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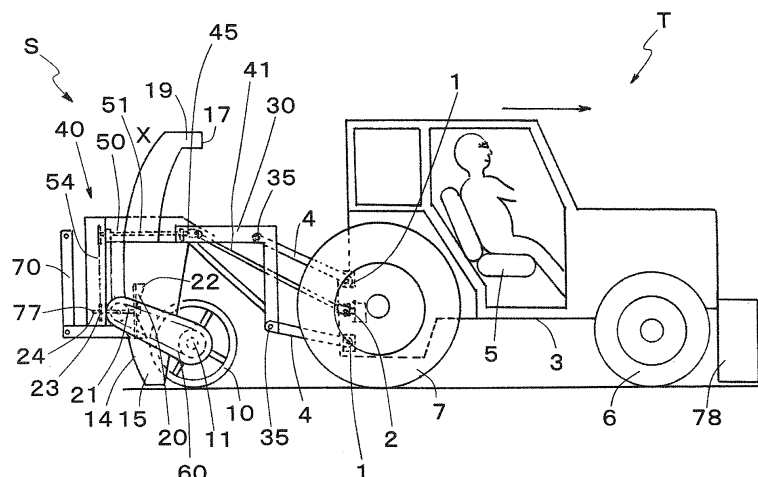
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(54) **SNOW REMOVING DEVICE AND SNOW REMOVING METHOD**

(57) Without special processing or installation of a mechanism on a tractor T side, an operator can remove snow by driving the tractor forward while facing forward and looking ahead, so that operability and workability are improved. An auger case 14 is connected to a tractor T which comprises connecting portions 1 and a PTO shaft 2 in the rear, and rotatably supports and covers an auger 10. The auger case 14 comprises a blower 20 which discharges snow, and a power transmitting portion 40 which is coupled to the PTO shaft 2 to transmit rotation to a rotary main shaft 11 of the auger 10 and a blower shaft

21 of a blower 20. The auger case 14 is provided with a forward facing connecting body 30 which is connectable to the connecting portions 1 of the tractor T at a forward facing position X where the auger 10 is disposed so as to be exposed toward the forward direction of the tractor T. The power transmitting portion 40 is provided with a forward facing coupling portion 45 which is configured to be coupled to the PTO shaft 2 through the outside of the auger 10 via a coupling shaft 41 at the forward facing position X.

FIG.1



## Description

[Technical Field]

**[0001]** The present invention relates to a snow removing device which is one of operating machines to be connected to a tractor. More particularly, it relates to a snow removing device which removes snow by obtaining power from a PTO shaft that is provided in the rear part of the tractor and that transmits engine power, and also relates to a snow removing method using the same.

[Background Art]

**[0002]** In general, as shown in FIG. 19, a tractor T comprises connecting portions 1 for connecting an operating machine to the rear, and a PTO shaft 2 for transmitting engine power to the operating machine.

**[0003]** Snow removing devices that are connected to this tractor T as one of operating machines have heretofore been known from, for example, JP-U-3137977 (PATENT LITERATURE 1), JP-U-2529454 (PATENT LITERATURE 2), and JP-Y-H6-21936 (PATENT LITERATURE 3). As shown in FIG. 19, the snow removing device Sa comprises an auger 100 which is rotated to collect snow, an auger case 102 which rotatably supports a rotary main shaft 101 of the auger 100 and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft 101 of the auger 100 and which covers the other side of the auger, a blower 104 which is provided in the auger case 102 and which is rotated to suck the snow collected by the auger 100 and then discharges the snow through a shooter 103, and a power transmitting portion 105 which is provided in the auger case 102 and which is coupled to the PTO shaft 2 of the tractor T to transmit the rotation of the PTO shaft 2 to the rotary main shaft 101 of the auger 100 and a blower shaft of the blower 104. A connecting body 107 which is connected to the connecting portions 1 of the tractor T via links 106 is provided outside the auger case 102, and a coupling portion 110 which is coupled to the PTO shaft 2 of the tractor T via a coupling shaft body 108 is provided in a part of the power transmitting portion 105 corresponding to the blower shaft.

**[0004]** When the snow removing device Sa is connected to the tractor T, the auger 100 exposed from the auger case 102 is disposed in the rear of the tractor T so as to be exposed toward the backward direction of the tractor T, and the connecting portions 1 of the tractor T are connected to the connecting body 107 of the auger case 102 via the links 106, and then the PTO shaft 2 is coupled to the coupling portion 110 via the coupling shaft body 108. When snow is removed by the tractor T to which the snow removing device Sa is connected, an operator drives the tractor T backward while facing backward and looking back. As a result, the rotation is transmitted to the rotary main shaft 101 of the auger 100 and the blower shaft of the blower 104 from the PTO shaft 2 via the coupling

shaft body 108 and the power transmitting portion 105. Thus, snow is collected by the auger 100, and the collected snow is sucked and then discharged through the shooter 103 by the blower 104.

**[0005]** Heretofore, as described in, for example, JP-Y-S63-19364 (PATENT LITERATURE 4) and JP-A-S57-104704 (PATENT LITERATURE 5), the aforementioned conventional snow removing device also has been used so as to be connected to the front of the tractor T. In this instance, as shown in FIG. 20, when the aforementioned snow removing device Sa is connected to the tractor T, the auger 100 exposed from the auger case 102 is disposed in the front of the tractor T so as to be exposed toward the forward direction of the tractor T, and connecting portions 112 provided at the front of the tractor T are connected to the connecting body 107 of the auger case 102 via links 111. For example, a connecting mechanism 113 which takes out power of the PTO shaft 2 is attached to the PTO shaft 2, a coupling shaft 114 extending in a vehicle front-back direction is coupled to the connecting mechanism 113, and the coupling shaft 114 is coupled to the coupling portion 110 of the power transmitting portion 105 via a joint mechanism 115 such as a universal joint. When snow is removed, the operator drives the tractor T forward while facing forward and looking ahead. As a result, the rotation is transmitted to the rotary main shaft 101 of the auger 100 and the blower shaft of the blower 104 from the PTO shaft 2 via the connecting mechanism 113, the coupling shaft 114, the joint mechanism 115 and the power transmitting portion 105. Thus, the snow is collected by the auger 100, and the collected snow is sucked and then discharged through the shooter 103 by the blower 104.

[Citation List]

[Patent Literatures]

**[0006]**

[PATENT LITERATURE 1] JP-U-3137977  
[PATENT LITERATURE 2] JP-U- 2529454  
[PATENT LITERATURE 3]: JP-Y-H6-21936  
[PATENT LITERATURE 4] JP-Y-S63-19364  
[PATENT LITERATURE 5] JP-A-S57-104704

[Summary of Invention]

[Technical Problem]

**[0007]** In the meantime, the aforementioned conventional snow removing device Sa has a problem of poor operability because when the snow removing device Sa is connected to the rear of the tractor T to remove snow as shown in FIG. 19, the operator drives the tractor T backward while facing backward and looking back, which is a heavy burden on the neck and shoulders, and which makes it difficult to work for a long time, and which also

leads to poor workability.

**[0008]** In contrast, when the conventional snow removing device Sa is connected to the front of the tractor T to remove snow as shown in FIG. 20, the operator drives the tractor forward while facing forward and looking ahead, so that the operability and workability improve. However, the problem is that it is necessary to additionally dispose, in the tractor T, the connecting mechanism 113, the coupling shaft 114, and the joint mechanism 115 that connect the PTO shaft 2 to the coupling portion 110, and also additionally provide the connecting portions 112 in the front part of the tractor T, so that the device becomes complicated, and costs are higher.

**[0009]** The present invention has been made in view of the problems described above, and is intended to provide a snow removing device and a snow removing method using the same so that an operator can remove snow by driving a tractor forward while facing forward and looking ahead without special processing or installation of a mechanism on the tractor side, and operability and workability may improve.

**[0010]** In order to achieve the above object, a first snow removing device of the present invention is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine. The first snow removing device comprises an auger which is rotated to collect snow, an auger case which rotatably supports a rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft of the auger and which covers the other side of the auger, a blower which is provided in the auger case and which is rotated to discharge the snow collected by the auger, and a coupling portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower. The coupling portion is provided on an auger side of the auger case, and a connecting body which is connected to the connecting portions of the tractor is provided on the auger side of the auger case.

**[0011]** When the snow removing device is connected to the tractor, the auger exposed from the auger case is disposed in the rear of the tractor so as to be exposed toward the forward direction of the tractor, the connecting portions of the tractor are connected to the connecting body of the auger case, and the PTO shaft is coupled to the coupling portion. In this case, the coupling portion is provided on the auger side of the auger case, and the connecting body is provided on the auger side of the auger case, so that connection to the tractor and coupling to the PTO shaft are easily conducted. It is possible to connect the snow removing device to the tractor without special processing or installation of a mechanism on the tractor side, so that costs can be reduced.

**[0012]** When snow is removed by the tractor to which

the snow removing device is connected, an operator drives the tractor forward while facing forward and looking ahead. As a result, the rotation is transmitted to the rotary main shaft of the auger and the blower shaft of the blower from the PTO shaft via the coupling portion. Thus, the snow is collected by the auger, and the collected snow is sucked and then discharged by the blower. The snow to be collected by the auger passes under a chassis of the tractor because the tractor is driven forward. Part of the snow is once stepped on by the wheels of the tractor, but is collected with almost no trouble in general capacity of the auger. In this case, the operator drives the tractor forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0013]** More specifically, the present invention provides a snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear via links, and a PTO shaft for transmitting engine power to the operating machine. The snow removing device comprises an auger in which one blade and the other blade that are helical are respectively fixed to a rotary main shaft on the left and right with respect to the center of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the center of the rotary main shaft, an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger, a guide path which is provided in the auger case and which is open in a part corresponding to the center of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening, a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the discharge opening, and a coupling portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower. The coupling portion is provided on the auger side of the auger case. The coupling portion comprises a coupling shaft which is provided across one blade and the other blade of the auger and which has one end connected to the blower shaft of the blower and the other end connected to the PTO shaft. A rotational power transmission mechanism which transmits the rotation of the blower shaft of the blower to the rotary main shaft of the auger is provided outside the auger case. A connecting body which is connected to the connecting portions of the tractor via the links is provided on the auger side of the auger case.

**[0014]** In addition to the functions and advantageous effects described above, the coupling shaft of the coupling portion is provided across one blade and the other

blade of the auger, so that the interference with the blades of the auger is certainly avoided, and assembly is easier. The rotational power transmission mechanism takes out the rotation of the blower shaft of the blower and then transmits the rotation to the rotary main shaft of the auger, and the power transmission efficiency of the rotation is improved.

**[0015]** If necessary, the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, the connecting body is formed by a frame which protrudes toward the auger side from the auger case, and attachment portions for the links corresponding to the respective connecting portions are provided in the connecting body. Because the connecting body is the frame, the structure can be simpler.

**[0016]** If necessary, a bearing which supports the coupling shaft is provided in the connecting body. The coupling shaft is held by the bearing and is therefore firmer.

