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(54) **Title**: DRIVE ROLL ASSEMBLY

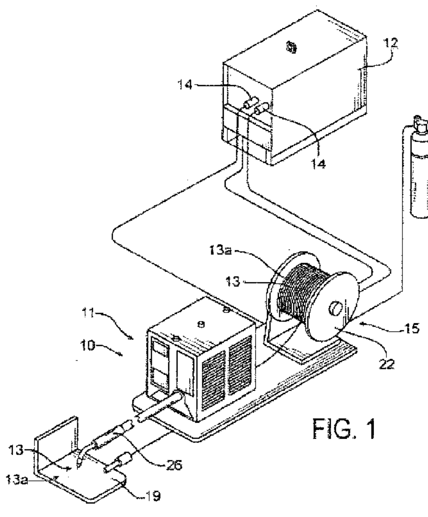

FIG. 1

(57) **Abstract**: A wire feeder (10) includes a wire feeder housing (39a) that encloses one or more drive roll assemblies rotatabiy connected with respect to the wire feeder housing (39a) for engaging welding wire (13). Each of drive roll assemblies includes a biasing element (60) that adjusts compressive forces applied to the welding wire (139).

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DRIVE ROLL ASSEMBLY

FIELD OF THE INVENTION

[0001] The invention is related to a wire feeder for conveying associated welding wire according to claim 1 and to a drive roll assembly for use with a welding wire feeder according to claim 9. The invention pertains to a welding wire feeder, and more particularly, to a welding wire feeder having drive rolls that include a biasing member that facilitates the movement of a welding wire to a workpiece.

TECHNICAL BACKGROUND

[0002] Wire feeders, like those used in arc welding applications, convey wire from a continuous feed source to a weld torch. Typically, wire feeders include motor-driven drive rolls that engage diametrically opposite sides of a wire to move the wire along a path through a housing of the feeding mechanism. Once through the housing, the wire is moved through a flexible tube or conduit leading to a welding gun. Often, the conduit also carries shielding gas and electrical current to the welding gun.

[0003] Typically, each of the drive roll is mounted on a roller support and all of the roll supports are driveably engaged with one another. Thus, powered rotation of a single roller support causes rotation of all the roll supports and the drive rolls supported thereon. Typically, the drive rolls are a single pair of opposed rolls or a double pair of opposed rolls spaced apart along the wire path. In either arrangement, the drive rolls have an upstream side at which the wire enters the drive rolls and a downstream side at which the wire exits the driver rolls. On the upstream side, the wire is guided through an upstream tube toward a bite created between the drive rolls adjacent the upstream side. Likewise, on the downstream side, the wire exits the drive rolls and is guided through a downstream tube adjacent the downstream side. If a double pair of opposed rolls are used, another tube can be provided between the pairs of drive rolls to further guide the wire.

[0004] To impart an advancing force or motion to the wire, opposing drive rolls are positioned sufficiently close to one another so that the wire extending along the pathway is compressed between the opposing rolls. The compressive force in combination with friction between the material of the wire and the rolls advances the continuous length of wire along the wire path in a generally smooth and continuous manner.

[0005] The wire passing through the drive rolls has a generally round cross-section and is engaged tangentially by opposing, flat-faced drive rolls mounted transversely to the wire. As a result of this arrangement, the compressive forces exerted on the wire by the driver rolls can often cause the wire to undesirably deform. The material characteristics of the wire largely determine the magnitude or amount the wire is deformed as a result of the compressive forces. Accordingly, a wire made from a material having a relatively high compressive yield strength, such as steel, will be deformed less than a wire made from a material having a moderate compressive yield strength, such as aluminum.

[0006] Reductions in the required compressive force are generally considered desirable and can decrease wear on the wire feeder and can also reduce slippage of the wire relative to the drive rolls. Accordingly, any improvements to the drive rolls that decreases the required compressive force needed to drive the wire engaged by the drive rolls is deemed desirable.

