **55**, or alternatively pins, may connect the drive rollers **36** with the bearings **50**. It follows that the shafts **55** may be received into the bearings **50** and may be press fit into a fixed relationship with respect to the bearing inner race. In this manner, the driver roller **36**, shaft **55** and inner bearing race rotate together.

[0037] With continued reference to *Fig. 4* and now to *Fig. 5*, in one exemplary embodiment, one or more components of the drive roll assembly may be constructed from non-conducting materials, i.e. electrically non-conducting or electrically insulating materials. For example, part or all of the drive roll assembly may be comprised of dielectric materials or any material(s) that substantially inhibits or prevents arcing, i.e. electrical discharging across a gap, due to differences in voltage potential. Example of these materials may include ceramic or ceramic-based material. Other types of materials may include glass. Moreover, certain types of polymeric materials may be utilized.

[0038] In one embodiment, part or all of the bearings **50** may be constructed from non-conducting materials. The bearings **50** may include a plurality of rolling elements, which may be bearing balls **56**, disposed between generally circular inner **58** and outer **59** races. In one particular embodiment, the bearing balls **56**, which may be spherical, are constructed from non-conducting material, while the remaining components may be constructed from more traditional materials, such as metal, e.g. steel or other alloy. Illustratively, bearing balls **56** may be made from ceramic and the inner and outer races **58**, **59** may be constructed from steel. Alternatively, one or both of the races **58**, **59** may be constructed from ceramic while the rolling elements are constructed from steel. In yet another embodiment, all of the bearing components may be constructed from ceramic. Still, it will be appreciated that any combination of the components making up bearing **50** may be

constructed from non-conducting material without departing from the intended scope of coverage of the embodiments of the subject invention. In this way, arcing or sparks resulting from differences in the voltage potential between the electrode **13a** contacting the drive rollers **36** and the feed plate **39**, **39a** will be substantially inhibited and/or prevented by the dielectric materials.

[0039] In another embodiment of the subject invention, one or more of the bearing components may be covered or coated with a dielectric material. In an illustrative manner, the bearing balls **56** may be covered with an outer most layer of ceramic. It will be appreciated that the entire surface of the bearing balls **56** may be covered with ceramic as the bearing balls rotate eventually making contact with the inner **58** and outer **59** bearing races over its entire surface, thus preventing or reducing sparks therebetween. Other bearing components may be completely or only partially covered with a dielectric material. For example, the inner **58** and outer **59** bearing races may be covered with ceramic, or other dielectric, on the surfaces contacting the bearing balls **56** or over its entire surface. Still, any combination of the aforementioned may be incorporated.

[0040] As illustrated in *Figs. 6-7*, and as mentioned previously, the invention is applicable to push-pull systems in which dual motors are used: an assist motor that pushes the electrode from the feeder, and a primary motor that is located in the gun that pulls the electrode. This is particularly useful when employing softer welding wires, e.g., aluminum. The invention is equally applicable to spool guns. *Figs. 6-7* show an exemplary embodiment of one configuration of feed rollers **60,62** (at least one of which is a drive roller) positioned within welding gun **68**, the welding gun having removable cover **70** to expose at least one of the feed rollers. Bearings **64** are installed under the feed rollers **60,62** which may have recesses that receive the outer bearing race. In particular, a bearing is employed with each feed roller in a manner similar to that illustrated in *Fig. 4* or as alternatively illustrated in *Fig. 7*. It is recognized that the number of bearings **64** may vary without departing from the intended scope of coverage of the embodiments of the subject invention. Shafts, or alternatively pins, may connect feed rollers **60,62** with bearings **64** or as illustrated in *Fig. 7*, the shaft and ceramic bearing are one piece, at least the shaft of which is constructed of a non-conductive material, and in one embodiment, both the shaft and bearing are constructed of a non-conductive material. It follows that the shafts may be received into bearings **64** and may be press fit into a fixed relationship with respect to the bearing inner race. In this manner, a feed roll **60** or **62**, and its respective shaft and inner bearing race rotate together.

[0041] One or more components of the drive roll assemblies are constructed from non-conducting materials, i.e. electrically non-conducting or electrically insulating materials. For example, part or all of the drive roll assembly may be comprised of dielectric materials or any material(s) that substantially inhibits or prevents arcing, i.e. electrical discharging across a gap, due to differences in voltage potential. Example of these materials may include ceramic or ceramic-based material. Other types of materials may include glass. Moreover, certain types of polymeric materials may be utilized.

[0042] In one embodiment, part or all of the bearings **64** may be constructed from non-conducting materials. The bearings **64** may include a plurality of rolling elements, which may be bearing balls **66**, disposed between generally circular inner and outer races in a manner to that described previously with regard to *Fig. 4*. In one particular embodiment, the bearing balls **66**, which may be spherical, are constructed from non-conducting material, while the remaining components may be constructed from more traditional materials, such as metal, e.g. steel or other alloy. Illustratively, bearing balls **66** may be made from ceramic and the inner and outer races may be constructed from steel. Alternatively, one or both of the races may be constructed from ceramic while the rolling elements are constructed from steel. In yet another embodiment, all of the bearing components may be constructed from ceramic. Still, it will be appreciated that any combination of the components making up bearing **64** may be constructed from non-conducting material without departing from the intended scope of coverage of the embodiments of the subject invention. In this way, arcing or sparks resulting from differences in the voltage potential between the electrode **13a** contacting the drive rollers **36** and the feed plate **39, 39a** in addition to the feed rollers **60, 62** will be substantially inhibited and/or prevented by the dielectric materials.

