



(43) International Publication Date
28 June 2012 (28.06.2012)

(10) International Publication Number
WO 2012/087859 A1

- (51) International Patent Classification:
A01M 7/00 (2006.01)
- (21) International Application Number:
PCT/US2011/065714
- (22) International Filing Date:
19 December 2011 (19.12.2011)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/426,774 23 December 2010 (23.12.2010) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: NOZZLE SPACING IN A CROP SPRAYER SYSTEM

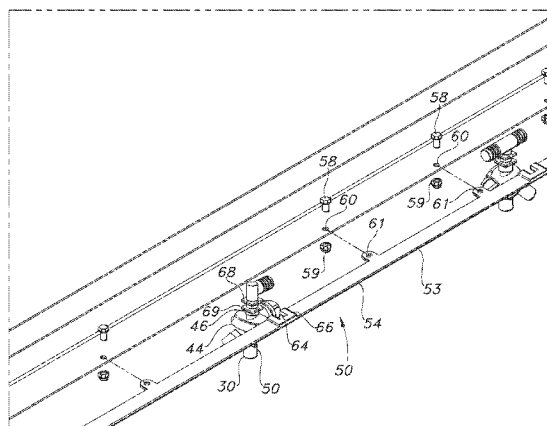


FIG. 4

(57) Abstract: Disclosed is a nozzle mounting system (52) for use with a boom arm of crop sprayer. The system includes a plurality of spray nozzles (30) connected to a fluid distribution conduit (36), wherein pressurized fluid passes through the conduit to the plurality of spray nozzles and a nozzle holding member removably mountable on the boom arm of the crop sprayer. The nozzle holding member (53) mounts the plurality of spray nozzles at a set interval along the boom arm. In one embodiment, the nozzle holding member is a mounting rail configured to mount to the boom arm, wherein the mounting rail has a plurality of nozzle-receiving slots (64) at the set interval and each nozzle-receiving slot interacts with one of the plurality of spray nozzles to securely mount the spray nozzle to the boom arm.



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NOZZLE SPACING IN A CROP SPRAYER SYSTEM

BACKGROUND OF THE INVENTION

Field of Invention

[0001] This invention relates generally to plumbing for a sprayer boom on a crop sprayer, and more particularly to a spray nozzle mounting system for the sprayer boom and method for mounting the spray nozzles.

Description of Related Art

[0002] The high crop yields of modern agribusiness require application of fertilizers, pesticides, and herbicides. Dispersing these chemicals onto high acreage fields requires specialized machines mounted on or towed by a vehicle. An example of such a machine is the self-propelled sprayer.

[0003] A common design for a self-propelled crop sprayer includes a dedicated chassis with a tank, boom arms, and nozzles connected to the boom arms. The tank contains fluid such as fertilizers, pesticides, and herbicides. Boom arms extend outward from the sides of the dedicated chassis. Boom plumbing contains supply lines and a plurality of nozzles spaced apart along the length of the boom arms at a standard spacing distance which corresponds to the spray pattern of the nozzles. In operation, as the crop sprayer crosses the field, fluid is pumped from the tank through the supply lines along the boom arms, and out through the nozzles. This allows the self-propelled sprayer to distribute the fluid along a relatively wide path. The length of conventional boom arms may vary from, for example, 6 meters (18 feet) up to 46 meters (150 feet), but smaller or longer booms are possible. The boom arms typically swing in for transport and out for operation.

[0004] Conventionally, the nozzles are connected in series such that the product flows through a pipe and/or hose from one nozzle to another. Booms have been of the "wet boom" type, where the boom comprises a frame member with a pipe mounted thereon, where the fluid passes through the pipe into nozzles mounted on the pipe and fluidly connected thereto, or a "dry boom" type, where the nozzles are mounted to the frame member and fluid passes to the nozzles through a hose which is connected between the nozzles.

[0005] Typically, available nozzle bodies or nozzle holders with one or more nozzle outlets are attached to the pipe or frame with brackets at desired intervals along the boom arm.

The distance between nozzles needs to be measured when fitted with brackets or is determined by the distance between holes in the pipes. The attachment of the nozzle holding member to the boom is a time consuming operation, both for the dealer or manufacturer at the set-up stage before delivery, and for the operator when doing repairs or maintenance. Additionally, it is sometimes required to change the nozzle spacing along the boom arm because of a change in the chemical being applied or the type of crop in the field. This changeover can be time intensive causing significant downtime of the crop sprayer.

[0006] Based on the foregoing, it would be desirable to provide a nozzle mounting system that is easily configurable for spacing nozzles at different intervals along the boom arm.

SUMMARY OF THE INVENTION

[0007] In one aspect, the invention relates to a nozzle mounting and fluid distribution system for use with a boom arm of crop sprayer. The system includes a plurality of spray nozzles connected to a fluid distribution conduit, wherein pressurized fluid passes through the conduit to the plurality of spray nozzles and a nozzle holding member removably mountable on the boom arm of the crop sprayer. The nozzle holding member mounts the plurality of spray nozzles at a set interval along the boom arm. In one embodiment, the nozzle holding member is a mounting rail configured to mount to the boom arm, wherein the mounting rail has a plurality of nozzle-receiving slots at the set interval and each nozzle-receiving slot interacts with one of the plurality of spray nozzles to securely mount the spray nozzle to the boom arm.

[0008] In one embodiment, the nozzle holding member is a first nozzle holding member and the spray nozzle interval is a first interval. The system further includes a second nozzle holding member configured to mount the plurality of spray nozzles at a second interval, wherein the second interval is different from the first interval. The plurality of nozzles are mounted either at the first interval by connecting the first nozzle holding member to the boom arm or mounted at the second interval by connecting the second nozzle holding member to the boom arm.

[0009] Another aspect of the invention is a method of reconfiguring nozzle spacing along a boom arm of crop sprayer. The method includes connecting a plurality of spray nozzles to a first nozzle holding member, wherein the first nozzle holding member is keyed to receive the spray nozzles at a first set interval. The spray nozzles are mounted at the first set interval along the boom arm of the crop sprayer by connecting the first nozzle holding member to the boom arm. The spacing is reconfigured by removing the first nozzle holder from the boom arm and removing the spray nozzles from the first nozzle holding member. The spray nozzles are then connected to a second nozzle holding member, wherein the second nozzle holding member

is keyed to receive the spray nozzles at a second set interval, wherein the second interval is different from the first interval. The spray nozzles are mounted at the second set interval along the boom arm of the crop sprayer by connecting the second nozzle holding member to the boom arm.