DESCRIPTION

[0007] In order to improve wire feeding a wire feeder for conveying associated welding wire according to claim 1 and a drive roll assembly for use with a welding wire feeder according to claims 9 are described. Further embodiments of the invention are subject of the subclaims. The present invention provides new and improved drive rolls for use in wire feeders that overcome the foregoing difficulties and others and provide the aforementioned and other advantageous features. More particularly, in accordance with one aspect of the present invention, a wire feeder for conveying associated welding wire comprises a wire feeder housing, a welding gun operatively connected to the wire feeder for conveying associated welding wire used in arc welding, and a drive roll assembly disposed within the housing and configured to advance a wire electrode along a wire path into the welding gun, the drive roll assembly including a plurality of shafts each driven by a motor, a drive hub assembly rotatably connected to a respective shaft and configured to rotate about an axis therewith, at least one pair of drive rolls rotatably positioned upon a respective drive hub assembly, wherein each drive roll has an exterior surface and an interior surface, and the interior surface includes a circumferential groove located therein, and at least one biasing member positioned within the groove of each of the at least one pair of drive rolls.

[0008] In accordance with another aspect of the invention, a drive roll assembly for use with a welding wire feeder is provided. The drive roll assembly comprises a drive hub assembly configured to rotate about an axis therewith, at least one pair of drive rolls rotatably positioned upon a respective drive hub assembly, wherein each drive roll has an exterior surface and an interior surface, and the interior surface includes a circumferential groove located therein, and at least one biasing member positioned within the groove of each of the at least one pair of drive rolls.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] *FIG. 1* is a perspective view of a wire feeder used in a welding application according to an embodiment of the invention;

[0010] *FIG. 2* is a side view of a wire feeder and wire feed source according to an embodiment of the invention;

[0011] *FIG. 3* is a close up side view of drive rolls feeding wire according to an embodiment of the invention;

[0012] *FIG. 4* is an expanded perspective view of a feed plate and accompanying drive rolls, according to the embodiments of the subject invention;

[0013] *FIG. 5* is side view of a drive roll assembly which includes a biasing member according to an embodiment of the invention;

[0014] *FIG. 6* is a cross sectional view of the drive roll assembly of *FIG. 5*;

[0015] *FIG. 7* is a side view of a pair of drive roll assemblies, each including a biasing member, and engaging a welding wire according to an embodiment of the invention; and

[0016] *FIG. 8* is a cross sectional view of the pair of drive roll assemblies engaging a welding wire of *FIG. 7.*

DETAILED DESCRIPTION OF THE INVENTION

[0017] 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**. Wire feeder **10** comprises a device for conveying wire **13** from feed source **15**, i.e. wire supply **15**, for use in a particular application. For illustrative purposes, 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 reel **22**, box or drum, and delivered to work piece **19**, which in the current embodiment is a weldment. Accordingly, wire feeder **10**, or welding wire feeder **11**, may include a drive assembly that utilizes power from one or more locomotive devices that drive wire **13**, **13a** to the application work site or work piece **19**.

[0018] With continued reference to *FIG. 1*, welding wire feeder **11** may be used in conjunction with welding power source **12** as manufactured by, for example, the Lincoln Electric company in Cleveland, Ohio. 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 welding power source **12**. Additionally, welding power source **12** may include a regulated power supply for delivering electrical power to one or more welding accessories, which may include welding wire feeder **11**. A welding gun, designated generally at **26**, and wire conduit may be electrically connected to welding power source **12** through welding wire feeder **11** for delivering welding current in a manner known in the art. It follows that welding wire **13a** is fed through 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 work piece **19** having a voltage potential equal to or approximately equal to the output voltage of welding power source **12**, which may be substantially greater than ground.

[0019] 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 weld gun **26**, which may have a trigger or other activation mechanism for dispensing 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 drive motor **18**, has an output that is adjustable for varying the rate which welding wire **13a** is discharged from wire feeder **10**. In particular, drive motor **18** itself may be a variable speed drive motor **18**.

[0020] It is noted here that wire feeder **11** and/or drive motor(s) **18** may draw operating power from the regulated power supply onboard welding power source **12**. Alternatively, welding wire feeder **11** may draw power from the open circuit voltage of welding power source **12**, or an altogether separate power source. Still any manner of providing power to operate welding wire feeder **11** and/or drive motors **18** may be chosen with sound engineering judgment as is appropriate for use with the embodiments of the present invention.