[0043] In another embodiment of the subject invention, one or more of the bearing components may be covered or coated with a dielectric material. In an illustrative manner, the bearing balls may be covered with an outer most layer of ceramic. It will be appreciated that the entire surface of the bearing balls may be covered with ceramic as the bearing balls rotate eventually making contact with the inner and outer bearing races over its entire surface, thus preventing or reducing sparks therebetween. Other bearing components may be completely or only partially covered with a dielectric material. For example, the inner and outer bearing races may be covered with ceramic, or other dielectric, on the surfaces contacting the bearing balls or over its entire surface. Still, any combination of the aforementioned may be incorporated.

[0044] As better illustrated in *Fig. 7*, an assembly view of a feed mechanism of the invention, a combination of at least one drive roll **62** is in operative relationship to idler drive roll **60**, each of which are positioned via a shaft with associated ceramic bearing **64** into apertured feed plate **72**, one end of which is in communication with gooseneck **90** of welding gun **68**. The tension of idler drive roll with driven drive roll **62** is maintained by spring **76** and adjustment screw **78** against idle arm **74**, into which is positioned the ceramic bearing and shaft **64** of idler drive roll **60**. Positioned adjacent the drive rolls is motor gearbox mounting plate **80** in communication with motor gearbox **82**. A plurality of tubes for gas, water, conduit **84** interface through motor gearbox and feed plate into gooseneck **90** via cable connection **86** adjacent to strain relief **88** and cable **92**.

[0045] The invention has been described herein with reference to the disclosed embodiments. Obviously, modifications and alterations will occur to others upon a reading and understanding of this specification. It is intended to include all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

REFERENCE NUMBERS

10	wire feeder	55	shaft
11	wire feeder	56	bearing ball
12	power source	58	circular inner race
13	wire	59	circular outer race
13a	welding electrode/ welding wire	60	feed roller
14	welding output terminal	62	feed roller
15	wire supply	64	bearing
18	drive motor	66	bearing ball
19	work piece	68	welding gun
21	wire support guide	70	cover
21a	first end guide	72	feed plate
21b	second end guide	74	idle arm
21c	center guide	76	spring
22	reel	78	screw
26	weld gun	80	mounting plate
36	drive roller	82	motor gearbox
37	outer circumference	84	conduit
39	feed plate	86	cable connection
39a	housing	88	strain relief
50	bearing	90	gooseneck
54	hub	92	cable

Claims:

1. A wire feeder (10,11) for conveying associated welding wire (13), comprising:
 - a wire feeder (10,11) having one or more drive rollers (36), the one or more drive rollers (36) being adapted to push the associated welding wire (13) toward the welding gun (26);
 - a welding gun (26) operatively connected to the wire feeder (10,11) for conveying associated welding wire (13) used in arc welding, the welding gun (26) having at least one drive roller (36) within the welding gun (26) to pull the welding wire (13) toward an egress aperture in the welding gun (26);
 - at least a first driver motor operatively connected to deliver power for rotating the one or more drive rollers (36) in the wire feeder (10,11);
 - at least a second driver motor operatively connected to deliver power for rotating the at least one drive roller (36) in the welding gun (26); and,
 - one or more bearings (50) positioned between the one or more drive rollers (36) in the wire feeder (10,11) and the at least one drive roller (36) within the welding gun (26), said one or more bearings coaxial with each of said one or more drive rollers (36), wherein each of the one or more bearings (50) is electrically non-conducting for preventing the discharge of electrical energy across the one or more bearings (50).
2. The wire feeder (10,11) as defined in claim 1, wherein
 - the one or more bearings (50) are constructed from a dielectric material.
3. The wire feeder (10,11) as defined in claim 1 or 2, wherein
 - the one or more bearings (50) are constructed from ceramic.
4. The wire feeder (10, 11) as defined in any of the claims 1 to 3, wherein
 - at least the drive rollers (36) are constructed from electrically non-conducting material.
5. The wire feeder (10,11) as defined in any of the claims 1 to 4, wherein said drive rollers (36) further comprise:
 - a plurality of adjacent spherical bearing balls (56), and, wherein the bearing balls (56) are constructed from ceramic.