[0010] These and other features and advantages of this invention are described in, or are apparent from, the following detailed description of various exemplary embodiments of the systems and methods according to this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The above mentioned and other features of this invention will become more apparent and the invention itself will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

[0012] FIG. 1 is a perspective view of a crop sprayer;

[0013] FIG. 2 is a perspective view of a portion of a boom arm on the crop sprayer of FIG. 1 showing a fluid distribution system according to an embodiment of the invention;

[0014] FIG. 3 is an enlarged perspective view of a portion of the fluid distribution system of FIG. 2 with portions of the boom arm removed for clarity;

[0015] FIG. 4 is an exploded view of a portion of the fluid distribution system of FIG. 2;

[0016] FIG. 5 is a perspective view of another embodiment of the fluid distribution system;

[0017] FIG. 6 is an enlarged perspective view of a portion of the fluid distribution system of FIG. 5;

[0018] FIG. 7 is another perspective view of a portion of a boom arm on the crop sprayer of FIG. 1 showing a fluid distribution system according to an embodiment of the invention;

[0019] FIG. 8 is another exploded view of a portion of the fluid distribution system of FIG. 2; and

[0020] FIG. 9 is another enlarged perspective view of a portion of the fluid distribution system of FIG. 5.

[0021] Corresponding reference characters indicate corresponding parts throughout the views of the drawings.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0022] The invention will now be described in the following detailed description with reference to the drawings, wherein preferred embodiments are described in detail to enable practice of the invention. Although the invention is described with reference to these specific preferred embodiments, it will be understood that the invention is not limited to these preferred embodiments. But to the contrary, the invention includes numerous alternatives, modifications and equivalents as will become apparent from consideration of the following detailed description.

[0023] FIG. 1 shows a crop sprayer 10 used to deliver chemicals to agricultural crops in a field. Crop sprayer 10 includes a chassis 12 and a cab 14 mounted on the chassis 12. Cab 14 may houses an operator and a number of controls for the crop sprayer 10. An engine 16 may be mounted on a forward portion of chassis 12 in front of cab 14 or may be mounted on a rearward portion of the chassis 12 behind the cab 14. The engine 16 may be commercially available from a variety of sources and may comprise, for example, a diesel engine or a gasoline powered internal combustion engine. The engine 16 provides energy to propel crop sprayer 10 and also may provide energy used to spray fluids from the crop sprayer 10.

[0024] The crop sprayer 10 further includes a storage tank 18 used to store a fluid to be sprayed on the field. The fluid may include chemicals, such as but not limited to, herbicides, pesticides, and/or fertilizers. Storage tank 18 may be mounted on chassis 12, either in front of or behind cab 14. Crop sprayer 10 may include more than one storage tank 18 to store different chemicals to be sprayed on the field. The stored chemicals may be dispersed by crop sprayer 10 one at a time or different chemicals may be mixed and dispersed together in a variety of mixtures.

[0025] A boom arm 20 on the crop sprayer 10 is used to distribute the fluid from the tank 18 over a wide swath as the crop sprayer 10 is driven through the field. As best seen in FIG. 2, the fluid is conveyed by way of a fluid distribution system 22 to various spray nozzles 30 spaced along the boom arm 20. The fluid distribution system 22, which may be mounted on the boom arm 20, includes at least one supply line 34 connected to the tank 18. As is known in the art, a pump (not shown) pumps fluid from the tank 18 through the supply line 34. An operator of the crop sprayer 10 may use controls (not shown) located in the cab 14 to control movement of the boom arm 20 and to turn on and to shut off the fluid flow to the plurality of spray nozzles 30.

[0026] Turning now to FIG. 3, fluid flows through the supply line 34 into a distribution pipe or hose 36, broadly a distribution conduit, that feeds the spray nozzles 30 connected to the distribution conduit 36. Desirably, the supply line 34 connects to the distribution conduit 36

with a suitable tee or knee connector 38. In the illustrated embodiment, the distribution conduit 36 comprises sections of hose 40 or other piping connected by a fitting 42 leading to each spray nozzle 30 connected generally in series. However, one skilled in the art will understand that other known configurations for the distribution conduit 36 may be used without departing from the scope of the invention. For example, the distribution line 36 may contain a plurality of tee fittings 42 with hose sections 40 leading to individual nozzles 30 as depicted in FIG. 5. As is known in the art, the fittings 42 may connect adjacent sections of hose 40 using hose barbs, ring clamps or other known fasteners. A plurality of spray nozzles 30 is mounted to the distribution conduit 36. From each spray nozzle 30, the fluid may be sprayed as the crop sprayer 10 is driven forward in the field to distribute chemicals onto crops in the field.

[0027] In one embodiment, the spray nozzle 30 consists of a spray nozzle body 44, which is provided with an inlet 46 connecting to the fitting 42, and a nozzle head 48. It should be understood that any type of spray nozzle head 48 can be used. For example, it is possible to use a spray nozzle 30 having a number of spray nozzle heads 48 which are fitted by means of a revolver-type construction on the spray nozzle body 44, so that the correct spray nozzle head 48 can be selected depending on the conditions in which spraying is to be carried out and the fluid which is to be sprayed. In one embodiment, the nozzle head 48 includes a rotor 49 having a plurality of outlets 50. Fluid passes from distribution conduit 36 into nozzle body 44 and exits the nozzle body 44 from one of the plurality of outlets 50. The spray nozzle 30 and spray nozzle head 48 desirably are conventional, commercially available components. However, one skilled in the art will understand that other known spray nozzles 30 may be used without departing from the scope of the invention.

[0028] A nozzle mounting system 52 mounts the spray nozzles 30 along the boom arm 20 at spaced intervals. In a first embodiment best seen in FIG. 4, the nozzle mounting system 52 includes a nozzle holding member 53 removably connected to the boom arm 20 configured to mount at least one spray nozzle 30 on the boom arm 20. In the illustrated embodiment, the nozzle holding member 53 is a mounting rail 54 configured to mount a plurality of spray nozzles 30 on the boom arm 20. The mounting rail 54 is removably connected to a flange 56 of the boom arm 20 with suitable bolts 58 and nuts 59 that interact with predefined mounting holes 60 in the flange 56 and predefined mounting holes 61 in the mounting rail 54. However, one skilled in the art will understand that the mounting rail 54 may be removably connected or clamped to the boom arm 20 by other means using sound engineering judgment. The means for mounting the mounting rail 54 on the boom arm 20, i.e., for example the position of the mounting holes 60, 61 in the flange 56 and in the mounting rail 54, is independent of the number of spray nozzles 30 mounted with the mounting rail 54.

[0029] In one embodiment, the mounting rail 54 is fabricated with nozzle-receiving slots 64 at a specified nozzle-spacing interval. The nozzle-receiving slot 64 interacts with the nozzle body 44 of spray nozzle 30 to securely mount the spray nozzle 30 to the boom arm 20 when the mounting rail 54 is attached to the boom arm 20. FIG. 4 illustrates a currently available nozzle body 44 having a square attachment shape. However, one skilled in the art will understand that other types of nozzle bodies 44 could possibly also be keyed to slots in the mounting rail 54 such that they are mounted at predefined nozzle spacing. In the illustrated embodiment, the nozzle-receiving slot 64 is bounded by a frame 66 that interacts with an upper flange 68 and a lower flange 69 on the nozzle body 44 such that the frame 66 slides between the flanges 68, 69 to hold the spray nozzle 30 in the nozzle-receiving slot 64. Of course, one skilled in the art will understand that other means to key the mounting rail 54 such that it receives spray nozzles 30 at desired intervals may be used using sound engineering judgment without departing from the scope of the invention. The nozzle-receiving slots 64 may be cut or fabricated in the mounting rail 54 at desired intervals, such as for example every 10 inches (25.4 cm), every 15 inches (38.1 cm), or at other desired intervals.