[0021] With continued reference to *FIG. 1* and now also to *FIGS. 2 and 3*, welding wire feeder **11** may include a drive assembly, or drive roll assembly. As mentioned above, drive motor **18**, also called a wire feeder motor **18**, delivers power, i.e. torque, to convey welding wire **13a** to weld gun **26** and subsequently to work piece **19**. Drive rolls **36** are included that grip welding wire **13a** for pushing or pulling welding wire **13a** in the appropriate direction, i.e. toward the work piece. Drive rolls **36** are rotatably connected with respect to a frame member or other portion of wire feeder **11**. In one particular embodiment, drive rolls **36** are rotatably connected to feed plate **39** or possibly the wire feeder housing.

[0022] With reference to *FIG. 3*, drive roll assembly may include a plurality of electrically conductive wire support guides **21** spaced along a wire trajectory. Wire support guides **21** may each incorporate a wire passage, or through-hole, for guiding wire **13**, **13a**. 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 drive rolls **36**, which may comprise adjacently positioned pairs of drive rolls **36**. The plurality of wire support guides **21** may include first and second end guides **21a**, **21b**. Additionally, center guide **21c** may be disposed between pairs of drive rolls **36**. Still, it will be appreciated that any configuration and quantity of wire support guides **21** and drive rolls **36** may be included as chosen with sound judgment.

[0023] Each drive roller **36**, in accordance with one embodiment of the subject invention, may include an outer circumference **37** for contacting welding wire **13a** and a hub **54** for rotation about a central axis. In an exemplary manner, drive rolls **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. outer circumference **37**, of driver roll **36** may be comprised of a sufficiently hardened material, like steel, that is durable and suitable for gripping wire **13**, **13a**. In one embodiment, drive rolls **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 wire **13**, **13a**. It is noted that the central axes of respective drive rolls **36** extend substantially parallel with one another and generally transverse to the trajectory of wire **13**, **13a**. In one particular embodiment, the relative position of drive rolls **36** in one set, or pair, may be adjustable for use with wires of different diameters. Stated differently, the outer circumference of one drive roll **36** may be adjustable with respect to the outer circumference of an adjacent driver roll **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 welding wire **13**, **13a** with the appropriate amount of gripping force.

[0024] Hubs **54** of the drive rolls **36** may be rotatably supported by feed plate **39** or other portion of the housing **39a**, as previously mentioned. In one embodiment, 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 drive rolls **36** may be chosen as is appropriate for use with the embodiments of the subject invention. Shafts **55** may be included that extend from hub **54** and into engagement with a bearing race. In one exemplary manner, drive rolls **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 rolls **36** may be incorporated. Additionally, shafts **55** for each set or pair of drive rolls **36** may be drive-ably engaged with drive motor **18** and with one another such that shafts **55** rotate together for conveying wire **13**, **13a** in a desired direction. Shafts **55** may be drive-ably engaged via gears or pulleys and belts, not shown, retained on 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 outer circumferences **37** of drive rolls **36** in a manner consistent with that described above. It is noted here that shafts **55** and corresponding driver rolls **36** rotate in opposing directions for advancing wire **13**, **13a** in a designated direction. In other words, driver roll **36** on one side of wire **13**, **13a** may rotate clockwise while drive roll **36** on the opposing side of wire **13**, **13a** rotates counterclockwise, as illustrated by the arrows in *FIG. 3*.

[0025] Still referencing *FIG. 2* and now also *FIG. 4*, feed plate **39** may comprise a generally rigid piece of material suitably strong for supporting the drive roll assembly. In one embodiment, feed plate **39** may be separate from the housing of 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. Feed plate **39** may be comprised of aluminum.