**[0017]** Furthermore, if necessary, a sweeping plate which is attached to the front of the tractor is provided. The sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward. Because the snow that may be stepped on by the wheels of the tractor is drawn to the central side of the vehicle width direction of the tractor by the sweeping plate, the snow can be certainly collected by the auger.

**[0018]** In order to achieve the above object, a second snow removing device of the present invention is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine. The second snow removing device comprises an auger which is rotated to collect snow, an auger case which rotatably supports a rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft of the auger and which covers the other side of the auger, a blower which is provided in the auger case and which is rotated to discharge the snow collected by the auger, and a power transmitting portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower. The auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the forward direction of the tractor. The power transmitting portion is provided with a forward facing coupling portion which is configured to be coupled to the PTO shaft through the outside of the auger via the coupling shaft at the forward facing position.

**[0019]** When this snow removing device is connected to the tractor, the auger exposed from the auger case is disposed at the forward facing position in the rear of the tractor so as to be exposed toward the forward direction

of the tractor, the connecting portions of the tractor are connected to the forward facing connecting body of the auger case, and the PTO shaft is coupled to the forward facing coupling portion. In this case, the forward facing connecting body and the forward facing coupling portion are used, so that connection to the tractor and coupling to the PTO shaft are easily conducted. Because the coupling shaft is coupled to the forward facing coupling portion from the outside of the auger, the interference between the coupling shaft and the blades of the auger is certainly avoided. Moreover, it is possible to connect the snow removing device to the tractor without special processing or installation of a mechanism on the tractor side, so that costs can be reduced.

**[0020]** When snow is removed by the tractor to which this snow removing device is connected, an operator drives the tractor forward while facing forward and looking ahead. As a result, the rotation is transmitted to the rotary main shaft of the auger and the blower shaft of the blower from the PTO shaft via the forward facing coupling portion and the power transmitting portion. Thus, the snow is collected by the auger, and the snow collected by the blower is sucked and then discharged. The snow collected by the auger passes under a chassis of the tractor because the tractor is driven forward. Part of the snow is once stepped on by the wheels of the tractor, but is collected with almost no trouble in general capacity of the auger. In this case, the operator drives the tractor forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0021]** More specifically, the present invention provides a snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine. The snow removing device comprises an auger in which one blade and the other blade that are helical are respectively fixed to a rotary main shaft on the left and right with respect to the center of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the center of the rotary main shaft, an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger, a guide path which is provided in the auger case and which is open in a part corresponding to the center of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening, a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the discharge opening, and a power transmitting portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor

to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower. The auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the forward direction of the tractor. The power transmitting portion is provided with a forward facing coupling portion which is configured to be coupled to the PTO shaft through the outside of the auger via the coupling shaft at the forward facing position.

**[0022]** If necessary, the forward facing coupling portion is located on the upper side of the auger case. Preferably, the forward facing coupling portion is located on the upper side of the auger case and on a vertical axis line that intersects with the axial direction of the PTO shaft. Accordingly, the forward facing coupling portion is located on the upper side of the auger case, so that coupling to the PTO shaft is easily conducted, and the interference with the blades of the auger can be certainly avoided.

**[0023]** If necessary, the power transmitting portion comprises a first power transmission mechanism which transmits rotation to the blower shaft of the blower, and a second power transmission mechanism which transmits the rotation transmitted from the first power transmission mechanism to the rotary main shaft of the auger. The first power transmission mechanism comprises a master rotary shaft having the forward facing coupling portion at the end thereof, and a blower shaft secondary power transmission mechanism which is provided between the rear end of the master rotary shaft and the rear end of the blower shaft and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism. The first power transmission mechanism is affixed to the outside of the auger case. Because the forward facing coupling portion is provided at the end of the master rotary shaft, the coupling shaft can be supported by the master rotary shaft, so that the support can be firm and certain. The first power transmission mechanism is affixed to the outside of the auger case, which allows compactness.

**[0024]** Furthermore, if necessary, the second power transmission mechanism comprises a slave rotary shaft having one end linked to the master rotary shaft of the first power transmission mechanism via a rotation axis direction converting mechanism so that the rotation of the master rotary shaft is transmitted thereto, and a main shaft secondary power transmission mechanism which is provided between the rear end of the slave rotary shaft and the end of the rotary main shaft of the auger and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism. The slave rotary shaft is provided parallel to the rotary main shaft of the auger in the upper part of the auger case, and the main shaft

secondary power transmission mechanism is provided along one side wall of the auger case. Because the rotation of the slave rotary shaft is obtained from the master rotary shaft, the rotation can be certainly transmitted. The second power transmission mechanism can be affixed to the upper part and side part of the auger case, which allows compactness.

**[0025]** Further yet, if necessary, the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, and the forward facing coupling portion is formed by a frame which protrudes toward the auger side from the auger case, and attachment portions for the links corresponding to the respective connecting portions are provided in the forward facing coupling portion. Because the forward facing coupling portion is formed by the frame, the structure can be simpler.

**[0026]** If necessary, the auger case is provided with a backward facing connecting body which is connectable to the connecting portions of the tractor at a backward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the backward direction of the tractor. The power transmitting portion is provided with a backward facing coupling portion which is connectable to the PTO shaft via a coupling shaft at the backward facing position. Accordingly, the auger exposed from the auger case can be connected at the backward facing position where the auger is disposed so as to be exposed toward the backward direction of the tractor, so that as heretofore, however, the operator can remove snow by driving the tractor backward while facing backward and looking back. Therefore, a method of removing snow can be selected at the backward facing position as heretofore in accordance with the depth of snow and the environment of the place where snow is to be removed, which allows reversibleness and thus the increase of versatility.

**[0027]** In this case, if necessary, the backward facing coupling portion is formed in an extension extended at the rear end of the blower shaft of the blower. Coupling of the PTO shaft via the coupling shaft can be easier.

**[0028]** If necessary, a sweeping plate which is attached to the front of the tractor is provided. The sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward. Because the snow that may be stepped on by the wheels of the tractor is drawn to the central side of the vehicle width direction of the tractor by the sweeping plate, the snow can be certainly collected by the auger.

**[0029]** In order to achieve the above object, a third snow removing device of the present invention is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine. The third snow removing device comprises an auger to which one blade and the other blade that are helical are respectively fixed on the left and right with respect to the center

of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the central side of the rotary main shaft, an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger, a guide path which is provided in the auger case and which is open in a part corresponding to the central part of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening, a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the discharge opening, and a power transmitting portion which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower.

**[0030]** The auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the forward direction of the tractor. The power transmitting portion comprises a connecting shaft which is connected to one end of the blower shaft located on one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft, and a power transmission box which is provided in the center of the rotary main shaft and which has a power transmission mechanism that is configured to relatively transmit the rotation of the connecting shaft to the rotary main shaft and a box main body that is supported by the auger case and that houses the power transmission mechanism. A forward facing connecting body which is linked to the power transmission mechanism and which is configured to be coupled to the PTO shaft via a coupling shaft is provided on one side of the power transmission box in a horizontal axis direction orthogonal to the rotary main shaft.

**[0031]** When this snow removing device is connected to the tractor, the auger exposed from the auger case is disposed at the forward facing position in the rear of the tractor so as to be exposed toward the forward direction of the tractor, the connecting portions of the tractor are connected to the forward facing connecting body of the auger case, and the PTO shaft is coupled to the forward facing coupling portion via the coupling shaft. In this case, the forward facing connecting body and the forward facing coupling portion are used, so that connection to the tractor and coupling to the PTO shaft are easily conducted. It is possible to connect the snow removing device to the tractor without special processing or installation of a mechanism on the tractor side, so that costs can be reduced. Moreover, because the coupling shaft is coupled to the power transmission box provided in the center of the rotary main shaft to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and the blower

shaft of the blower, the power transmitting portion does not need to be provided outside the auger case, and the device can therefore be compact.

**[0032]** When snow is removed by the tractor to which this snow removing device is connected, an operator drives the tractor forward while facing forward and looking ahead. As a result, the rotation is transmitted to the rotary main shaft of the auger from the PTO shaft via the forward facing coupling portion and the power transmission box, the rotation is also transmitted to the blower shaft of the blower from the power transmission box via the connecting shaft. Thus, the snow is collected by the auger, and the snow collected by the blower is sucked and then discharged. The snow collected by the auger passes under a chassis of the tractor because the tractor is driven forward. Part of the snow is once stepped on by the wheels of the tractor, but is collected with almost no trouble in general capacity of the auger. In this case, the operator drives the tractor forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0033]** If necessary, the forward facing coupling portion comprises a link shaft which is linked to the power transmission mechanism in the power transmission box and to which the coupling shaft is coupled at the end, and the link shaft is supported by a bearing which is supported by the auger case via a support member. Because the link shaft is provided, the coupling shaft can be coupled at a position away from the auger, and the interference between the coupling shaft and the auger can be prevented.

**[0034]** If necessary, the power transmission mechanism of the power transmission box comprises a master bevel gear provided at the end of the connecting shaft, and a slave bevel gear which meshes with the master bevel gear and which transmits rotation to the rotary main shaft, and the link shaft is continuously provided in the connecting shaft. Because the bevel gear mechanism is used, the power transmission box can be small in size, and the interference with the blades of the auger can be certainly avoided.

**[0035]** Further yet, if necessary, the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, and the forward facing coupling portion is formed by a frame which protrudes toward the auger side from the auger case, and attachment portions for the links corresponding to the respective connecting portions are provided in the forward facing coupling portion. Because the forward facing coupling portion is formed by the frame, the structure can be simpler.

**[0036]** If necessary, the auger case is provided with a backward facing connecting body which is connectable to the connecting portions of the tractor at a backward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the backward direction of the tractor. The power transmitting por-

tion is provided with a backward facing coupling portion which is connectable to the PTO shaft via a coupling shaft at the backward facing position. Accordingly, the auger exposed from the auger case can be connected at the backward facing position where the auger is disposed so as to be exposed toward the backward direction of the tractor, so that as heretofore, the operator can remove snow by driving the tractor backward while facing backward and looking back. Therefore, a method of removing snow can be selected at the backward facing position as heretofore in accordance with the depth of snow and the environment of the place where snow is to be removed, which allows reversibleness and thus the increase of versatility.

**[0037]** In this case, if necessary, the backward facing coupling portion is provided at the other end of the blower shaft located on the other side in the horizontal axis direction orthogonal to the rotary main shaft. Coupling of the PTO shaft via the coupling shaft can be easier.

**[0038]** If necessary, a sweeping plate which is attached to the front of the tractor is provided. The sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward. Because the snow that may be stepped on by the wheels of the tractor is drawn to the central side of the vehicle width direction of the tractor by the sweeping plate, the snow can be certainly collected by the auger.

**[0039]** Moreover, in order to achieve the above object, there is provided a snow removing method of the present invention to connect any one of the first to third snow removing devices as one of operating machines to the rear of a tractor to remove snow. The tractor comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine. The snow removing method comprises using the third snow removing device, connecting this snow removing device so that the auger exposed from the auger case is disposed in the rear of the tractor so as to be exposed toward the forward direction of the tractor, and coupling the PTO shaft to the coupling portion or the forward facing coupling portion, in which state snow is removed by the snow removing device while the tractor is being driven forward. Functions and advantageous effects similar to those described above are provided.