6. The wire feeder (10,11) as defined in any of the claims 1 to 5, wherein
- the drive motors are variable speed drive motors for conveying the associated welding wire (13) at varying speeds.
7. A push-pull drive system for a welding wire feeder conveying associated electrically charged wire (13) , comprising:
- a first wire feeding means positioned external to a welding wire gun (26), said first wire feeding means comprising:
- a generally rigid apertured first feed plate (39) having one or more recesses;
 - at least one first pair of drive rollers (36) rotatably connected with respect to the first feed plate (39,72), wherein the drive rollers (36) are spaced apart to propel the associated electrically charged wire (13), said first pair of drive rollers (36) having a first pair of opposed rollers which matingly engage with each of said drive rollers (36);
 - a first means for reducing rolling friction operatively positioned between each of said first rollers and the first feed plate (39, 72), said first means for reducing rolling friction being coaxially positioned with said first rollers, and wherein said first means for reducing rolling friction is electrically non-conducting for substantially preventing the discharge of electrical energy between the first feed plate (39, 72) and the first rollers; and
- a second wire feeding means positioned within the welding wire gun, said second wire feeding means comprising:
- a second apertured welding wire feed plate (39,72) positioned within the welding gun, one side of the second feed plate (39,72) connected to a gun gooseneck;
 - at least one second pair of drive rollers rotatably connected with respect to the second feed plate (39,72), wherein the second pair of drive rollers are spaced apart to propel the associated electrically charged wire (13), said second drive rollers having a pair of second opposed rollers which matingly engage with each of said second drive rollers; and
 - a second means for reducing rolling friction operatively positioned between each of said second rollers and the second feed plate (39, 72), said second means for reducing rolling friction being coaxially positioned with said second rollers, and wherein said second means for reducing rolling friction is electrically

non-conducting for substantially preventing the discharge of electrical energy between the second feed plate (39, 72) and the second roller.

8. The system as defined in claim 7, wherein each of said means for reducing rolling friction comprises:

at least one bearing race and a plurality of rolling elements, wherein the at least one bearing race is received into the one or more recesses of each of said feed plates (39,72); and wherein

the at least one bearing race or the plurality of rolling elements is coated or constructed from a non-conductive dielectric material.

9. A spool gun drive system for a welding wire feeder conveying associated electrically charged wire (19), comprising:

a wire feeding means positioned within the welding wire gun, said wire feeding means comprising:

an apertured welding wire feed plate positioned within the welding gun, one side of the feed plate (39,72) connected to a gun gooseneck (90);

at least one pair of drive rollers rotatably connected with respect to the feed plate (39,72), wherein the pair of drive rollers are spaced apart to propel the associated electrically charged wire (13), said drive rollers having a pair of opposed rollers which matingly engage with each of said drive rollers; and

a means for reducing rolling friction operatively positioned between each of said rollers and the feed plate (39,72), said means for reducing rolling friction being coaxially positioned with said rollers, and wherein said means for reducing rolling friction is electrically non-conducting for substantially preventing the discharge of electrical energy between the feed plate (39,72) and the roller.

10. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 9, wherein said means for reducing rolling friction comprises

one or more rolling elements constructed from ceramic.

11. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 10, wherein
each of the one or more rolling elements are constructed from metal and wherein the one or more rolling elements are coated with ceramic thereby completely covering the one or more metal rolling elements.
12. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 10, wherein each of said means for reducing rolling friction comprises
one or more rolling elements constructed from non-conducting polymeric material.
13. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 12, wherein
the at least one pair of drive rollers includes first and second drive rollers, and, wherein
the position of the first drive roller is adjustable with respect to the second drive roller for driving differently sized associated wire.
14. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 13, further comprising:
a wire support guides having a wire passage for channeling the associated electrically charged wire (13).
15. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 14, wherein
the feed plate is constructed from electrically non-conducting material.
16. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 15, wherein said means for reducing rolling friction comprises:
a bushing constructed from a dielectric material.
17. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 16, wherein
the bushing is constructed from ceramic.

18. The push-pull drive system or the spool gun drive system as defined in any of the claims 7 to 17, wherein

the bushing is constructed from glass.