However, 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 wire feeder **11**, feed plate **39** may be subject elevated temperature. Accordingly, feed plate **39** will have the requisite rigidity and the ability to withstand high temperatures without failure. In one particular embodiment, 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 feed plate **39** as chosen with sound engineering judgment. Feed plate **39** may have a thickness in the range of 1/4 inch to 11/2 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 assembly is connected directly to the housing of wire feeder **11**, and not to feed plate **39**. In this instance, housing **39a** itself may be sufficiently rigid and strong to support the drive roll assembly functioning effectively as 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.

[0026] *FIG. 4* shows an embodiment of one configuration of feed plate **39** and drive rolls **36**. In this configuration, bearings **50** may be installed into 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 drive rolls **36** with bearings **50**. It follows that 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, driver roll **36**, shaft **55** and inner bearing race rotate together.

[0027] In a further embodiment, as shown in *FIGS. 5 and 6*, each drive roll **36** also includes at least one biasing member. Each drive roll **36** has an exterior surface and an interior surface, and the interior surface includes a circumferential groove located therein and biasing member **36** is positioned within the groove of each of drive rolls **36**.

[0028] Biasing member **60** includes, but is not limited to, a thermoplastic o-ring, a thermoset o-ring, and a toroidal spring. When biasing member **60** is a thermoplastic o-ring, the composition includes a thermoplastic elastomer, a thermoplastic polyolefin, a thermoplastic polyurethane, a thermoplastic polyamide, a melt processible rubber, a thermoplastic vulcanizate, and mixtures thereof. When biasing member 60 is a thermoset o-ring, the composition includes a butadiene rubber, butyl rubber, chlorosulfonated polyethylene, ethylene propylene rubber, ethylene propylene diene monomer, fluoroelastomer, nitrile rubber, perfluoroelastomer, polyacrylates rubber, polychloroprene, polyisoprene, polysufide rubber, silicone rubber, and styrene butadiene rubber.

[0029] If biasing member **60** is an insulator, then drive rolls **36** may be insulated from bearing **50**. This will eliminate the need for the use of separate insulators in order to prevent an electrical current from passing through bearing **50**. In general, biasing member **60** is positioned between drive roll **36** and bearing **50**. In the free state, i.e. when the drive roll assembly is not assembled to the wire drive, drive roll **36** is concentric with bearing **50**.

[0030] When housed in wire feeder **10**, the drive roll assemblies are mounted to a wire drive. The mounted drive roll assemblies are shown in *FIGS. 7 and 8*. The wire drive has a mechanism to position the drive roll assemblies to a position that causes biasing member **60** to compress. The mechanism of the wire drive is an idle arm (not shown) that is moved either rotationally or translationally in order to provide the compressive forces to biasing member **60**. In one embodiment, biasing element **60** is not fully compressed, and a gap in the range from about 0.001 to about 0.010 inches exists between bearing **50** and driver roll **36**. This gap allows for drive roll **36** to "float" relative to the axis of bearing **50** as welding wire **13** size changes, and to compensate for machining tolerances of drive roll **36** itself. The selection of the appropriate biasing member **60** is determined by the wire type, size, and composition. This selection results in the compressive force being set in conjunction with drive rolls **36**.

[0031] Power supplied to drive rolls **36** causing them to spin can be applied directly to drive rolls **36** or through the drive hub assembly. In one embodiment, a gear interfaces with drive roller **36** and is on the same centerline as bearing **50**. Pins on the gear go into holes located in drive rolls **36**. The size of the holes are large enough to compensate for the movement of bearing **50** within the drive roll assembly as biasing element **60** compresses. It is envisioned that other shapes, other than holes, may be used for transmitting torque to drive rolls **36** including, but not limited to, slots, grooves, and couplings such as

Oldham couplings. In another embodiment, the gear may drive the drive hub assembly. In this manner, torque is transferred through biasing element **60** into drive roller **36**. This configuration allows biasing element **60** to also function as a clutch. In this manner, when the torque becomes too high, biasing element **60** will allow for slip between drive roller **36** and the drive hub assembly. This is useful in the prevention of birdnesting.

[0032] The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding description. It is intended that the invention be construed as including all such modifications and alterations insofar as they are within the scope of the appended claims or the equivalents thereof.