[0030] According to an embodiment of the invention, when the boom arm 20 is to be configured with a desired nozzle spacing, a mounting rail 54 having that spacing profile is selected and used to mount the spray nozzles 30. A spray nozzle 30 is inserted in each of the nozzle-receiving slots 64; there is no need to measure or mark spray nozzle locations. If the spacing of the spray nozzles 30 needs to be changed, such as for use of the crop sprayer 10 with a different product or on a different type of crop, the previous mounting rail 54 having the old, undesired nozzle spacing is removed and a new mounting rail 54 having the new, desired spacing interval is connected to the boom arm 20. The means for mounting the mounting rail 54 on the boom arm 20, for example the position of the mounting holes 60, 61 in the flange 56 and in the mounting rail 54, is the same for both mounting rails 54 and is independent of the number of nozzle-receiving slots 64 on the particular rail. Therefore, in order to change the nozzle spacing, the operator simply selects a mounting rail 54 having the desired spacing, inserts spray nozzles 30 in each nozzle-receiving slot 64, and attaches the mounting rail 54 to the boom arm 20. Accordingly, the positioning of the spray nozzles 30 is independent of the distribution pipe 36 and the spacing can easily be changed without the need for remeasuring distances along the boom arm 20. The supply line 34 to the nozzle bodies 44 may be best set up in a way that it is easy to attach extra nozzle bodies 44 to the supply line 34 or that it is easy to remove them and plug outlets. With a nozzle spacing rail 54 the supply line 34 and sections of hose 40 can still be semi-permanent.

[0031] FIG. 5 illustrates an alternate embodiment of nozzle mounting system 52 and nozzle holding member wherein the boom arm 20 has a mounting rail 54' that interacts with the clamping component of the nozzle body 44' of spray nozzle 30. The shape of the mounting rail 54' and the shape of the clamping component of the nozzle body 44' interact with each other such that the nozzle body 44' can be placed anywhere on the mounting rail 54' along the length of the boom arm 20.

[0032] Markings 72 on the mounting rail 54' indicate particular nozzle spacing positions or dimensions such as, but not limited to in 5 inch (12.7 cm) increments. The markings can be a regular measurer scale in inches and/or cm, colored dots to indicate certain nozzle spacing, dents/cuts in the mounting flange where a part of the nozzle body is to be attached. The markings could be engraved in the mounting rail 54', painted on the mounting flange, and/or comprise a decal or decals affixed to the mounting flange.

[0033] In one embodiment, the nozzle body 44' comprises a clamp 80 that interacts with the mounting rail 54'. FIG. 6 shows a "clothes pin" style clamp 80 that attaches to the mounting rail 54'. However, one skilled in the art will understand that the nozzle body 44' could include other mounting structures such as, but not limited to, a clamp system other than as shown in FIG. 6, a bolt or screw to generate friction between nozzle body and mounting rail 54', a pin type of connection, or other means using sound engineering judgment. This method makes it easy to change nozzle spacing or eliminates measuring of the desired nozzle spacing. The markings 72 indicate certain positions throughout the boom arm 20 and make it easy to attach extra spray nozzles 30 or reposition attached ones to a different spacing.

[0034] Since the invention provides flexibility to add or remove spray nozzles 30 and also to shift the location of the spray nozzles 30, it would be desirable to have the maximum number of outlets available from the supply line 34 for the maximum number of spray nozzles 30 that can be mounted. If the required nozzle spacing increases and fewer spray nozzles 30 are needed, unnecessary outlets from the supply line 34 may be plugged using means known in the art.

[0035] While this invention has been described in conjunction with the specific embodiments described above, it is evident that many alternatives, combinations, modifications and variations are apparent to those skilled in the art. Accordingly, the preferred embodiments of this invention, as set forth above are intended to be illustrative only, and not in a limiting sense. Various changes can be made without departing from the spirit and scope of this invention.

CLAIMS

What is claimed is:

1. A nozzle mounting system for use with a boom arm of crop sprayer comprising:

a plurality of spray nozzles connected to a fluid distribution conduit, wherein pressurized fluid selectively passes through said conduit to said plurality of spray nozzles;

a nozzle holding member removably mountable on the boom arm of the crop sprayer, said nozzle holding member mounting said plurality of spray nozzles at a set interval along said boom arm.

2. The nozzle mounting system of claim 1 wherein the nozzle holding member is a mounting rail configured to mount to the boom arm, wherein the mounting rail has a plurality of nozzle-receiving slots at said set interval and each nozzle-receiving slot interacts with one of said plurality of spray nozzles to securely mount said spray nozzle to the boom arm.

3. The nozzle mounting system of claim 2 wherein each nozzle-receiving slot in said plurality of nozzle-receiving slots is bounded by a frame that interacts with an upper flange and a lower flange on its received spray nozzle such that the frame slides between the flanges to hold the spray nozzle in the nozzle-receiving slot.

4. The nozzle mounting system of claim 2 wherein the nozzle-receiving slots are cut in the mounting rail at the set interval.

5. A configurable crop sprayer system comprising the nozzle mounting system of claim 1 wherein said nozzle holding member is a first nozzle holding member and said spray nozzle interval is a first interval, the system further comprising a second nozzle holding member configured to mount said plurality of spray nozzles at a second interval, wherein said second interval is different from said first interval, and said plurality of nozzles are mounted either at said first interval by connecting the first nozzle holding member to the boom arm or mounted at said second interval by connecting the second nozzle holding member to the boom arm.

6. The nozzle mounting system of claim 1 wherein the nozzle holding member comprises a mounting rail and a clamping component on each of the spray nozzles in said plurality of spray nozzles, wherein the shape of the mounting rail and the shape of the clamping component interact with each other to secure the spray nozzle along the length of the boom arm, the mounting rail further comprising markings along the length of the mounting rail to indicate the set interval along said boom arm.