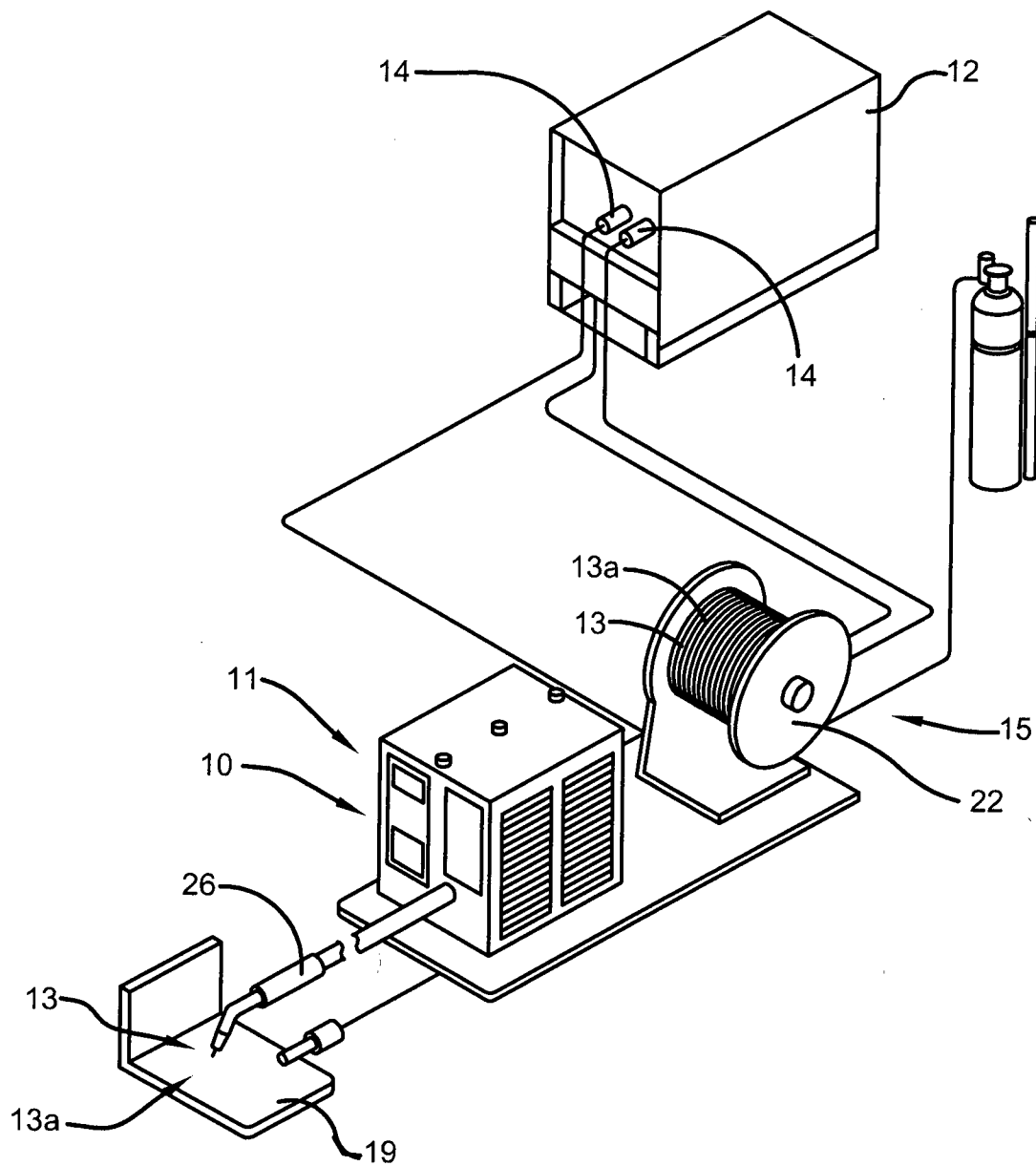


FIG. 1

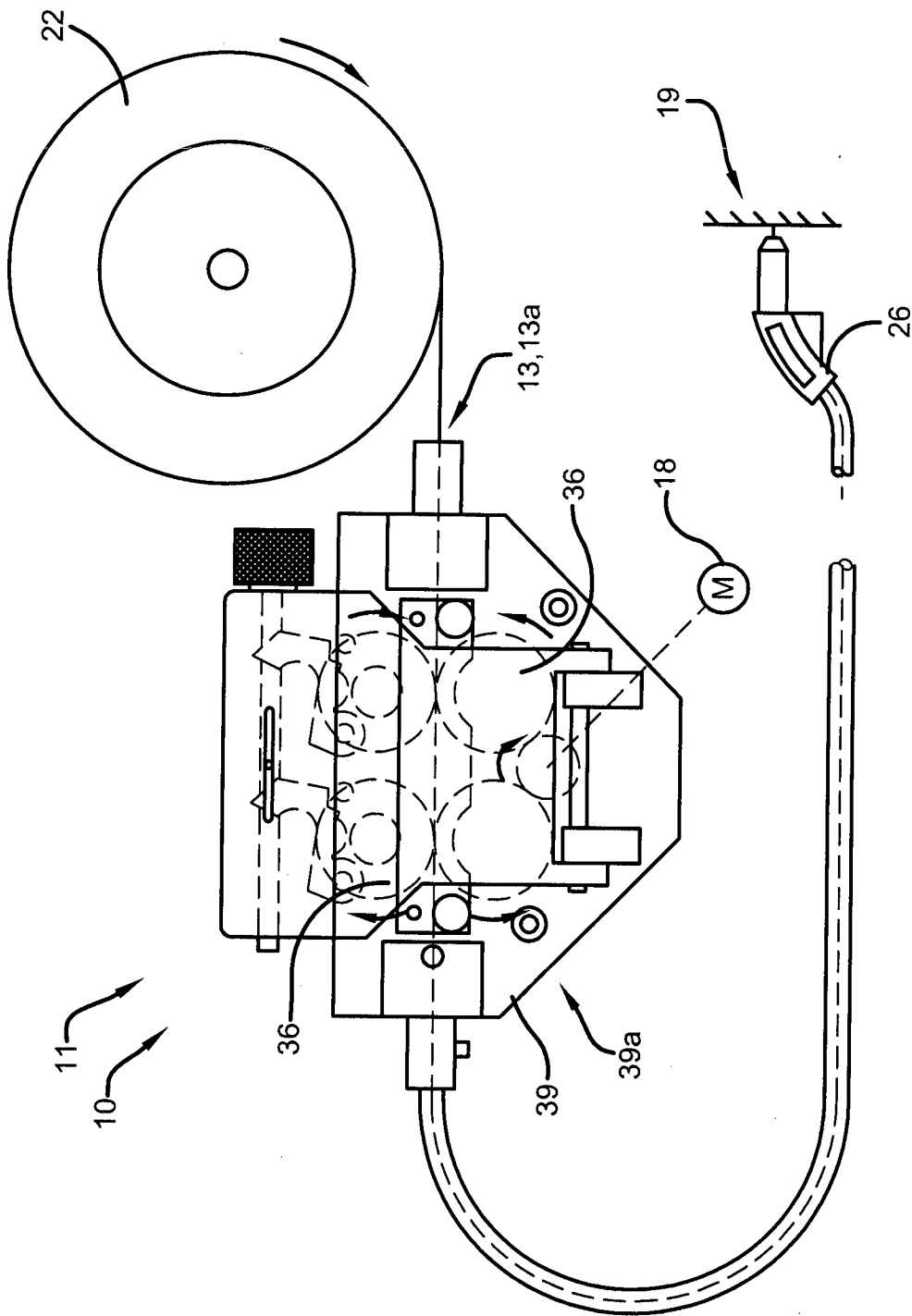