REFERENCE NUMBERS

10	wire feeder
12	power source
13	wire
13a	welding wire
15	wire supply
18	drive motor
19	work piece
21	wire support guide
21a	first end guide
21b	second end guide
21c	center guide
22	reel
26	weld gun
36	drive roll
37	outer circumference
39	feed plate
39a	housing
50	bearing
54	hub
55	shaft
60	biasing member

CLAIMS

What is claimed is:

1. A wire feeder (10) for conveying associated welding wire (13), the wire feeder (10) c comprising:

a wire feeder housing (39a);

a welding gun (26) operatively connected to the wire feeder (10) for conveying associated welding wire (13) used in arc welding; and

a drive roll assembly disposed within the housing (39a) and configured to advance a wire electrode along a wire path into the welding gun (26), the drive roll assembly including:

at least one drive hub assembly driven by a motor (18)

said at least one drive hub assembly rotatably connected to a respective shaft (55) and configured to rotate about an axis therewith;

at least one drive roll (36) rotatably positioned upon a respective drive hub assembly, wherein each drive roll (36) has an exterior surface and an interior surface, and the interior surface includes a circumferential groove located therein; and

at least one biasing member (60) positioned within the groove of each of the at least one drive roll.

2. The wire feeder (10) of claim 1, wherein the at least one biasing member (60) is selected from the group consisting of a thermoplastic o-ring, a thermoset o-ring, and a toroidal spring.

3. The wire feeder (10) of claim 2, wherein the thermoplastic o-ring is composed of a material selected from the group consisting of a thermoplastic elastomer, a thermoplastic polyolefin, a thermoplastic polyurethane, a thermoplastic polyamide, a melt processible rubber, a thermoplastic vulcanizate, and mixtures thereof.

4. The wire feeder (10) of claim 2, wherein the thermoset o-ring is composed of a material selected from the group consisting of a butadiene rubber, butyl rubber, chlorosulfonated polyethylene, ethylene propylene rubber, ethylene propylene diene monomer, fluoroelastomer, nitrile rubber, perfluoroelastomer, polyacrylates rubber, polychloroprene, polyisoprene, polysufide rubber, silicone rubber, and styrene butadiene rubber.

5. The wire feeder (10) of any of the claims 1 to 4, wherein the biasing member (60) is compressible.

6. The wire feeder (10) of any of the claims 1 to 5, wherein the biasing element (60) creates a gap between the interior surface of each drive roll (36) and the hub assembly.

7. The wire feeder (10) of any of the claims 7 to 6, wherein the gap between the interior surface of each drive roll (36) and the hub assembly is in the range from about 0.001 inches to about 0.010 inches.

8. The wire feeder (10) of any of the claims 1 to 7, wherein the biasing member (60) is an insulator.

9. A drive roll assembly for use with a welding wire feeder (10), the drive roll assembly comprising:

a drive hub assembly configured to rotate about an axis therewith;

at least one pair of drive rolls rotatably positioned upon a respective drive hub assembly, wherein each drive roll (36) has an exterior surface and an interior surface, and the interior surface includes a circumferential groove located therein; and

at least one biasing member (60) positioned within the groove of each of the at least one pair of drive rolls.

10. The drive roll assembly of claim 9, wherein the at least one biasing member (60) is selected from the group consisting of a thermoplastic o-ring, a thermoset o-ring, and a toroidal spring.

11. The drive roll assembly of claim 10, wherein the thermoplastic o-ring is composed of a material selected from the group consisting of a thermoplastic elastomer, a thermoplastic polyolefin, a thermoplastic polyurethane, a thermoplastic polyamide, a melt processible rubber, a thermoplastic vulcanizate, and mixtures thereof.

12. The drive roll assembly of claim 10, wherein the thermoset o-ring is composed of a material selected from the group consisting of a butadiene rubber, butyl rubber, chlorosulfonated polyethylene, ethylene propylene rubber, ethylene propylene diene monomer,

fluoroelastomer, nitrile rubber, perfluoroelastomer, polyacrylates rubber, polychloroprene, polyisoprene, polysufide rubber, silicone rubber, and styrene butadiene rubber.