#### [Advantageous Effects of the Invention]

**[0040]** According to the first to third snow removing devices of the present invention and the snow removing method using the same, it is possible to connect the snow removing device to the tractor without special processing or installation of a mechanism on the tractor side, so that costs can be reduced. When snow is removed by the tractor, the operator can drive the tractor forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved with-

out any burden on the neck and shoulders because the operator is facing forward.

**[0041]** Furthermore, according to the third snow removing device of the present invention, the coupling shaft is coupled to the power transmission box provided in the center of the rotary main shaft to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and the blower shaft of the blower, so that the power transmitting portion does not need to be provided outside the auger case, and the device can therefore be compact.

#### [Brief Description of Drawings]

#### [0042]

FIG. 1 is a diagram showing a state in which a snow removing device according to a first embodiment of the present invention is connected to a tractor at a forward facing position;

FIG. 2 is a plan view showing functions of the snow removing device according to the first embodiment of the present invention;

FIG. 3 is an exploded perspective view showing the snow removing device according to the first embodiment of the present invention in relation to a connecting part of the tractor;

FIG. 4 is a perspective view of the snow removing device according to the first embodiment of the present invention;

FIG. 5 is a side partially cutaway sectional view showing the snow removing device according to the first embodiment of the present invention;

FIG. 6 is a diagram showing a state in which the snow removing device according to the first embodiment of the present invention is connected to the tractor at a backward facing position;

FIG. 7 is a diagram showing a state in which a snow removing device according to an alternative embodiment of the present invention is connected to a tractor at the forward facing position;

FIG. 8 is a perspective view of a snow removing device according to the alternative embodiment of the present invention;

FIG. 9 is a diagram showing a state in which a snow removing device according to a second embodiment of the present invention is connected to a tractor;

FIG. 10 is a plan view showing functions of the snow removing device according to the second embodiment of the present invention;

FIG. 11 is an exploded perspective view showing the snow removing device according to the second embodiment of the present invention in relation to the connecting part of the tractor;

FIG. 12 is a side partially cutaway sectional view showing the snow removing device according to the second embodiment of the present invention;

FIG. 13 is a diagram showing a state in which a snow removing device according to a third embodiment of

the present invention is connected to a tractor at the forward facing position;

FIG. 14 is a plan view showing functions of the snow removing device according to the third embodiment of the present invention;

FIG. 15 is an exploded perspective view showing the snow removing device according to the third embodiment of the present invention in relation to the connecting part of the tractor;

FIG. 16 is a perspective view showing the configuration of a power transmission box of the snow removing device according to the third embodiment of the present invention;

FIG. 17 is a side partially cutaway sectional view showing the snow removing device according to the third embodiment of the present invention;

FIG. 18 is a diagram showing a state in which the snow removing device according to the third embodiment of the present invention is connected to the tractor at the backward facing position;

FIG. 19 is a diagram showing a state in which a conventional snow removing device is connected to a tractor; and

FIG. 20 is a diagram showing another example of connection of the conventional snow removing device to the tractor.

#### [Description of Embodiments]

**[0043]** Hereinafter, a snow removing device and a snow removing method according to embodiments of the present invention will be described in detail with reference to the accompanying drawings. Parts similar to those described above are described with the same reference numbers.

#### (First Embodiment)

**[0044]** As shown in FIG. 1 to FIG. 6, a chassis 3 of a tractor T to which a snow removing device S according to the first embodiment is connected comprises connecting portions 1 to connect an operating machine to the rear via links 4, and a PTO shaft 2 in which an end to transmit engine power to the operating machine is formed by a spline shaft. The connecting portions 1 of the tractor T are provided at three places: the top, left, and right of the PTO shaft 2. The reference number 5 denotes a seat, the reference number 6 denotes front wheels, and the reference number 7 denotes rear wheels. The snow removing device S according to the embodiment is connected to the rear of this tractor T as one of operating machines.

**[0045]** Specifically, the snow removing device S according to the embodiment comprises an auger 10, and an auger case 14 which covers the auger 10. The auger 10 comprises a rotary main shaft 11 that is along the width direction of the tractor T, and one blade 12 and the other blade 13 which are helical and which are respec-

tively fixed to the rotary main shaft 11 on the left and right with respect to the center of the rotary main shaft 11. The auger 10 is rotated around the rotary main shaft 11 in one direction to collect snow to the center of the rotary main shaft 11. The auger case 14 comprises a case body 15 which rotatably supports both ends of the rotary main shaft 11 of the auger 10 and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft 11 and which covers the other side of the auger. The auger case 14 is provided with a guide path 18 which is open in a part corresponding to the center of the rotary main shaft 11 of the auger 10 and which has a suction opening 16 to suck snow and a discharge opening 17. A shooter 19 in which the guide path 18 is formed and which has the discharge opening 17 at the end and which discharges snow is provided so as to protrude in the case body 15.

**[0046]** A blower 20 which sucks the collected snow through the suction opening 16 and then discharges the snow through the discharge opening 17 is rotatably provided in the suction opening 16 of the guide path 18 provided in the case body 15. The blower 20 has a blower shaft 21 supported by the case body 15, and is provided with, at the end, a blade 22 which takes in snow. A rear end 23 of the blower shaft 21 protrudes outward, and a further extended extension 24 is provided at the rear end 23. A later-described backward facing coupling portion 77 is formed in the extension 24.

**[0047]** The auger case 14 is provided with a forward facing connecting body 30 which is connectable to the connecting portions 1 of the tractor T at a forward facing position X where the auger 10 exposed from the auger case 14 is disposed so as to be exposed toward the forward direction of the tractor T. The forward facing connecting body 30 protrudes toward the auger 10 side of the auger case 14, and is connected to the connecting portions 1 of the tractor T via the links 4. Specifically, the forward facing connecting body 30 comprises L-shaped frame bodies 31 which are formed by frames protruding toward the auger 10 side from the top of the case body 15 of the auger case 14 and which are located a predetermined distance apart from each other in the rotary main shaft 11 direction and which are fixed to the case body 15 at one end, for example, by welding and which droop at the other end, an upper bridging rod 32 laid between the frame bodies 31, and reinforcing rods 33 obliquely laid between both end sides of the L-shaped frame bodies 31. Attachment portions 35 for the links 4 corresponding to the respective connecting portions 1 of the tractor T are provided in the forward facing connecting body 30. The attachment portion 35 corresponding to the connecting portion 1 at the top of the PTO shaft 2 is provided in the center of the upper bridging rod 32, and the attachment portions 35 corresponding to the left and right of the PTO shaft 2 are provided at the other ends of the respective frame bodies 31. Because the forward facing connecting body 30 is the frame, the structure can be simpler.

**[0048]** The auger case 14 is also provided with a power transmitting portion 40 which is coupled to the PTO shaft 2 of the tractor T to transmit the rotation of the PTO shaft 2 to the rotary main shaft 11 of the auger 10 and the blower shaft 21 of the blower 20. The power transmitting portion 40 is provided with a forward facing coupling portion 45 which is configured to be coupled to the PTO shaft 2 through the outside of the auger 10 via a coupling shaft 41 at the forward facing position X. The coupling shaft 41 comprises a rotary shaft 42, and universal joints 43 respectively provided at both ends of the rotary shaft 42. Joint portions 43a and 43b of the respective universal joints 43 are formed by spline holes. One joint portion 43a meshes with the spline shaft at the end of the PTO shaft 2. The forward facing coupling portion 45 is located on the upper side of the auger case 14, and in the embodiment, the forward facing coupling portion 45 faces the substantially central upper side of the axial direction of the auger case 14, and is located on a vertical axis line that intersects with the axial line direction of the PTO shaft 2 and the axial line direction of the blower shaft 21. The forward facing coupling portion 45 is configured by a spline shaft which is formed by the end of a later-described master rotary shaft 51 and which meshes with the spline hole of the other joint portion 43b.

**[0049]** The power transmitting portion 40 comprises a first power transmission mechanism 50 which transmits rotation to the blower shaft 21 of the blower 20, and a second power transmission mechanism 60 which transmits the rotation transmitted from the first power transmission mechanism 50 to the rotary main shaft 11 of the auger 10. The first power transmission mechanism 50 is affixed to the outside of the auger case 14, and comprises the master rotary shaft 51 having the forward facing coupling portion 45 at the end thereof. A support 52 is provided on the substantially central outer side of the auger case 14, and the master rotary shaft 51 is rotatably supported by a pair of bearings 53 respectively provided in the upper part of the auger case 14 and the upper part of the support 52 so that the axis line is parallel to the blower shaft 21. The first power transmission mechanism 50 comprises a blower shaft secondary power transmission mechanism 54 which is provided between a rear end 51a of the master rotary shaft 51 and the rear end 23 of the blower shaft 21 and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism. In the embodiment, the chain power transmission mechanism is adopted. A perpendicular plate 55 which the master rotary shaft 51 and the blower shaft 21 rotatably pierce is provided to be attached to the support 52, and the chain power transmission mechanism is provided outside the perpendicular plate 55. The blower shaft secondary power transmission mechanism 54 comprising the chain power transmission mechanism comprises a pair of sprockets 56 provided at the rear end 51a of the master rotary shaft 51 and the rear end 23 of the blower

shaft 21, and an endless chain 57 wound across the sprockets 56. The master rotary shaft 51 is covered with a first cover 58 which is fixedly attached to the upper part of the support 52 by screws (not shown), and the blower shaft secondary power transmission mechanism 54 comprising the chain power transmission mechanism is covered with a second cover 59 which is fixedly attached to the perpendicular plate 55 by screws (not shown).

**[0050]** The second power transmission mechanism 60 comprises a slave rotary shaft 62 having one end linked to the rear end 23 of the blower shaft 21 via a rotation axis direction converting mechanism 61 such as a bevel gear so that the rotation of the blower shaft 21 is transmitted, and a main shaft secondary power transmission mechanism 63 which is provided between the other end of the slave rotary shaft 62 and the end of the rotary main shaft 11 of the auger 10 and which is configured by, for example, a gear belt power transmission mechanism. The slave rotary shaft is provided so as to be covered with a cover 64 on the outer back surface of the auger case 14 parallel to the rotary main shaft 11 of the auger 10, and the main shaft secondary power transmission mechanism 63 is provided so as to be covered with a cover 65 along one side wall of the auger case 14.

**[0051]** The auger case 14 is also provided with a backward facing connecting body 70 which is connectable to the connecting portions 1 of the tractor T at a backward facing position Y (FIG. 6) where the auger 10 exposed from the auger case 14 is disposed so as to be exposed toward the backward direction of the tractor. The backward facing connecting body 70 comprises a pair of first arms 72 which is provided so as to protrude outward from the outer back surface of the auger case 14, and a pair of second arms 73 which extend from the ends of the respective first arms 72 and which have their ends in close contact. One first arm 72 is reinforced by a reinforcing beam 71. Attachment portions 75 for the links 4 corresponding to the respective connecting portions 1 of the tractor T are provided in the backward facing connecting body 70. The attachment portions 75 corresponding to the left and right of the PTO shaft 2 are respectively provided at the ends of the first arms 72, and the attachment portion 75 corresponding to the connecting portion 1 at the top of the PTO shaft 2 is provided at the ends of the second arms 73.