7. A method of reconfiguring nozzle spacing along a boom arm of crop sprayer, the method comprising:

- connecting a plurality of spray nozzles to a first nozzle holding member, wherein the first nozzle holding member is keyed to receive the spray nozzles at a first set interval;

- mounting the spray nozzles at said first set interval along the boom arm of the crop sprayer by connecting the first nozzle holding member to the boom arm;

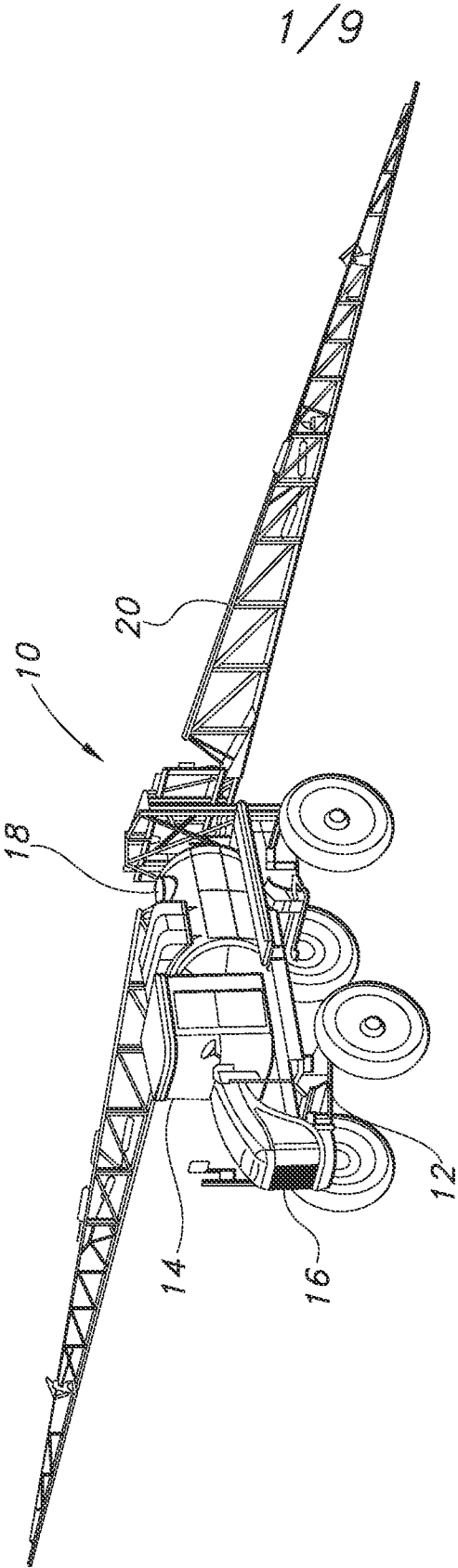
- removing the first nozzle holder from the boom arm;

- removing the spray nozzles from the first nozzle holding member;

- connecting the spray nozzles to a second nozzle holding member, wherein the second nozzle holding member is keyed to receive the spray nozzles at a second set interval, wherein said second interval is different from said first interval;

- mounting the spray nozzles at said second set interval along the boom arm of the crop sprayer by connecting the second nozzle holding member to the boom arm.

8. The method of claim 7 wherein the first and second nozzle holding members are mounting rails configured to mount to the boom arm, the first mounting rails having a plurality of nozzle-receiving slots at said first set interval and the second mounting rails having a plurality of nozzle-receiving slots at said second set interval, and each nozzle-receiving slot interacting with one of said plurality of spray nozzles to securely mount said spray nozzle to the boom arm.



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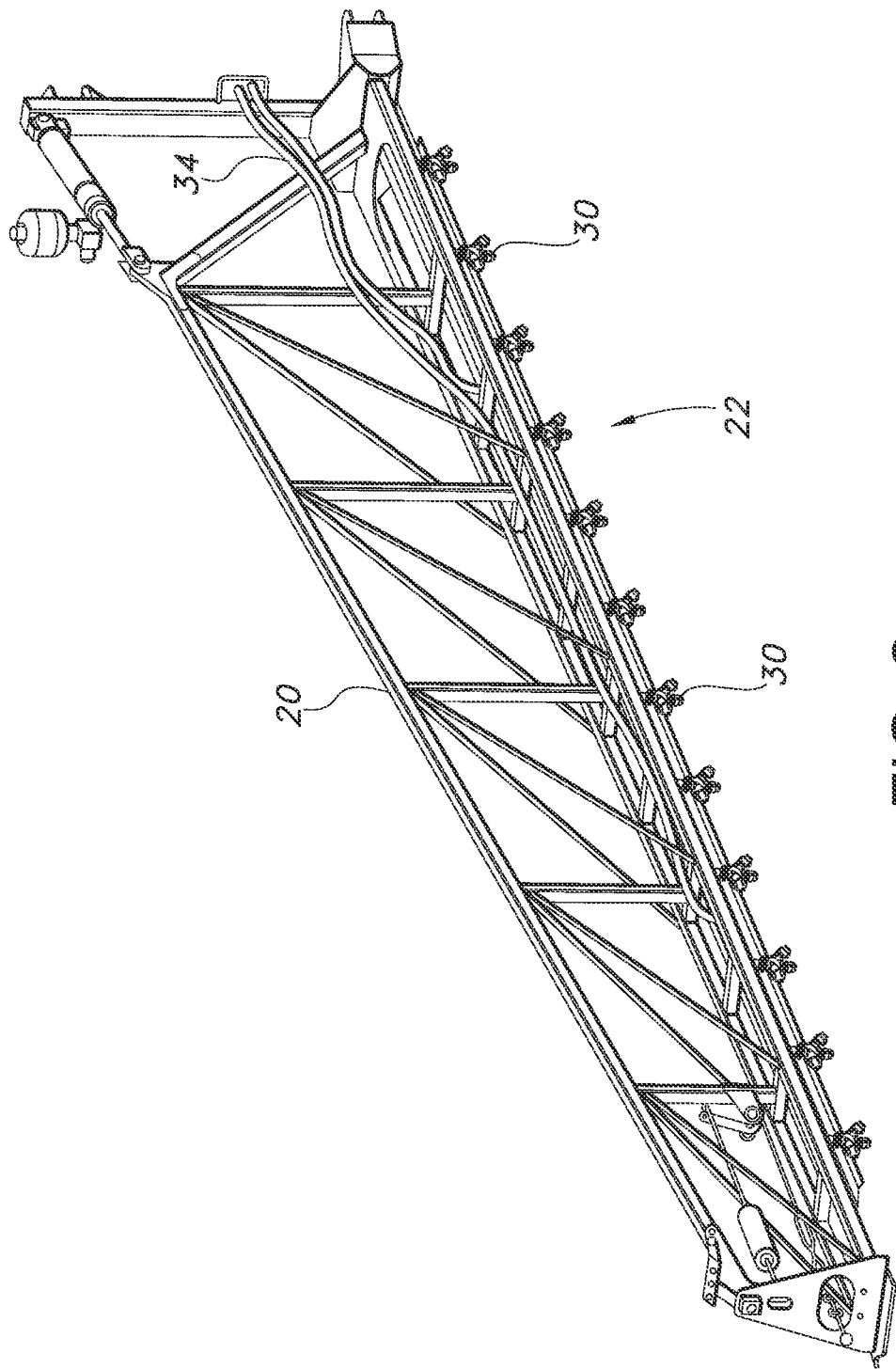