13. The drive roll assembly of any of the claims 9 to 12, wherein the biasing member (60) is compressible, and/or wherein the biasing member (60) is an insulator.

14. The drive roll assembly of any of the claims 9 to 13, wherein the biasing element (60) creates a gap between the interior surface of each drive roll and the hub assembly.

15. The drive roll assembly of claim 14, wherein the gap between the interior surface of each drive roll (36) and the hub assembly is in the range from about 0.001 inches to about 0.010 inches.

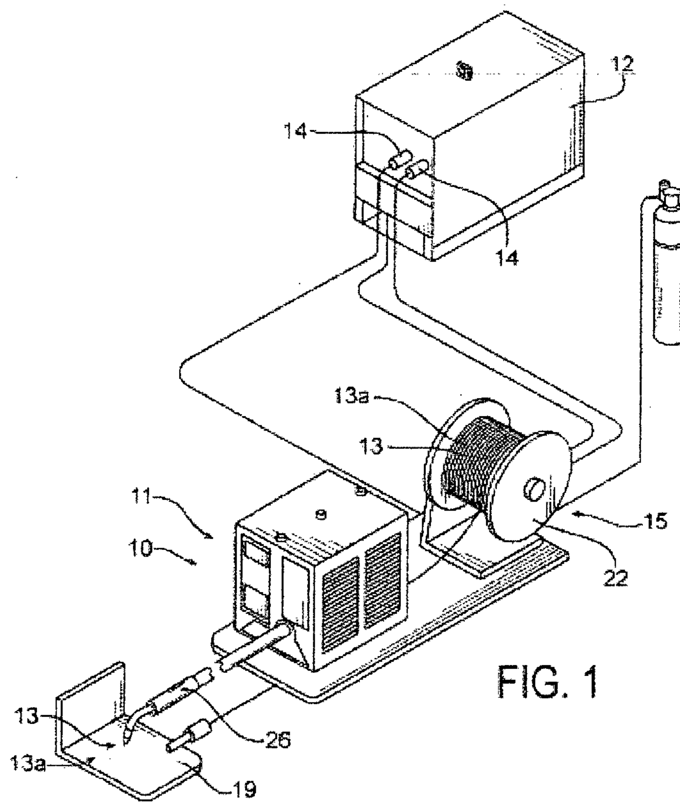

FIG. 1

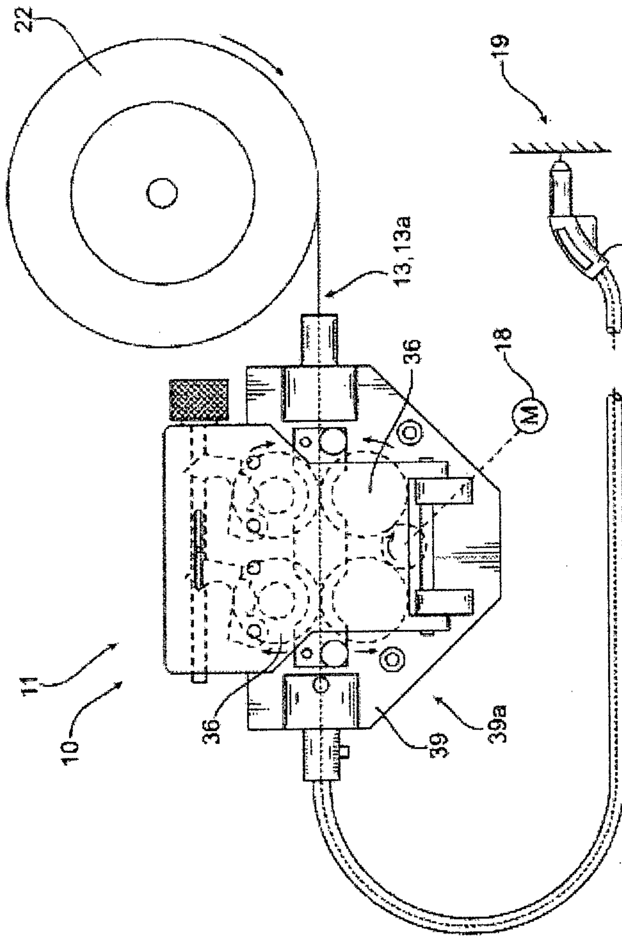

FIG. 2

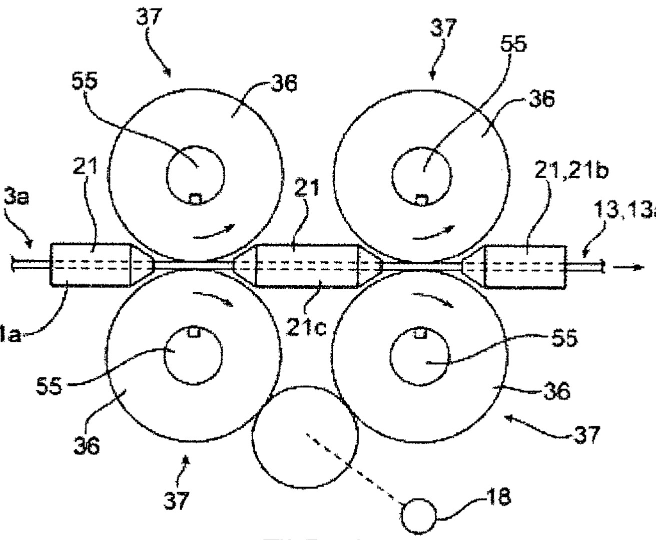
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FIG. 3