**[0052]** Furthermore, the power transmitting portion 40 is provided with the backward facing coupling portion 77 which is connectable to the PTO shaft 2 via an additional coupling shaft 76a (FIG. 6) having a different length that is formed at the backward facing position Y in the same manner as described above. The backward facing coupling portion 77 is formed in the extension 24 which is integrally extended at the rear end 23 of the blower shaft 21 of the blower 20, and is configured by a spline shaft which meshes with the spline hole of the other joint portion of the additional coupling shaft 76a. A coupling shaft 76 is coupled to the backward facing coupling portion 77 through a cutout 59a in the second cover 59.

**[0053]** The snow removing device S according to the embodiment further comprises a pair of sweeping plates 78 which are attached to the front of the tractor T and which sweep snow present ahead of the front wheels 6 of the tractor T to the central side of the vehicle width direction of the tractor T when the tractor T is driven forward.

**[0054]** Therefore, when this snow removing device S is connected to the tractor T, the auger 10 exposed from the auger case 14 is disposed at the forward facing position X in the rear of the tractor T so as to be exposed toward the forward direction of the tractor T, and each of the connecting portions 1 of the tractor T is connected to each of the attachment portions 35 of the forward facing connecting body 30 of the auger case 14 via the link 4. Moreover, the PTO shaft 2 is coupled to the forward facing coupling portion 45 via the coupling shaft 41. In this case, the forward facing connecting body 30 and the forward facing coupling portion 45 are used, so that connection to the tractor T and coupling to the PTO shaft 2 are easily conducted. In particular, the forward facing coupling portion 45 is provided on the upper side of the center of the auger case 14, and is therefore easily coupled. Because the coupling shaft 41 is coupled to the forward facing coupling portion 45 through the outside of the auger 10, the interference between the coupling shaft 41 and the blades 12 and 13 of the auger 10 can be certainly avoided. Moreover, it is possible to connect the snow removing device S to the tractor T without special processing or installation of a mechanism on the tractor T side, so that costs can be reduced.

**[0055]** When snow is removed by the tractor T to which the snow removing device S is connected, an operator drives the tractor T forward while facing forward and looking ahead as shown in FIG. 1. As a result, the rotation is transmitted to the blower shaft 21 of the blower 20 from the PTO shaft 2 via the coupling shaft 41, the forward facing coupling portion 45, and the power transmitting portion 40, and the rotation is further transmitted to the rotary main shaft 11 of the auger 10. Thus, the snow is collected by the auger 10, and the snow collected by the blower 20 is sucked and then discharged through the shooter 19.

**[0056]** In this case, because the sweeping plates 78 are provided at the front of the tractor T, the snow present ahead of the front wheels 6 of the tractor T is swept to the central side of the vehicle width direction of the tractor T when the tractor T is driven forward. Thus, because the snow that may be stepped on by the wheels 6 and 7 of the tractor T is drawn to the central side of the vehicle width direction of the tractor T by the sweeping plates 78, the snow can be certainly collected by the auger 10. The snow to be collected by the auger 10 passes under the chassis 3 of the tractor T and reaches the auger 10 because the tractor T is driven forward.

**[0057]** In this removal of snow, the operator of the tractor T drives the tractor T forward while facing forward and looking ahead, so that operability is high, and workability

can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0058]** Next, another way of using the present snow removing device S is described. As shown in FIG. 6, the snow removing device S is set so that the auger 10 exposed from the auger case 14 is disposed at the backward facing position Y in the rear of the tractor T so as to be exposed toward the backward direction of the tractor T, and each of the connecting portions 1 of the tractor T is connected to each of the attachment portions 75 of the backward facing connecting body 70 of the auger case 14 via the link 4. Moreover, the PTO shaft 2 is coupled to the backward facing coupling portion 77 by the additional coupling shaft 76a. In this case, because the backward facing coupling portion 77 is formed in the extension 24 extended at the rear end 23 of the blower shaft 21 of the blower 20, coupling of the PTO shaft 2 via the coupling shaft 76 can be easier.

**[0059]** In this state, as heretofore, however, the operator removes snow by driving the tractor T backward while facing backward and looking back. As a result, the rotation is transmitted to the blower shaft 21 of the blower 20 from the PTO shaft 2 via the coupling shaft 76, the backward facing coupling portion 77, and the power transmitting portion 40, and the rotation is further transmitted to the rotary main shaft 11 of the auger 10. Thus, the snow is collected by the auger 10, and the snow collected by the blower 20 is sucked and then discharged through the shooter 19. This is considerably advantageous to, for example, a situation in which it is difficult to drive the tractor T forward because of deep snow. That is, a method of removing snow can be selected at the backward facing position Y as heretofore in accordance with the depth of snow and the environment of the place where snow is to be removed, which all the more increases versatility.

**[0060]** A snow removing device S according to an alternative embodiment of the present invention is shown in FIG. 7 and FIG. 8. The snow removing device S according to this alternative embodiment is configured in the same manner as described above, but is different from the above in the configuration of the second power transmission mechanism of the power transmitting portion 40. The second power transmission mechanism 80 comprises a slave rotary shaft 82 having one end linked to the master rotary shaft 51 of the first power transmission mechanism 50 via a rotation axis direction converting mechanism 81 such as a bevel gear mechanism so that the rotation of the master rotary shaft 51 is transmitted thereto, and a main shaft secondary power transmission mechanism 83 which is provided between the rear end of the slave rotary shaft 82 and the end of the rotary main shaft 11 of the auger 10 and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism. In the embodiment, the chain power trans-

mission mechanism is adopted. The slave rotary shaft 82 is supported by a bearing 84 in the upper part of the auger case 14, and is provided parallel to the rotary main shaft 11 of the auger 10. The main shaft secondary power transmission mechanism 83 is provided along one side wall of the auger case 14. The slave rotary shaft 82 is provided so as to be covered with an unshown cover, and the main shaft secondary power transmission mechanism 83 is covered with a cover 85. According to the snow removing device S in this embodiment, the rotation of the slave rotary shaft 82 is obtained from the master rotary shaft 51, so that the rotation can be certainly transmitted. Because the second power transmission mechanism 60 can be affixed to the upper part and side part of the auger case 14, the outer back surface of the auger case 14 is uncluttered, and the device can be compact. Functions and advantageous effects are similar to those described above.

**[0061]** The position of the forward facing coupling portion 45 is provided substantially in the center of the upper part of the auger case 14 in the embodiment of the present invention, but is not limited to this position, and may be located in a different part. That is, at the forward facing position X, the forward facing coupling portion 45 may be set at any position where the coupling shaft 41 is coupled from the outside of the auger 10. The sweeping plates 78 are, but not exclusively, provided at the front of the tractor T in the embodiment of the present invention, and no sweeping plates may be provided. In this case, part of the snow is once stepped on by the wheels 6 and 7 of the tractor T, but is collected with almost no trouble in general capacity of the auger 10.

(Second Embodiment)

**[0062]** As shown in FIG. 9 to FIG. 12, a chassis 3 of a tractor T to which a snow removing device S according to the embodiment is connected comprises connecting portions 1 for connecting an operating machine to the rear via links 4, and a PTO shaft 2 for transmitting engine power to the operating machine. The connecting portions 1 of the tractor T are provided at three places: the top, left, and right of the PTO shaft 2. The reference number 5 denotes a seat, the reference number 6 denotes front wheels, and the reference number 7 denotes rear wheels. The snow removing device S according to the embodiment is connected to the rear of the tractor T as one of operating machines.

**[0063]** Specifically, the snow removing device S according to the embodiment comprises an auger 10, and an auger case 14 which covers the auger 10. The auger 10 comprises a rotary main shaft 11 that is along the width direction of the tractor T, and one blade 12 and the other blade 13 which are helical and which are respectively fixed to the rotary main shaft 11 on the left and right with respect to the center of the rotary main shaft 11. The auger 10 is rotated around the rotary main shaft 11 in one direction to collect snow to the center of the rotary

main shaft 11. The auger case 14 comprises a case body 15 which rotatably supports both ends of the rotary main shaft 11 of the auger 10 and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft 11 and which covers the other side of the auger. The auger case 14 is provided with a guide path 18 which is open in a part corresponding to the center of the rotary main shaft 11 of the auger 10 and which has a suction opening 16 to suck snow and a discharge opening 17. A shooter 19 in which the guide path 18 is formed and which has the discharge opening 17 at the end and which discharges snow is provided so as to protrude in the case body 15. A blower 20 which sucks the collected snow through the suction opening 16 and then discharges the snow through the discharge opening 17 is rotatably provided in the suction opening 16 of the guide path 18 provided in the case body 15.

**[0064]** A connecting body 30 which is connected to the connecting portions 1 of the tractor T via links 4 is provided on the auger 10 side of the auger case 14. The connecting body 30 comprises L-shaped frame bodies 31 which are formed by frames protruding toward the auger 10 side from the top of the case body 15 of the auger case 14 and which are located a predetermined distance apart from each other in the rotary main shaft 11 direction and which are fixed to the case body 15 at one end, for example, by welding and which droop at the other end, an upper bridging rod 32 and lower bridging rod 33a laid between the frame bodies 31, and a central bridging rod 34 laid between the upper part of the case body 15 and the upper bridging rod 32. Attachment portions 35 for the links 4 corresponding to the respective connecting portions 1 of the tractor T are provided in the connecting body 30. The attachment portion 35 corresponding to the connecting portion 1 at the top of the PTO shaft 2 is provided in the center of the upper bridging rod 32, and the attachment portions 35 corresponding to the left and right of the PTO shaft 2 are provided at the other ends of the respective frame bodies 31. Because the connecting body 30 is the frame, the structure can be simpler.

**[0065]** The auger case 14 is also provided a coupling portion 50a which is coupled to the PTO shaft 2 of the tractor T to transmit the rotation of the PTO shaft 2 to the rotary main shaft 11 of the auger 10 and a blower shaft of the blower 20. This coupling portion 50a is provided on the auger 10 side of the auger case 14, and comprises a coupling shaft 41a which is provided across one blade 12 and the other blade 13 of the auger 10 and which has one end connected to the blower shaft 21 of the blower 20 and the other end connected to the PTO shaft 2 via a coupling shaft 41. In this case, the coupling shaft 41a of the coupling portion 50a is provided across one blade 12 and the other blade 13 of the auger 10, so that the interference between the coupling shaft 41 and the blades 12 and 13 of the auger 10 is certainly avoided, and assembly is easier. A bearing 53a which supports the coupling shaft 41a is provided in the connecting body

30. The bearing 53a is provided at the end of a support bar 53b provided to suspend from the central bridging rod 34 of the connecting body 30. The coupling shaft 41a is held by the bearing 53a and is therefore firmer. The coupling shaft 41a is coupled to the coupling shaft 41 via a universal joint 43, and the coupling shaft 41 is also coupled to the PTO shaft 2 via a universal joint 44.