FIG. 2

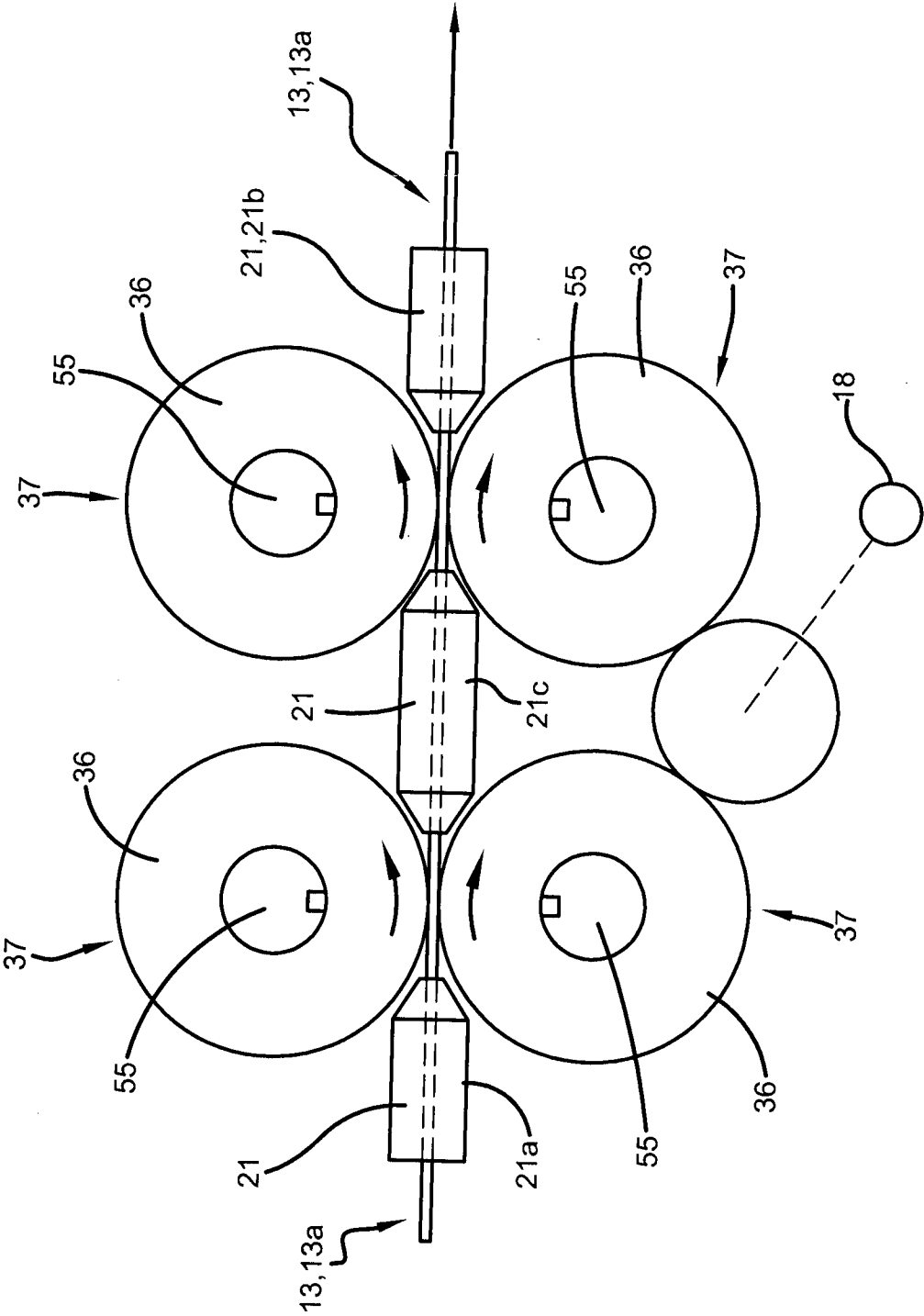


FIG. 3