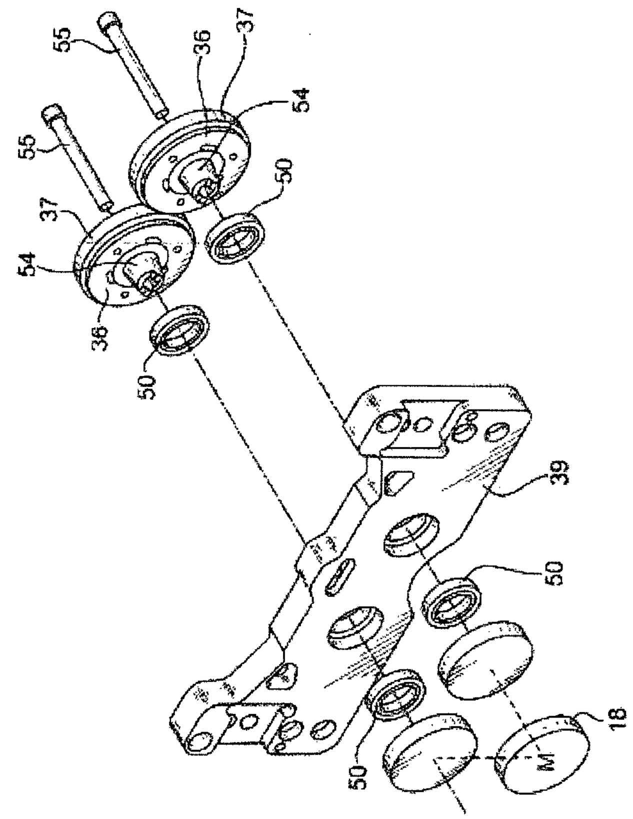

FIG. 4

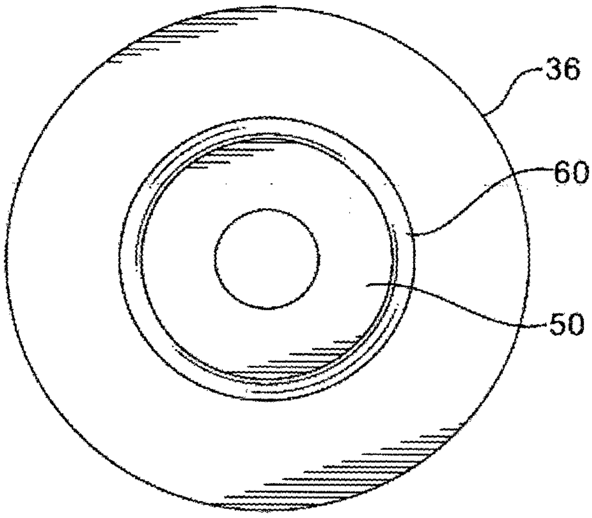

FIG. 5

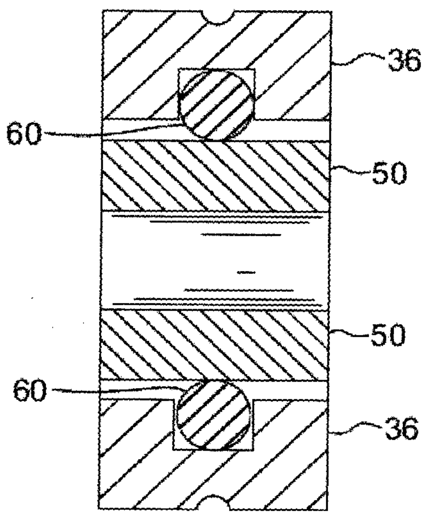