**[0066]** Furthermore, a rotational power transmission mechanism 60a, such as a chain power transmission mechanism, which transmits the rotation of the blower shaft 21 of the blower 20 to the rotary main shaft 11 of the auger 10 is provided outside the case body 15 of the auger case 14. Because the rotational power transmission mechanism 60a takes out the rotation of the blower shaft 21 of the blower 20 and then transmits the rotation to the rotary main shaft 11 of the auger 10, the power transmission efficiency of the rotation is improved.

**[0067]** The snow removing device S according to the embodiment further comprises a pair of sweeping plates 78 which are attached to the front of the tractor T and which sweep snow present ahead of the front wheels 6 of the tractor T to the central side of the vehicle width direction of the tractor T when the tractor T is driven forward.

**[0068]** Therefore, when this snow removing device S is connected to the tractor T, the auger 10 exposed from the auger case 14 is disposed in the rear of the tractor T so as to be exposed toward the forward direction of the tractor T, and each of the connecting portions 1 of the tractor T is connected to each of the attachment portions 35 of the connecting body 30 of the auger case 14 via the link 4. Moreover, the PTO shaft 2 is coupled to the coupling shaft 41a of the coupling portion 50a via the coupling shaft 41. In this case, the coupling portion 50a is provided on the auger 10 side of the auger case 14, and the connecting body 30 is provided on the auger 10 side of the auger case 14, so that connection to the tractor T and coupling to the PTO shaft 2 are easily conducted. Moreover, it is possible to connect the snow removing device S to the tractor T without special processing or installation of a mechanism on the tractor T side, so that costs can be reduced.

**[0069]** When snow is removed by the tractor T to which this snow removing device S is connected, an operator drives the tractor T forward while facing forward and looking ahead as shown in FIG. 9. As a result, the rotation is transmitted to the blower shaft 21 of the blower 20 from the PTO shaft 2 via the coupling shaft 41 and the coupling shaft 41a of the coupling portion 50a, and the rotation is further transmitted to the rotary main shaft 11 of the auger 10 via the rotational power transmission mechanism 60a. Thus, the snow is collected by the auger 10, and the collected snow is sucked and then discharged by the blower 20.

**[0070]** In this case, because the sweeping plates 78 are provided at the front of the tractor T, the snow present ahead of the front wheels 6 of the tractor T is swept to the central side of the vehicle width direction of the tractor

T when the tractor T is driven forward. Thus, because the snow that may be stepped on by the wheels 6 and 7 of the tractor T is drawn to the central side of the vehicle width direction of the tractor T by the sweeping plates 78, the snow can be certainly collected by the auger 10. The snow collected by the auger 10 passes under the chassis 3 of the tractor T and reaches the auger 10 because the tractor T is driven forward.

**[0071]** In this removal of snow, the operator of the tractor T drives the tractor T forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0072]** The sweeping plates 78 are, but not exclusively, provided at the front of the tractor T in the embodiment of the present invention, and no sweeping plates may be provided. In this case, part of the snow is once stepped on by the wheels 6 and 7 of the tractor T, but is collected with almost no trouble in general capacity of the auger 10.

(Third Embodiment)

**[0073]** As shown in FIG. 13 to FIG. 18, a chassis 3 of a tractor T to which a snow removing device S according to the embodiment is connected comprises connecting portions 1 to connect an operating machine to the rear via links 4, and a PTO shaft 2 in which an end to transmit engine power to the operating machine is formed by a spline shaft. The connecting portions 1 of the tractor T are provided at three places: the top, left, and right of the PTO shaft 2. The reference number 5 denotes a seat, the reference number 6 denotes front wheels, and the reference number 7 denotes rear wheels. The snow removing device S according to the embodiment is connected to the rear of this tractor T as one of operating machines.

**[0074]** Specifically, the snow removing device S according to the embodiment comprises an auger 10, and an auger case 14 which covers the auger 10. The auger 10 comprises a rotary main shaft 11 that is along the width direction of the tractor T, and one blade 12 and the other blade 13 which are helical and which are respectively fixed to the rotary main shaft 11 on the left and right with respect to the center of the rotary main shaft 11. The auger 10 is rotated around the rotary main shaft 11 in one direction to collect snow to the center of the rotary main shaft 11. The auger case 14 comprises a case body 15 which rotatably supports both ends of the rotary main shaft 11 of the auger 10 and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft 11 and which covers the other side of the auger. The auger case 14 is provided with a guide path 18 which is open in a part corresponding to the central part of the rotary main shaft 11 of the auger 10 and which has a suction opening 16 to suck snow and a discharge opening 17. A shooter 19 in which the guide path 18 is formed and which has the discharge opening 17 at

the end and which discharges snow is provided so as to protrude in the case body 15.

**[0075]** A blower 20 which sucks the collected snow through the suction opening 16 and then discharges the snow through the discharge opening 17 is rotatably provided in the suction opening 16 of the guide path 18 provided in the case body 15. The blower 20 has a blower shaft 21 supported by the case body 15, and is provided with, at one end 25, a blade 22 which takes in snow. The other end 23 which is on the other side of the horizontal axis direction orthogonal to the rotary main shaft 11 of the blower shaft 21 protrudes outward, and a further extended extension 24 is provided at this other end 23. A later-described backward facing coupling portion 77 is formed in this extension 24.

**[0076]** The auger case 14 is provided with a forward facing connecting body 30 which is connectable to the connecting portions 1 of the tractor T at a forward facing position X where the auger 10 exposed from the auger case 14 is disposed so as to be exposed toward the forward direction of the tractor T. The forward facing connecting body 30 protrudes toward the auger 10 side of the auger case 14, and is connected to the connecting portions 1 of the tractor T via the links 4. Specifically, the forward facing connecting body 30 comprises L-shaped frame bodies 31 which are formed by frames protruding toward the auger 10 side from the top of the case body 15 of the auger case 14 and which are located a predetermined distance apart from each other in the axial direction of the rotary main shaft 11 and which are fixed to the case body 15 at one end, for example, by welding and which droop at the other end, an upper bridging rod 32 laid between the frame bodies 31, reinforcing rods 33 obliquely laid between both end sides of the L-shaped frame bodies 31, and a lower bridging rod 33a laid between the frame bodies 31. Attachment portions 35 for the links 4 corresponding to the respective connecting portions 1 of the tractor T are provided in the forward facing connecting body 30. The attachment portion 35 corresponding to the connecting portion 1 at the top of the PTO shaft 2 is provided in the center of the upper bridging rod 32, and the attachment portions 35 corresponding to the left and right of the PTO shaft 2 are provided at the other ends of the respective frame bodies 31. Because the forward facing connecting body 30 is the frame, the structure can be simpler.

**[0077]** The auger case 14 is also provided with a power transmitting portion 90 which is coupled to the PTO shaft 2 of the tractor T to transmit the rotation of the PTO shaft 2 to the rotary main shaft 11 of the auger 10 and the blower shaft 21 of the blower 20. The power transmitting portion 90 comprises a connecting shaft 91 which is connected to one end 25 of the blower shaft 21 located on one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft 11 and which extends to the position where the center of the rotary main shaft 11 is located, and a power transmission box 92. As shown in FIG. 16, the power transmission box 92 comprises a

power transmission mechanism 93 which is provided in the center of the rotary main shaft 11 and which can relatively transmit the rotation of the connecting shaft 91 to the rotary main shaft 11, and a box main body 94 which is supported by the auger case 14 via a support arm 34a and which houses the power transmission mechanism 93. The connecting shaft 91 and the rotary main shaft 11 pierce the box main body 94, and a later-described link shaft 51 b is continuously provided in this connecting shaft 91. The power transmission mechanism 93 comprises a master bevel gear 95 provided at the end of the connecting shaft 91 in the box main body 94, a slave bevel gear 97 which meshes with the master bevel gear 95 and which is provided on a rotary rod 96 supported by the box main body 94, a master spur gear 98 provided on the rotary rod 96, and a slave spur gear 99 which is provided on the rotary main shaft 11 and which meshes with the master spur gear 98. The power transmission mechanism 93 decelerates the rotation of the connecting shaft 91 and then transmits the rotation to the rotary main shaft 11.

**[0078]** A forward facing coupling portion 50b which is linked to the power transmission mechanism 93 and which is configured to be coupled to the PTO shaft 2 via a coupling shaft 41 is provided on one side of the power transmission box 92 in a horizontal axis direction orthogonal to the rotary main shaft 11. The forward facing coupling portion 50b comprises the link shaft 51b which is linked to the power transmission mechanism 93 in the power transmission box 92 and to which the coupling shaft 41 is coupled at the end. The link shaft 51 b has the proximal end continuously provided integrally with the connecting shaft 91, and the distal side supported by a bearing 53 which is supported by the auger case 14 via a support member 52a. The support member 52a is configured by the lower bridging rod 33a laid between the frame bodies 31.

**[0079]** As shown in FIG. 15 and FIG. 17, the coupling shaft 41 comprises a rotary shaft 42, and universal joints 43 respectively provided at both ends of the rotary shaft 42. Joint portions 43a and 43b of the respective universal joints 43 are formed by spline holes. One joint portion 43a meshes with the spline shaft at the end of the PTO shaft 2. An end 51c of the link shaft 51b is configured by a spline shaft which meshes with the spline hole of the other joint portion 43b.

**[0080]** The auger case 14 is also provided with a backward facing connecting body 70 which is connectable to the connecting portions 1 of the tractor T at a backward facing position Y (FIG. 18) where the auger 10 exposed from the auger case 14 is disposed so as to be exposed toward the backward direction of the tractor. The backward facing connecting body 70 comprises a pair of first arms 72 which is provided so as to protrude outward from the outer back surface of the auger case 14, and a pair of second arms 73 which extend from the ends of the respective first arms 72 and which have their ends in close contact. One first arm 72 is reinforced by a rein-

forcing beam 71. Attachment portions 75 for the links 4 corresponding to the respective connecting portions 1 of the tractor T are provided in the backward facing connecting body 70. The attachment portions 75 corresponding to the left and right of the PTO shaft 2 are respectively provided at the ends of the first arms 72, and the attachment portion 75 corresponding to the connecting portion 1 at the top of the PTO shaft 2 is provided at the ends of the second arms 73.

**[0081]** Furthermore, the power transmitting portion 90 is provided with the backward facing coupling portion 77 which is connectable to the PTO shaft 2 via an additional coupling shaft 76a (FIG. 18) having a different length that is formed at the backward facing position Y in the same manner as described above. The backward facing coupling portion 77 is formed in the extension 24 which is extended at the other end 23 of the blower shaft 21 of the blower 20, and is configured by a spline shaft which meshes with the spline hole of the other joint portion of the additional coupling shaft 76a.

**[0082]** The snow removing device S according to the embodiment further comprises a pair of sweeping plates 78 which are attached to the front of the tractor T and which sweep snow present ahead of the front wheels 6 of the tractor T to the central side of the vehicle width direction of the tractor T when the tractor T is driven forward.