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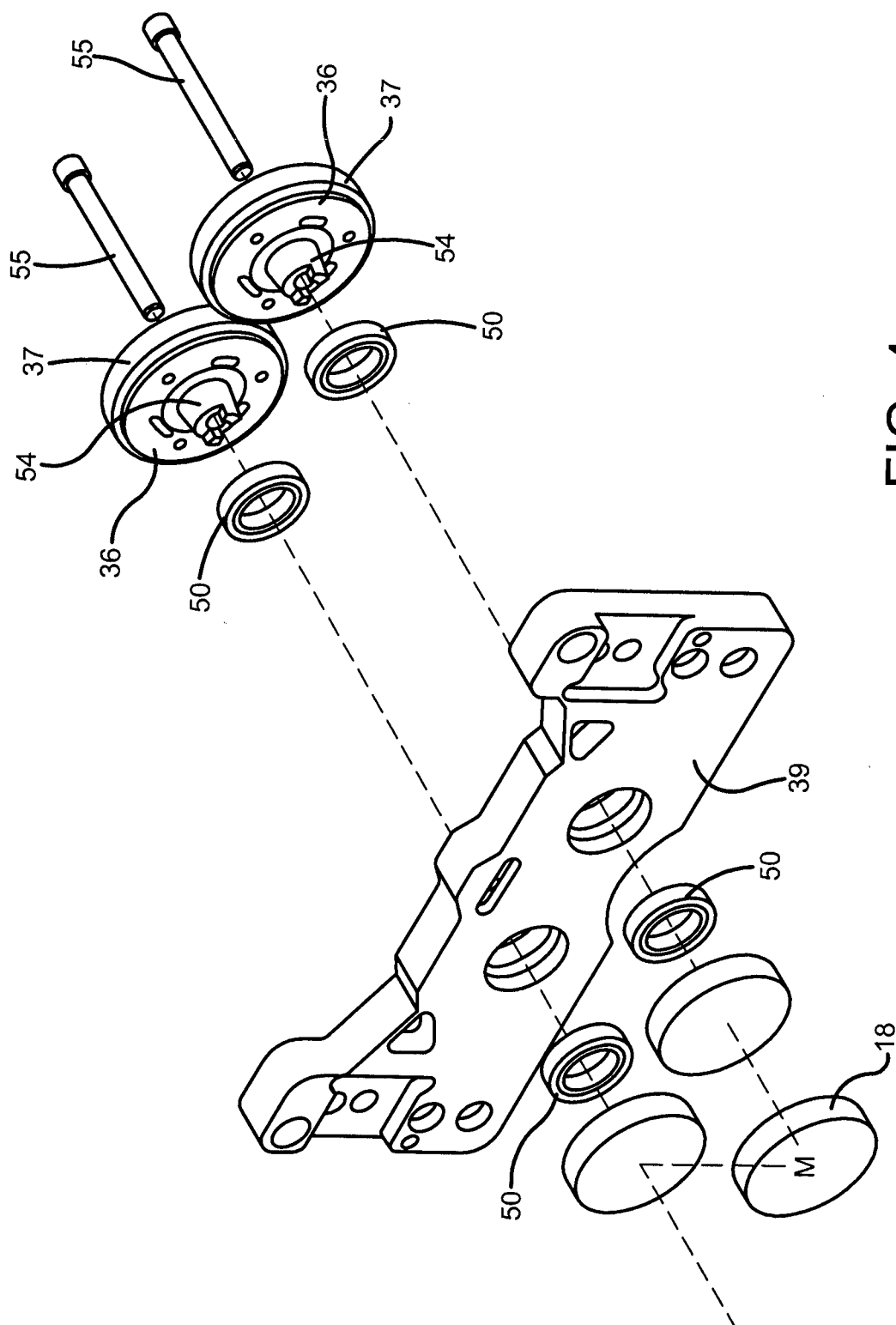