FIG. 6

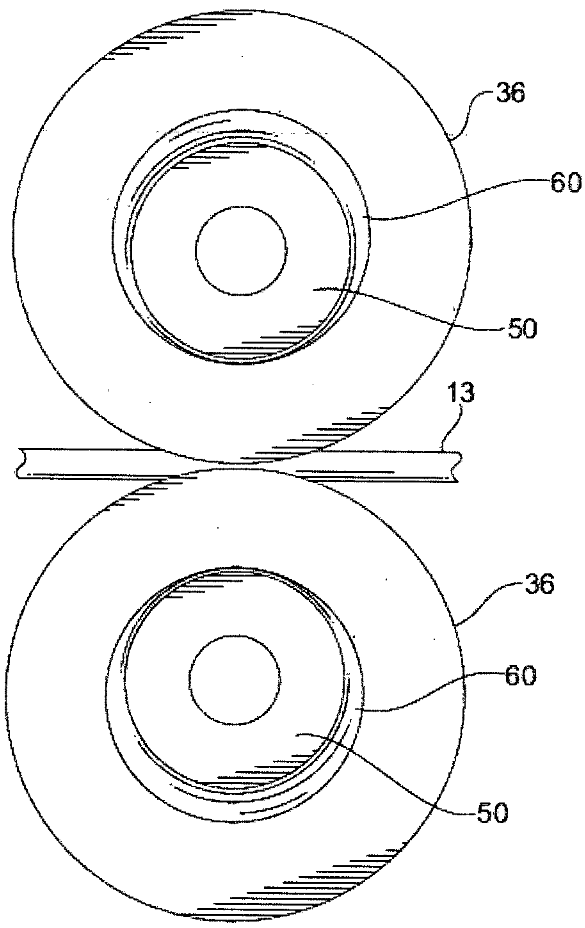

FIG. 7

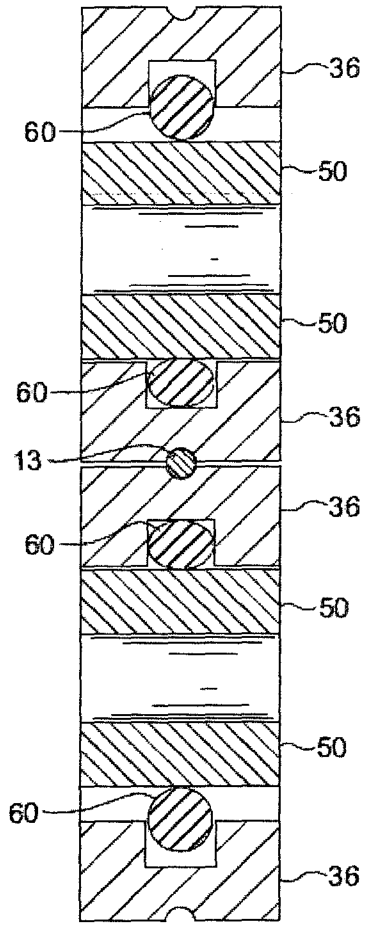

FIG. 8