**[0083]** Therefore, when the snow removing device S is connected to the tractor T, the auger 10 exposed from the auger case 14 is disposed at the forward facing position X in the rear of the tractor T so as to be exposed toward the forward direction of the tractor T, and each of the connecting portions 1 of the tractor T is connected to each of the attachment portions 35 of the forward facing connecting body 30 of the auger case 14 via the link 4. Moreover, the PTO shaft 2 is coupled to the forward facing coupling portion 50b via the coupling shaft 41. In this case, the forward facing connecting body 30 and the forward facing coupling portion 50b are used, so that connection to the tractor T and coupling to the PTO shaft 2 are easily conducted. In particular, the coupling shaft 41 is connected to the end of the link shaft 51 b of the forward facing coupling portion 50b, so that the coupling shaft 41 can be coupled at a position away from the auger 10, and the interference between the coupling shaft 41 and the auger can be prevented. Moreover, it is possible to connect the snow removing device S to the tractor T without special processing or installation of a mechanism on the tractor T side, so that costs can be reduced. Furthermore, the coupling shaft 41 is coupled to the power transmission box 92 provided in the center of the rotary main shaft 11 to transmit the rotation of the PTO shaft 2 to the rotary main shaft 11 of the auger 10 and the blower shaft 21 of the blower 20, so that the power transmitting portion 90 does not need to be provided outside the auger case 14, and the device can therefore be compact.

**[0084]** When snow is removed by the tractor T to which the snow removing device S is connected, an operator

drives the tractor T forward while facing forward and looking ahead as shown in FIG. 13. As a result, the rotation is transmitted to the blower shaft 21 of the blower 20 from the PTO shaft 2 via the coupling shaft 41, the forward facing coupling portion 50b, and the power transmitting portion 90, and the rotation is further transmitted to the rotary main shaft 11 of the auger 10. Thus, the snow is collected by the auger 10, and the collected snow is sucked and then discharged by the blower 20.

**[0085]** In this case, because the sweeping plates 78 are provided at the front of the tractor T, the snow present ahead of the front wheels 6 of the tractor T is swept to the central side of the vehicle width direction of the tractor T when the tractor T is driven forward. Thus, because the snow that may be stepped on by the wheels 6 and 7 of the tractor T is drawn to the central side of the vehicle width direction of the tractor T by the sweeping plates 78, the snow can be certainly collected by the auger 10. The snow to be collected by the auger 10 passes under the chassis 3 of the tractor T and reaches the auger 10 because the tractor T is driven forward.

**[0086]** In this removal of snow, the operator of the tractor T drives the tractor T forward while facing forward and looking ahead, so that operability is high, and workability can be significantly improved without any burden on the neck and shoulders because the operator is facing forward.

**[0087]** Next, another way of using the present snow removing device S is described. As shown in FIG. 18, the snow removing device S is set so that the auger 10 exposed from the auger case 14 is disposed at the backward facing position Y in the rear of the tractor T so as to be exposed toward the backward direction of the tractor T, and each of the connecting portions 1 of the tractor T is connected to each of the attachment portions 75 of the backward facing connecting body 70 of the auger case 14 via the link 4. Moreover, the PTO shaft 2 is coupled to the backward facing coupling portion 77 by the additional coupling shaft 76a. In this case, because the backward facing coupling portion 77 is formed in the extension 24 extended at the rear end 23 of the blower shaft 21 of the blower 20, coupling of the PTO shaft 2 via the coupling shaft 76 can be easier.

**[0088]** In this state, as heretofore, the operator removes snow by driving the tractor T backward while facing backward and looking back. As a result, the rotation is transmitted to the blower shaft 21 of the blower 20 from the PTO shaft 2 via the coupling shaft 76, the backward facing coupling portion 77, and the power transmitting portion 90, and the rotation is further transmitted to the rotary main shaft 11 of the auger 10. Thus, the snow is collected by the auger 10, and the collected snow is sucked and then discharged by the blower 20. This is considerably advantageous to, for example, a situation in which it is difficult to drive the tractor T forward because of deep snow. That is, a method of removing snow can be selected at the backward facing position Y as heretofore in accordance with the depth of snow and the envi-

ronment of the place where snow is to be removed, which can increase versatility.

**[0089]** The forward facing coupling portion 50b comprises, but not exclusively, the link shaft 51 b in the embodiment of the present invention, and the coupling shaft 41 may be directly connected to the power transmission box 92, and suitable changes may be made. The sweeping plates 78 are, but not exclusively, provided at the front of the tractor T in the embodiment of the present invention, and no sweeping plates may be provided. In this case, part of the snow is once stepped on by the wheels 6 and 7 of the tractor T, but is collected with almost no trouble in general capacity of the auger 10.

[Description of Reference Numbers]

**[0090]**

S: snow removing device

T: tractor

1: connecting portions

2: PTO shaft

3: chassis

4: links

5: seat

6: front wheels

7: rear wheels

10: auger

11: rotary main shaft

12: one blade

13: the other blade

14: auger case

15: case body

16: suction opening

17: discharge opening

18: guide path

19: shooter

20: blower

21: blower shaft

22: blade

23: rear end

24: extension

23a, 24a: universal joints

25: one end

X: forward facing position

30: forward facing connecting body

31: frame bodies

32: upper bridging rod

33: reinforcing rods

33a: lower bridging rod

34: central bridging rod

34a: support arm

35: attachment portions

40: power transmitting portion

41: coupling shaft, coupling rod

41 a: coupling shaft

42: rotary shaft

43: universal joints

43a, 43b: joint portions

44: universal joint

45: forward facing coupling portion

50: first power transmission mechanism

50a: coupling portion

50b: forward facing coupling portion

51: master rotary shaft

51 a: rear end

51 b: link shaft

51 c: end

52: support

52a: support member (lower bridging rod)

53, 53a: bearing

53b: support bar

54: blower shaft secondary power transmission mechanism (chain power transmission mechanism)

55: perpendicular plate

56: sprockets

57: chain

58: first cover

59: second cover

60: second power transmission mechanism

60a: rotational power transmission mechanism

61: rotation axis direction converting mechanism

62: slave rotary shaft

63: main shaft secondary power transmission mechanism

64: cover

65: cover

Y: backward facing position

70: backward facing connecting body

71: reinforcing beam

72: first arms

73: second arms

75: attachment portions

76: coupling shaft

76a: additional coupling shaft

77: backward facing coupling portion

78: sweeping plates

80: second power transmission mechanism

81: rotation axis direction converting mechanism

82: slave rotary shaft

83: main shaft secondary power transmission mechanism

90: power transmitting portion

91: connecting shaft

92: power transmission box

93: power transmission mechanism

94: box main body

95: master bevel gear

96: rotary rod

97: slave bevel gear

98: master spur gear

99: slave spur gear

## Claims

1. A snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine, comprising:
  - an auger which is rotated to collect snow;
  - an auger case which rotatably supports a rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft of the auger and which covers the other side of the auger;
  - a blower which is provided in the auger case and which is rotated to discharge the snow collected by the auger; and
  - a coupling portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower,
 wherein the coupling portion is provided on an auger side of the auger case, and  
 wherein a connecting body which is connected to the connecting portions of the tractor is provided on the auger side of the auger case.
2. A snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear via links, and a PTO shaft for transmitting engine power to the operating machine, comprising:
  - an auger in which one blade and the other blade that are helical are respectively fixed to a rotary main shaft on the left and right with respect to the center of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the center of the rotary main shaft;
  - an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger;
  - a guide path which is provided in the auger case and which is open in a part corresponding to the center of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening;
  - a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the discharge opening; and
- charge opening; and
- a coupling portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower,
- wherein the coupling portion is provided on the auger side of the auger case,
- wherein the coupling portion comprises a coupling shaft which is provided across one blade and the other blade of the auger and which has one end connected to the blower shaft of the blower and the other end connected to the PTO shaft,
- wherein a rotational power transmission mechanism which transmits the rotation of the blower shaft of the blower to the rotary main shaft of the auger is provided outside the auger case, and
- wherein a connecting body which is connected to the connecting portions of the tractor via the links is provided on the auger side of the auger case.
3. The snow removing device according to claim 2, **characterized in that** the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, the connecting body is formed by a frame which protrudes toward the auger side from the auger case, and attachment portions for the links corresponding to the respective connecting portions are provided in the connecting body.
4. The snow removing device according to claim 3, **characterized in that** a bearing which supports the coupling shaft is provided in the connecting body.
5. The snow removing device according to any one of claims 1 to 4, **characterized in that** a sweeping plate which is attached to the front of the tractor is provided, and the sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward.
6. A snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine, comprising:
  - an auger which is rotated to collect snow;
  - an auger case which rotatably supports a rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft of the auger and which covers the other side of the auger;
  - a blower which is provided in the auger case and

which is rotated to discharge the snow collected by the auger; and

a power transmitting portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower, wherein the auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the forward direction of the tractor, and

wherein the power transmitting portion is provided with a forward facing coupling portion which is configured to be coupled to the PTO shaft through the outside of the auger via the coupling shaft at the forward facing position.

7. A snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine, comprising:

an auger in which one blade and the other blade that are helical are respectively fixed to a rotary main shaft on the left and right with respect to the center of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the center of the rotary main shaft;

an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger;

a guide path which is provided in the auger case and which is open in a part corresponding to the center of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening, a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the discharge opening; and

a power transmitting portion which is provided in the auger case and which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower, wherein the auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger ex-

posed from the auger case is disposed so as to be exposed toward the forward direction of the tractor, and

wherein the power transmitting portion is provided with a forward facing coupling portion which is configured to be coupled to the PTO shaft through the outside of the auger via the coupling shaft at the forward facing position.

8. The snow removing device according to claim 6 or 7, **characterized in that** the forward facing coupling portion is located on the upper side of the auger case.

9. The snow removing device according to claim 8, **characterized in that** the power transmitting portion comprises a first power transmission mechanism which transmits rotation to the blower shaft of the blower, and a second power transmission mechanism which transmits the rotation transmitted from the first power transmission mechanism to the rotary main shaft of the auger, the first power transmission mechanism comprises a master rotary shaft having the forward facing coupling portion at the end thereof, and a blower shaft secondary power transmission mechanism which is provided between the rear end of the master rotary shaft and the rear end of the blower shaft and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism, and the first power transmission mechanism is affixed to the outside of the auger case.

10. The snow removing device according to claim 9, **characterized in that** the second power transmission mechanism comprises a slave rotary shaft having one end linked to the master rotary shaft of the first power transmission mechanism via a rotation axis direction converting mechanism so that the rotation of the master rotary shaft is transmitted thereto, and a main shaft secondary power transmission mechanism which is provided between the rear end of the slave rotary shaft and the end of the rotary main shaft of the auger and which includes at least one of a belt power transmission mechanism, a chain power transmission mechanism, a frictional power transmission mechanism, and a gear power transmission mechanism, the slave rotary shaft is provided parallel to the rotary main shaft of the auger in the upper part of the auger case, and the main shaft secondary power transmission mechanism is provided along one side wall of the auger case.

11. The snow removing device according to any one of claims 6 to 10, **characterized in that** the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, and the forward facing coupling portion is formed by a frame which pro-

trudes toward the auger side from the auger case, and attachment portions for the links corresponding to the respective connecting portions are provided in the forward facing coupling portion.