FIG. 4

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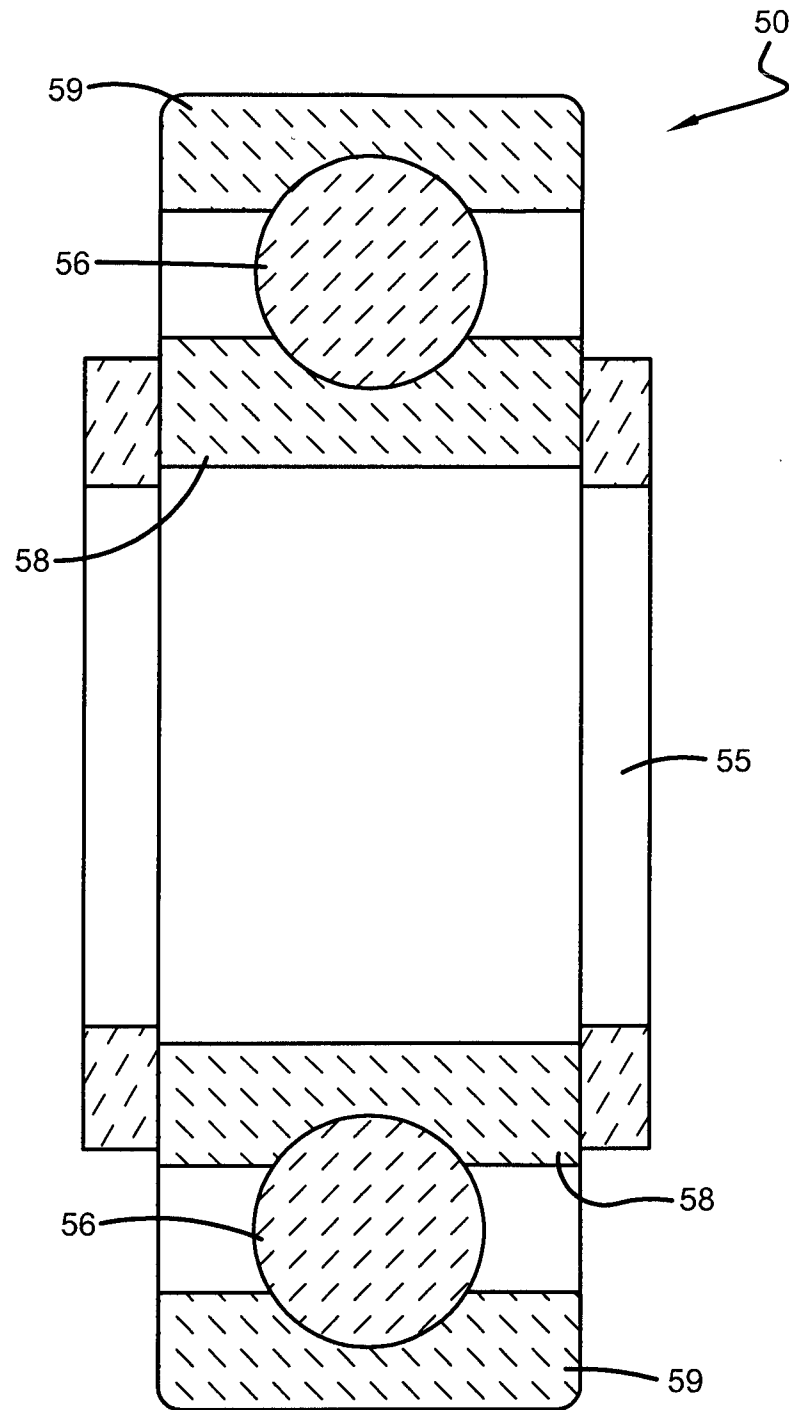


FIG. 5

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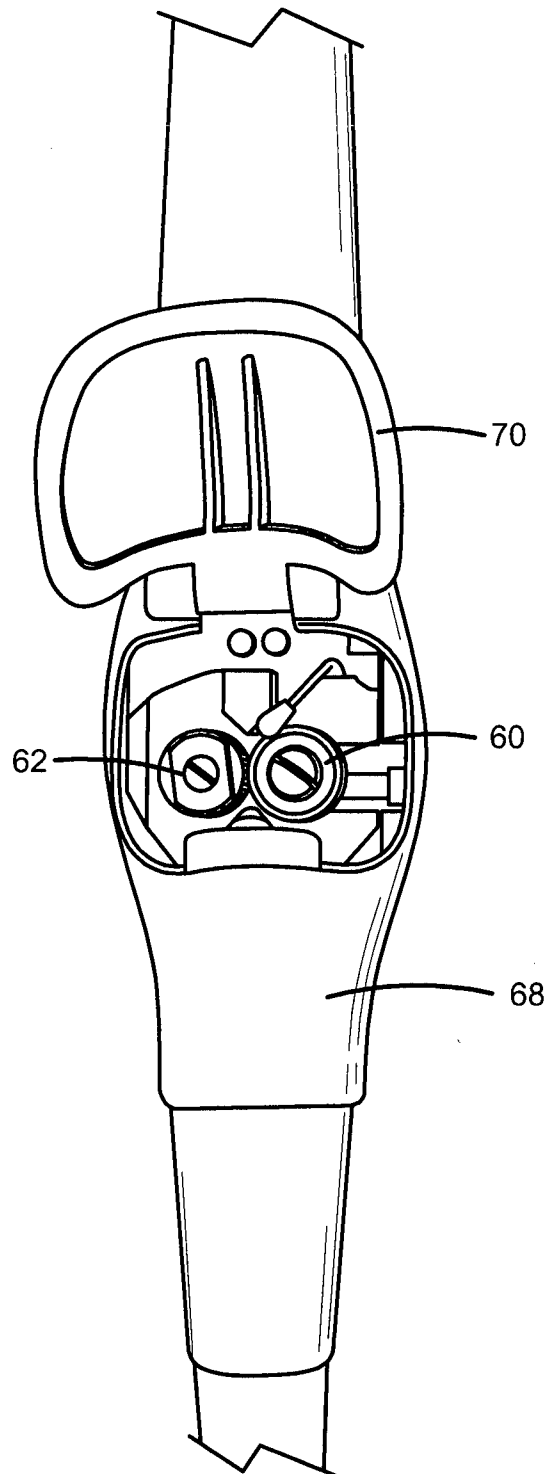