FIG. 2

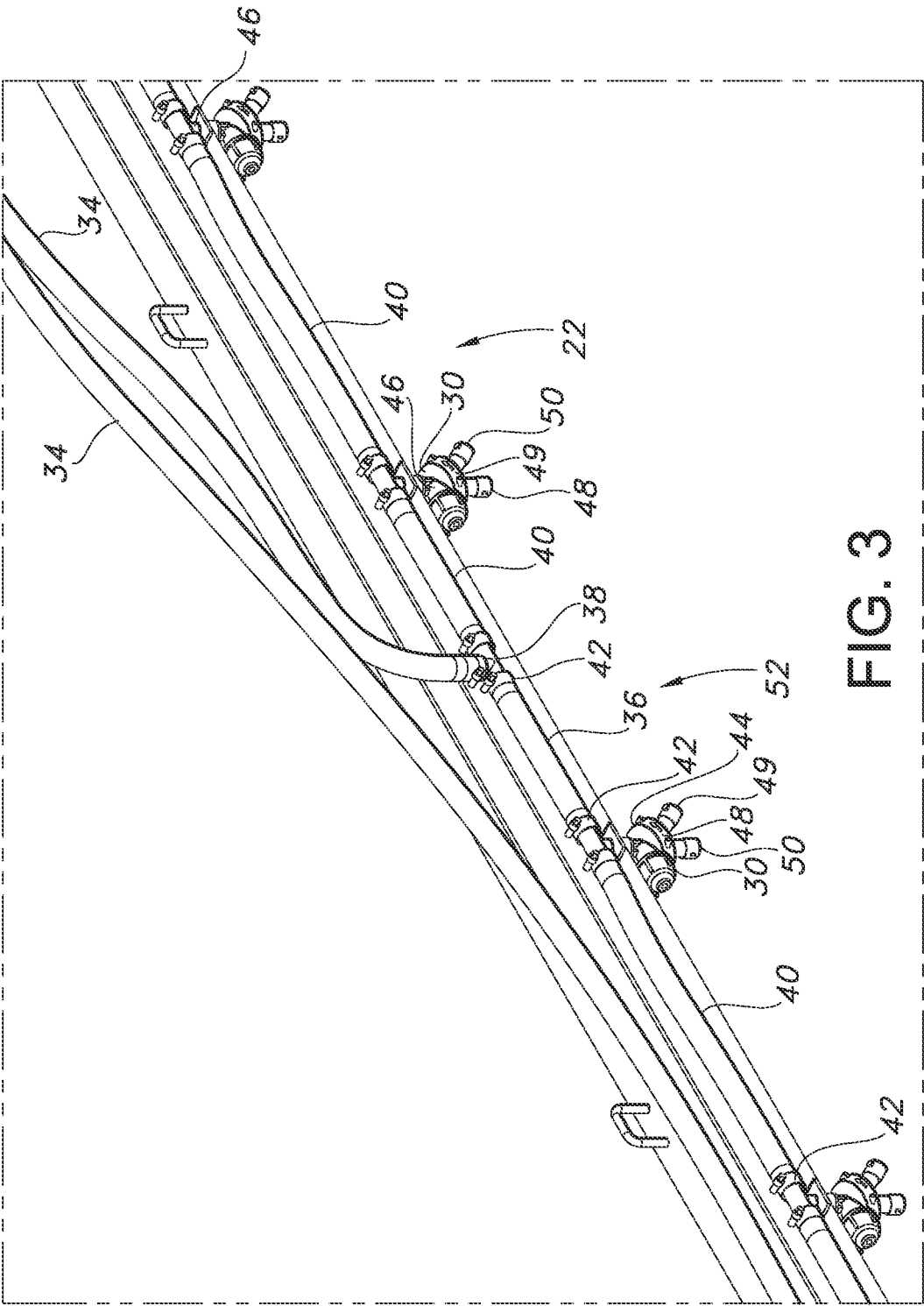
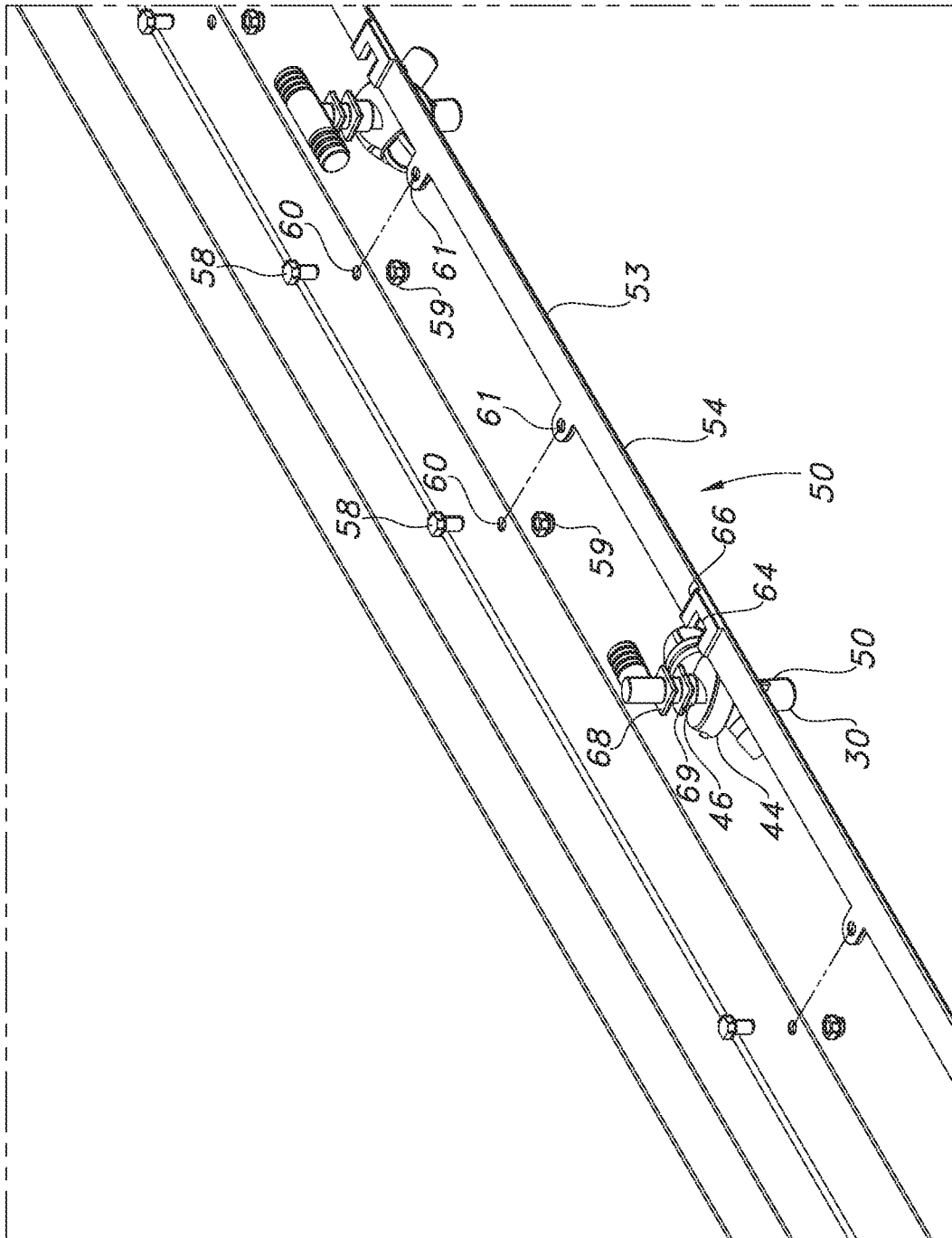