12. The snow removing device according to any one of claims 6 to 11, **characterized in that** the auger case is provided with a backward facing connecting body which is connectable to the connecting portions of the tractor at a backward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the backward direction of the tractor, and the power transmitting portion is provided with a backward facing coupling portion which is connectable to the PTO shaft via a coupling shaft at the backward facing position. 5
13. The snow removing device according to claim 7, **characterized in that** the backward facing coupling portion is formed in an extension extended at the rear end of the blower shaft of the blower. 10
14. The snow removing device according to any one of claims 1 to 8, **characterized in that** a sweeping plate which is attached to the front of the tractor is provided, and the sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward. 15
15. A snow removing device which is connected, as one of operating machines, to the rear of a tractor that comprises connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine, comprising: 20

an auger to which one blade and the other blade that are helical are respectively fixed on the left and right with respect to the center of the rotary main shaft that is along the width direction of the tractor and which is rotated in one direction to collect snow to the central side of the rotary main shaft; 25

an auger case which rotatably supports both ends of the rotary main shaft of the auger and which exposes one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft and which covers the other side of the auger, a guide path which is provided in the auger case and which is open in a part corresponding to the central part of the rotary main shaft of the auger and which has a suction opening to suck snow and a discharge opening; 30

a blower which is rotatably provided in the suction opening of the guide path and which sucks the collected snow through the suction opening and then discharges the snow through the dis-

charge opening; and

a power transmitting portion which is coupled to the PTO shaft of the tractor to transmit the rotation of the PTO shaft to the rotary main shaft of the auger and a blower shaft of the blower, wherein the auger case is provided with a forward facing connecting body which is connectable to the connecting portions of the tractor at a forward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the forward direction of the tractor, and

wherein the power transmitting portion comprises

a connecting shaft which is connected to one end of the blower shaft located on one side of the auger in a horizontal axis direction orthogonal to the rotary main shaft,

a power transmission box which is provided in the center of the rotary main shaft and which has a power transmission mechanism that is configured to relatively transmit the rotation of the connecting shaft to the rotary main shaft and a box main body that is supported by the auger case and that houses the power transmission mechanism, and

a forward facing connecting body which is linked to the power transmission mechanism and which is configured to be coupled to the PTO shaft via a coupling shaft is provided on one side of the power transmission box in a horizontal axis direction orthogonal to the rotary main shaft. 35

16. The snow removing device according to claim 15, **characterized in that** the forward facing coupling portion comprises a link shaft which is linked to the power transmission mechanism in the power transmission box and to which the coupling shaft is coupled at the end, and the link shaft is supported by a bearing which is supported by the auger case via a support member. 40

17. The snow removing device according to claim 15 or 16, **characterized in that** the power transmission mechanism of the power transmission box comprises a master bevel gear provided at the end of the connecting shaft, and a slave bevel gear which meshes with the master bevel gear and which transmits rotation to the rotary main shaft, and the link shaft is coupled to the connecting shaft. 45

18. The snow removing device according to any one of claims 15 to 17, **characterized in that** the connecting portions of the tractor are provided at the top, left, and right of the PTO shaft, and the forward facing coupling portion is formed by a frame which protrudes toward the auger side from the auger case, and attachment portions for the links corresponding 50

to the respective connecting portions are provided in the forward facing coupling portion.

19. The snow removing device according to any one of claims 15 to 18, **characterized in that** the auger case is provided with a backward facing connecting body which is connectable to the connecting portions of the tractor at a backward facing position where the auger exposed from the auger case is disposed so as to be exposed toward the backward direction of the tractor, and the power transmitting portion is provided with a backward facing coupling portion which is connectable to the PTO shaft via a coupling shaft at the backward facing position.
20. The snow removing device according to claim 19, **characterized in that** the backward facing coupling portion is provided at the other end of the blower shaft located on the other side in the horizontal axis direction orthogonal to the rotary main shaft.
21. The snow removing device according to any one of claims 15 to 20, **characterized in that** a sweeping plate which is attached to the front of the tractor is provided, and the sweeping plate sweeps snow present ahead of the front wheels of the tractor to the central side of the vehicle width direction of the tractor when the tractor is driven forward.
22. A snow removing method to connect a snow removing device as one of operating machines to the rear of a tractor to remove snow, the tractor comprising connecting portions for connecting an operating machine to the rear, and a PTO shaft for transmitting engine power to the operating machine, the snow removing method being **characterized by** comprising using the snow removing device according to any one of claims 1 to 21, connecting the snow removing device so that the auger exposed from the auger case is disposed in the rear of the tractor so as to be exposed toward the forward direction of the tractor, and coupling the PTO shaft to the coupling portion or the forward facing coupling portion, in which state snow is removed by the snow removing device while the tractor is being driven forward.