FIG. 6

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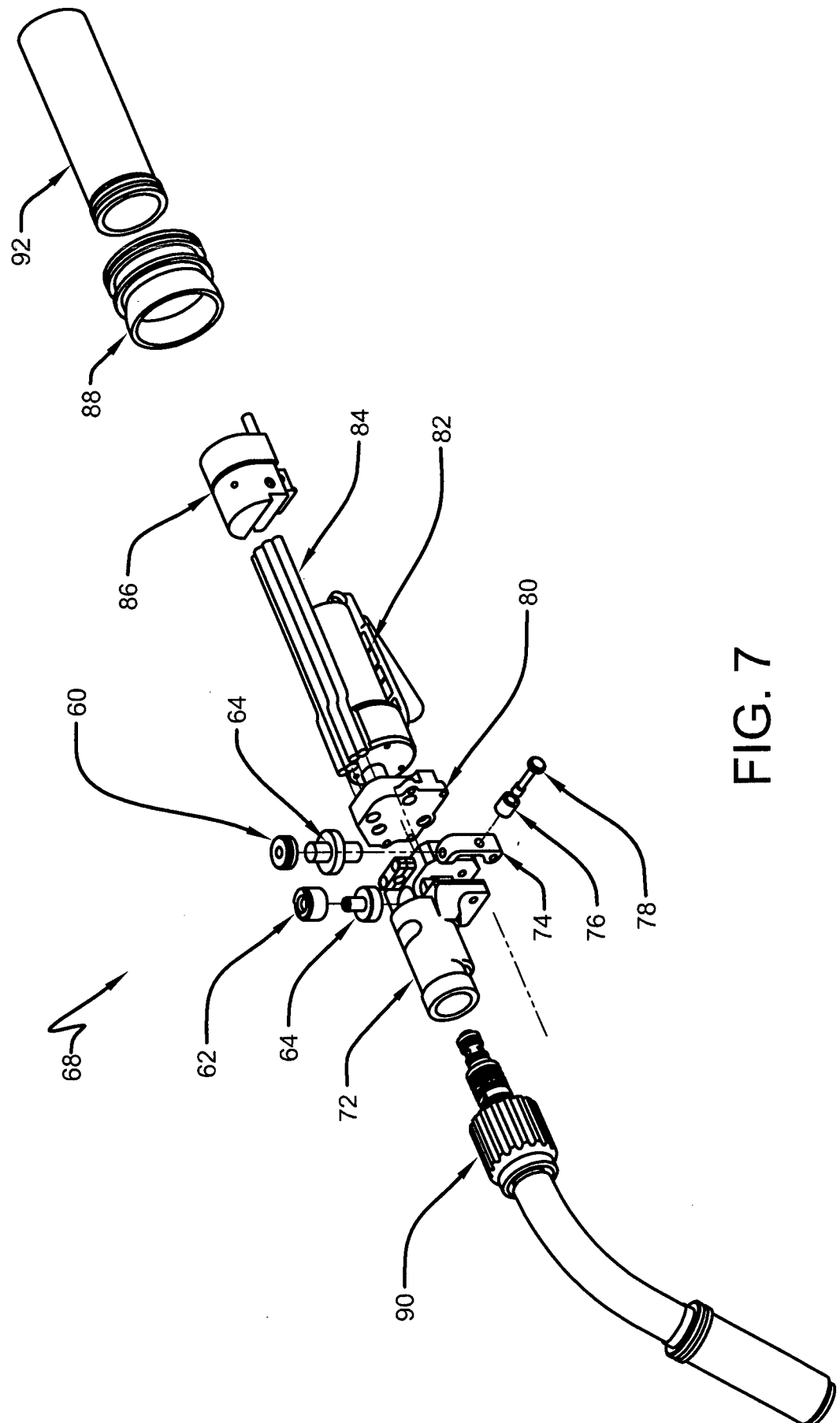


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2014/002069

A. CLASSIFICATION OF SUBJECT MATTER

INV. B23K9/133 B23K35/28
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B23K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/204034 A1 (SCHARTNER QUINN W [US] ET AL) 25 August 2011 (2011-08-25) paragraphs [0004], [0022] - [0000], [0030], [0037]; claims 1-27; figure 1 -----	1-18
Y	US 2011/100969 A1 (ENYEDY EDWARD [US]) 5 May 2011 (2011-05-05) paragraph [0002]; claims 1-18; figures 1-5 -----	1-18
Y	US 2012/285939 A1 (KESSLER UDO-RALF [DE] ET AL) 15 November 2012 (2012-11-15) paragraphs [0001], [0053] - [0056], [0073] - [0077]; claims 1-21; figure 1 -----	1-18
A	JP S63 26271 A (MATSUSHITA ELECTRIC IND CO LTD) 3 February 1988 (1988-02-03) abstract; figures 1-9 -----	1,9



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

20 February 2015

Date of mailing of the international search report

02/03/2015

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European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2014/002069

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011204034 A1	25-08-2011	CA 2788694 A1 CN 102770229 A EP 2539101 A1 US 2011204034 A1 WO 2011106175 A1	01-09-2011 07-11-2012 02-01-2013 25-08-2011 01-09-2011
US 2011100969 A1	05-05-2011	AU 2010311045 A1 CA 2779399 A1 CN 102695578 A EP 2496378 A1 RU 2012122472 A US 2011100969 A1 WO 2011051795 A1	24-05-2012 05-05-2011 26-09-2012 12-09-2012 10-12-2013 05-05-2011 05-05-2011
US 2012285939 A1	15-11-2012	AU 2010332808 A1 DE 102009058869 A1 EP 2512719 A1 US 2012285939 A1 WO 2011073336 A1	21-06-2012 22-06-2011 24-10-2012 15-11-2012 23-06-2011
JP S6326271 A	03-02-1988	NONE	