FIG. 3

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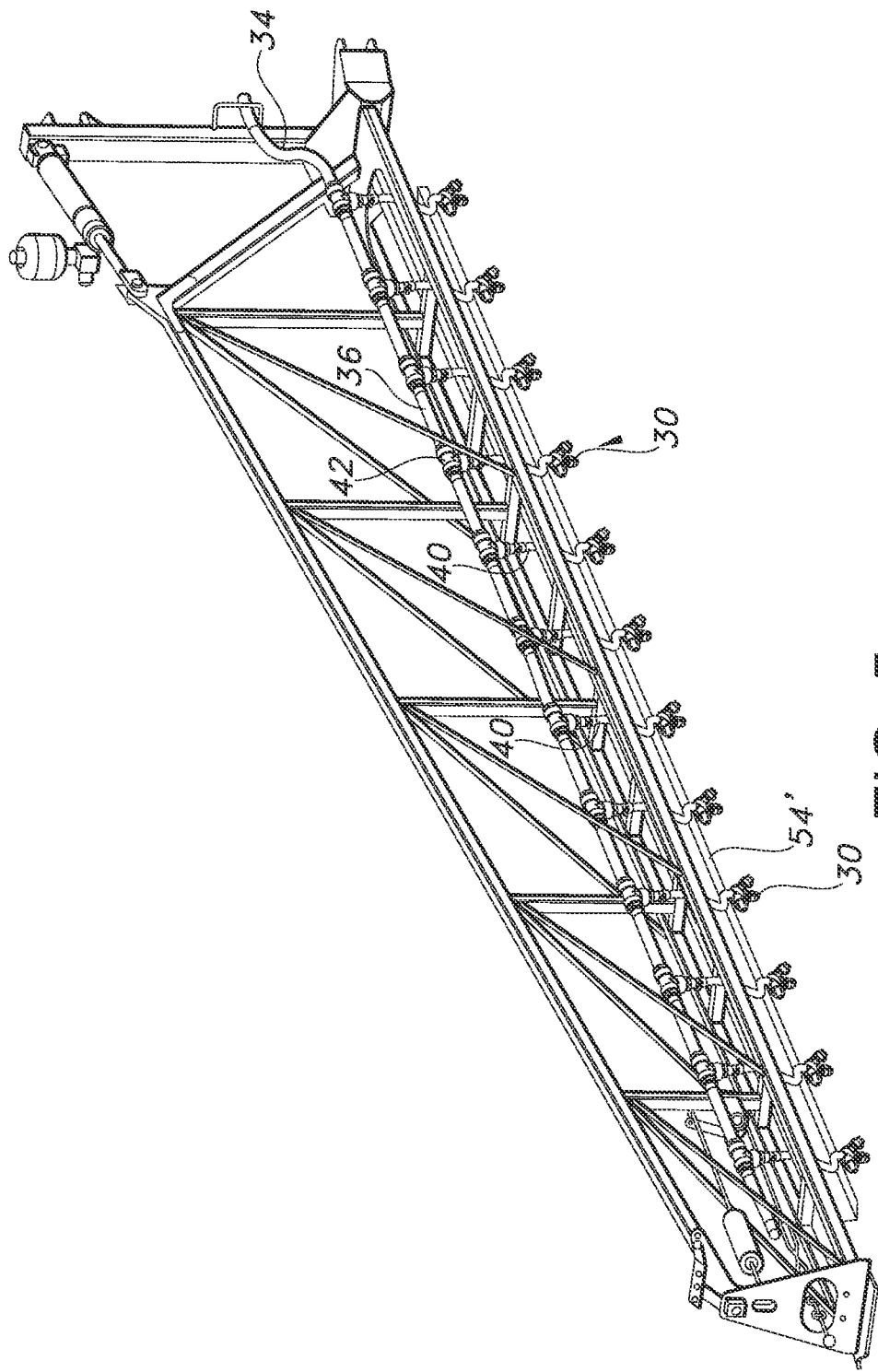


FIG. 5

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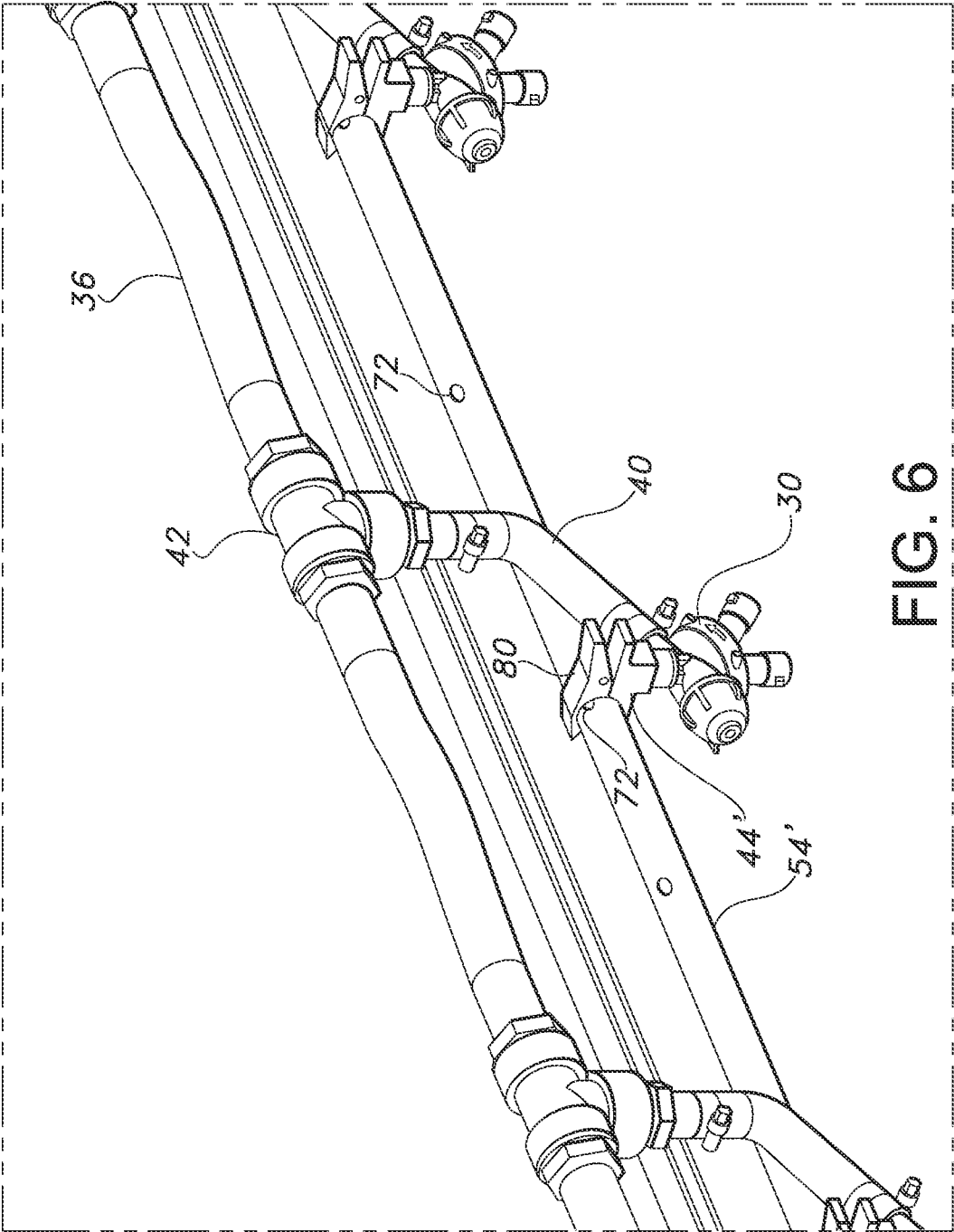


FIG. 6

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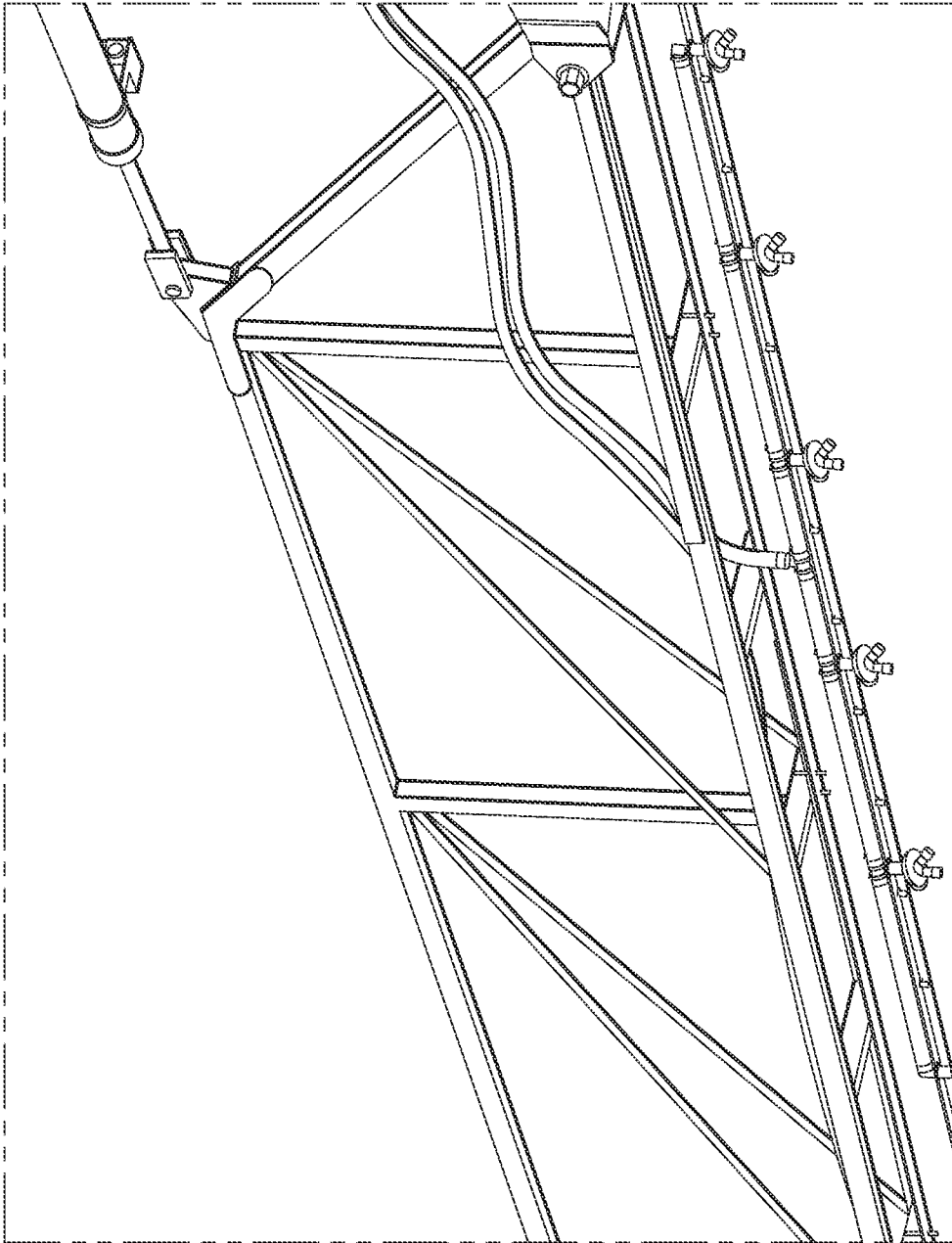


FIG. 7

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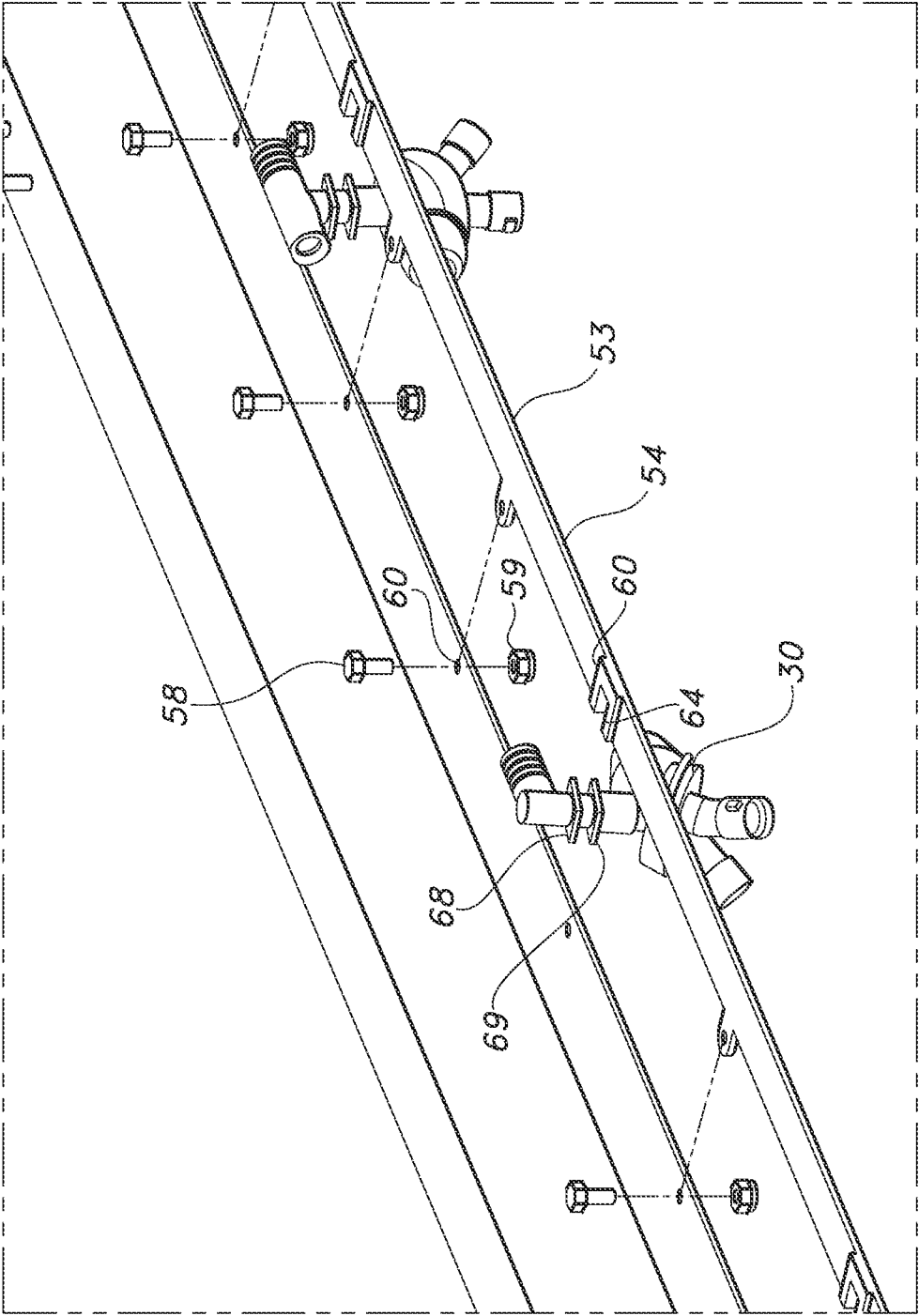


FIG. 8

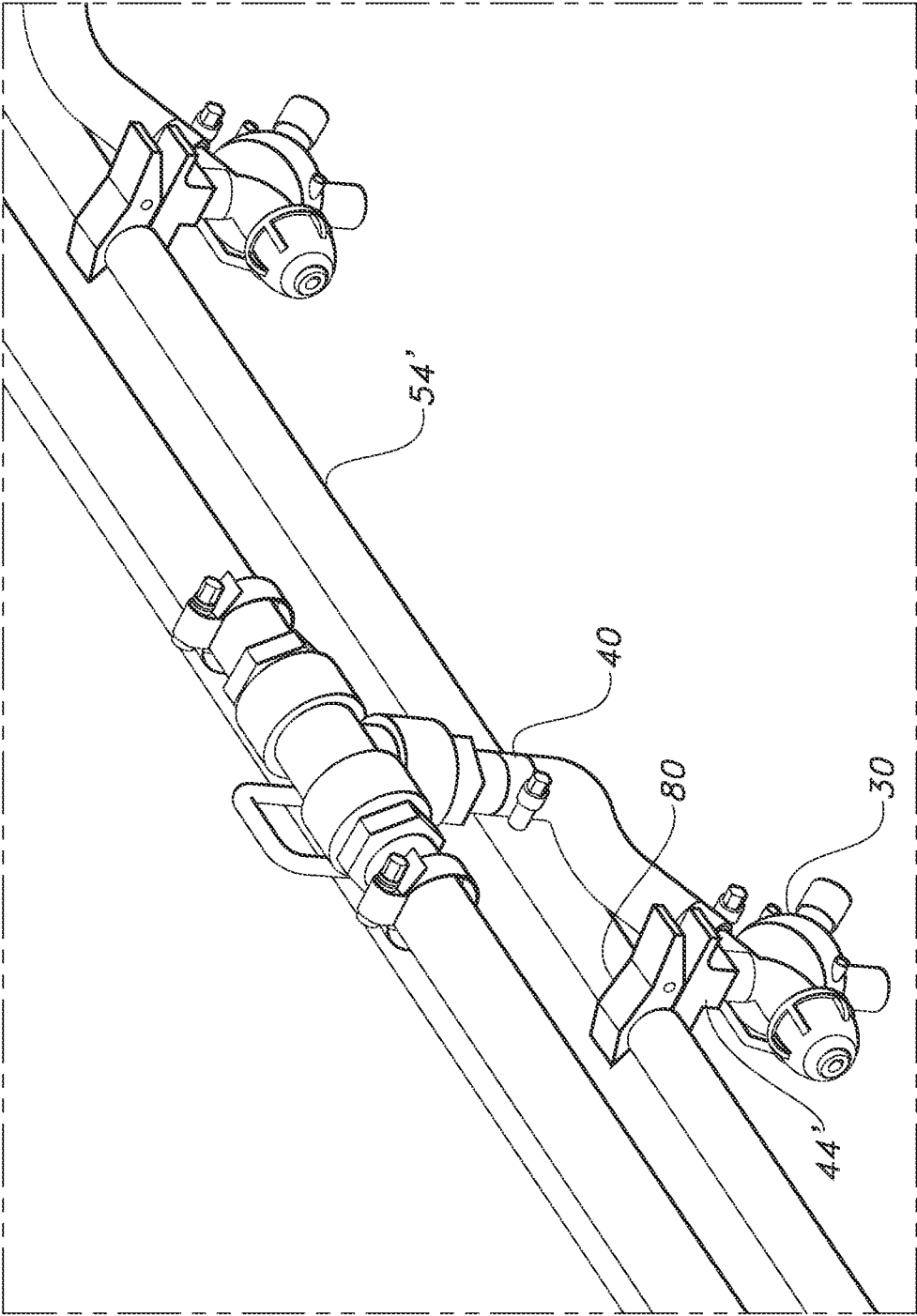


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/065714

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01M7/00
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)

A01M

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)

EP0-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.
X	WO 98/47624 A1 (SPAYING SYSTEMS CO [US]) 29 October 1998 (1998-10-29) abstract; figures 1-3 -----	1,2,4,7, 8
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search

27 April 2012

Date of mailing of the international search report

10/05/2012

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Moeremans, Benoit

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/065714

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