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FIG. 1

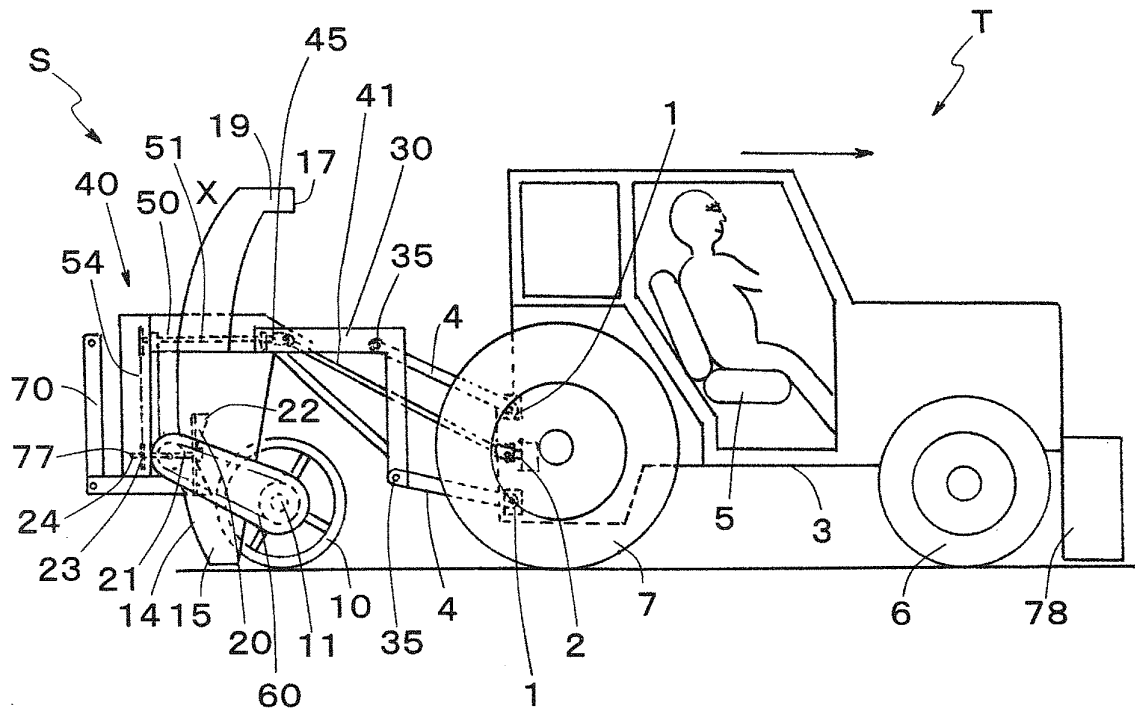


FIG. 2

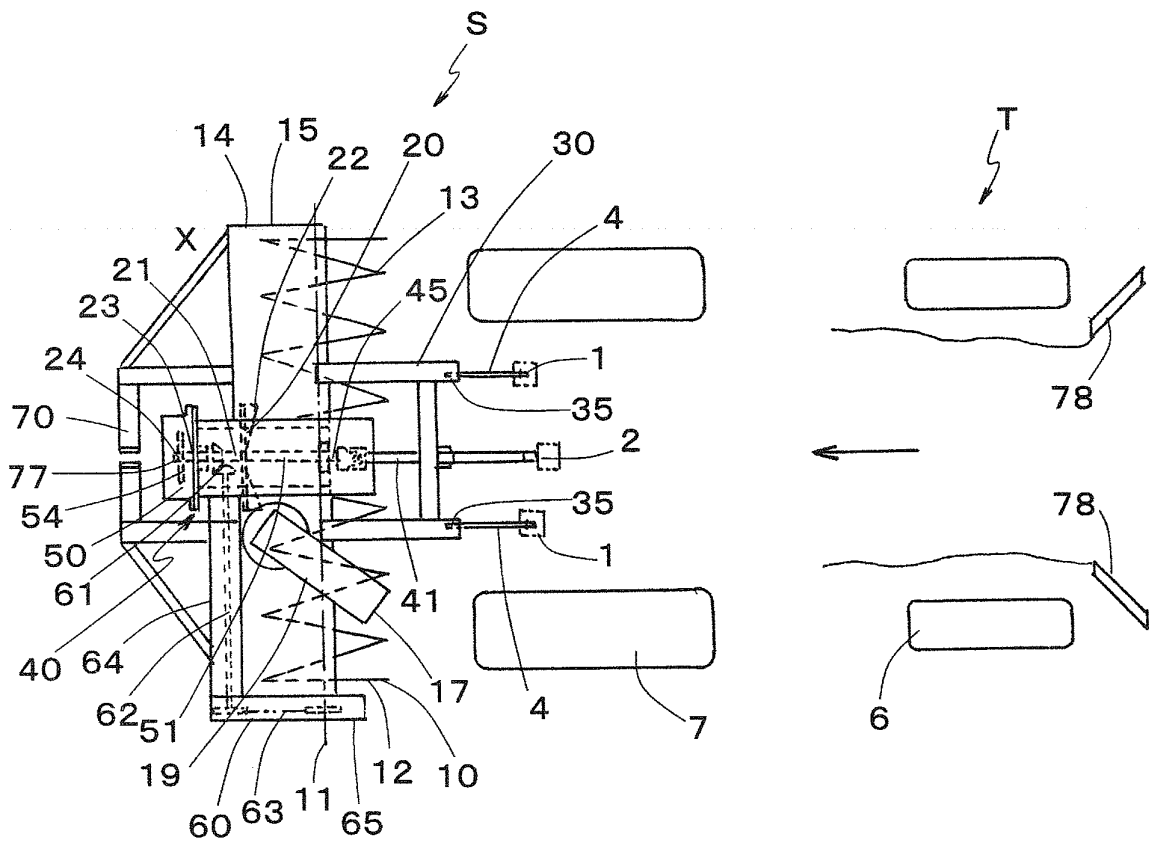


FIG. 3

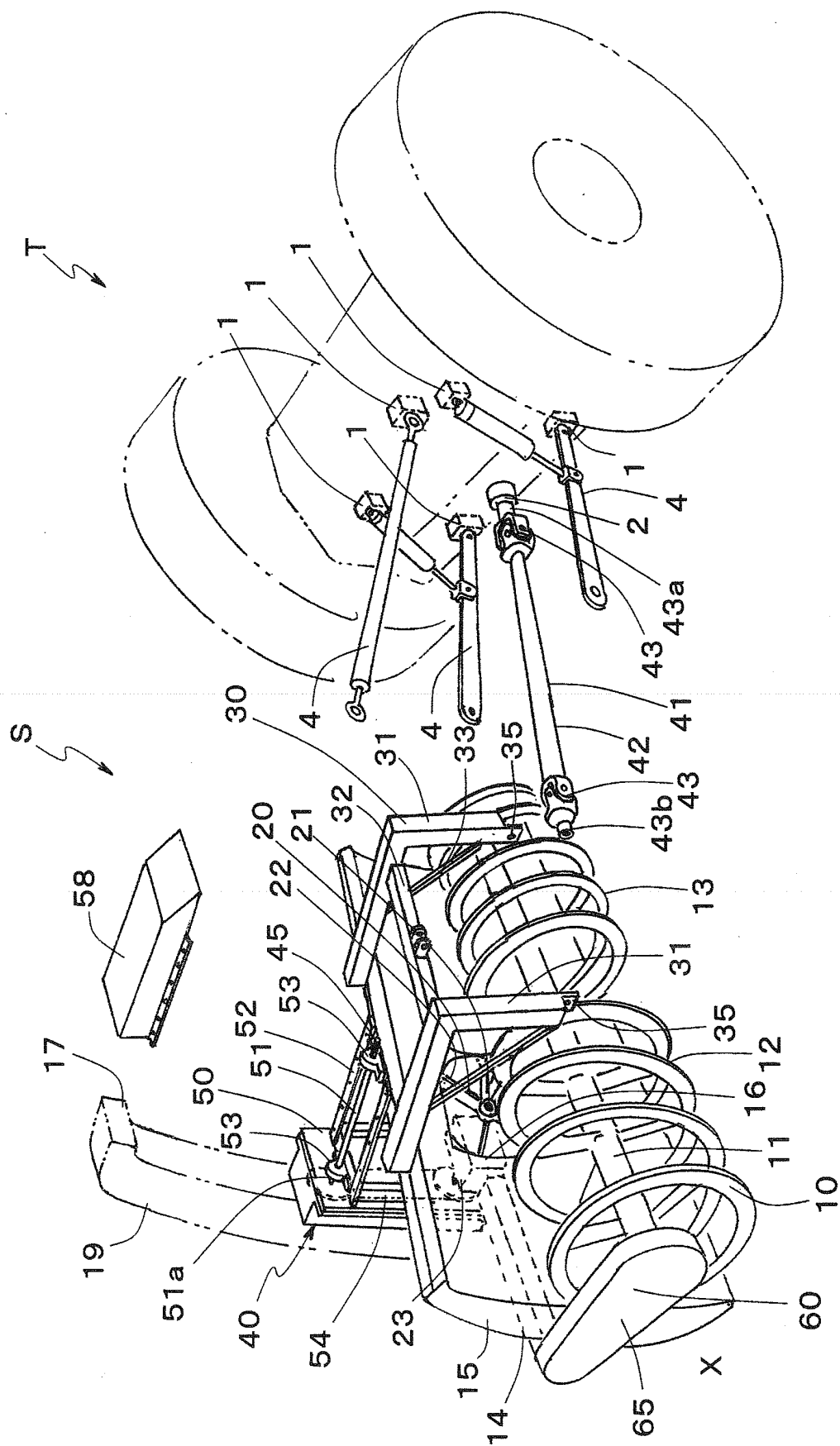


FIG. 4

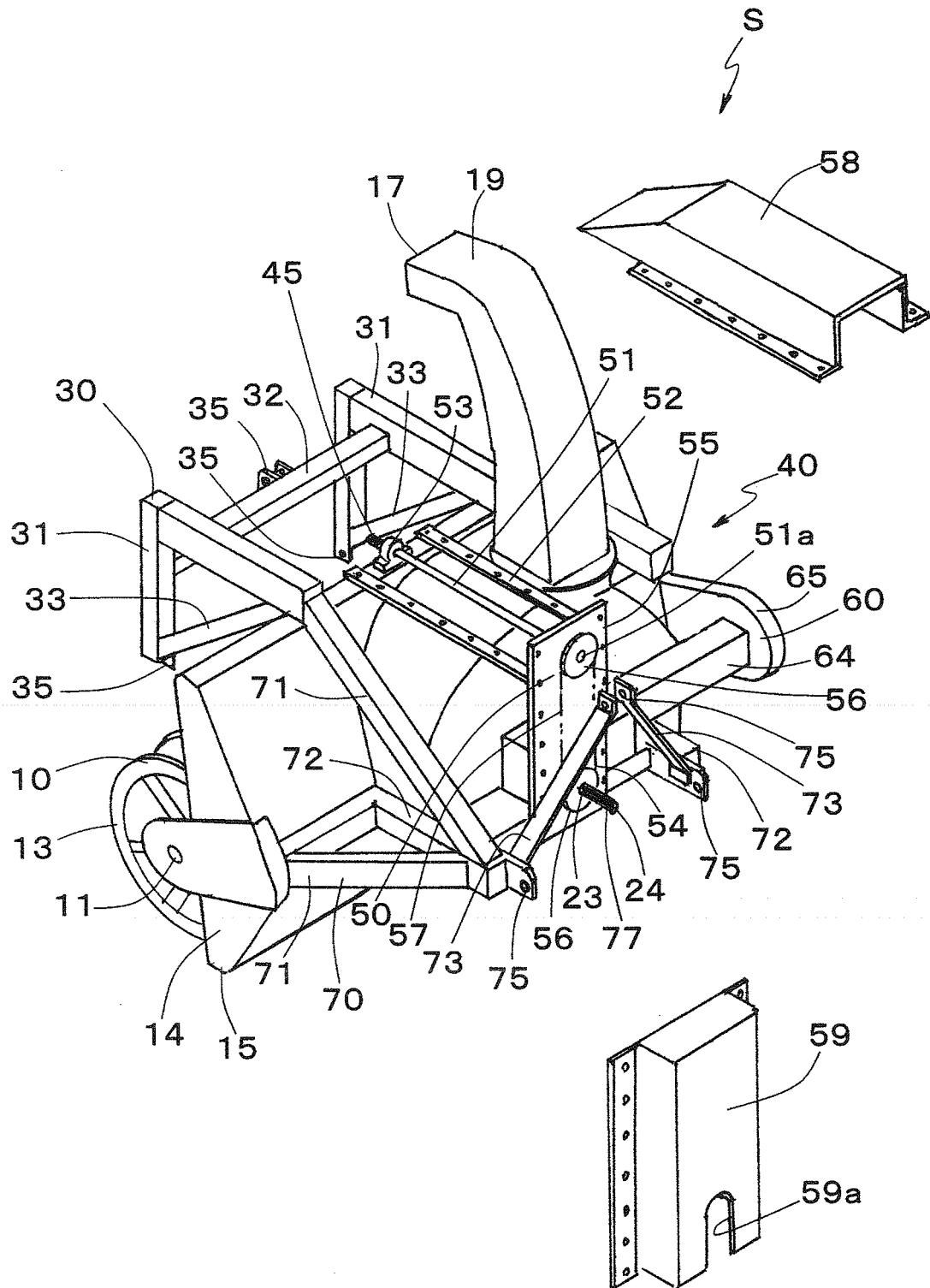


FIG. 5

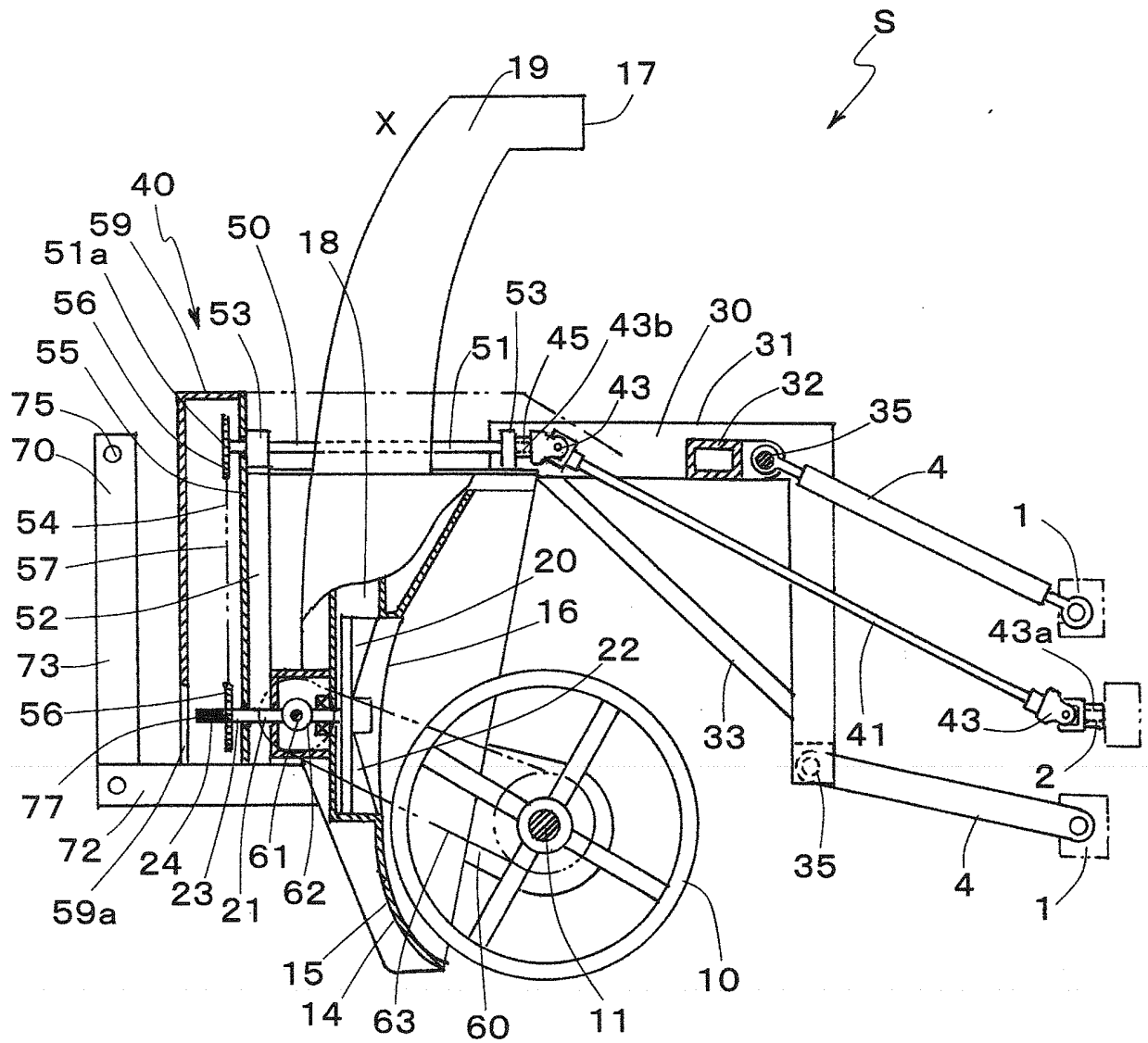


FIG. 6

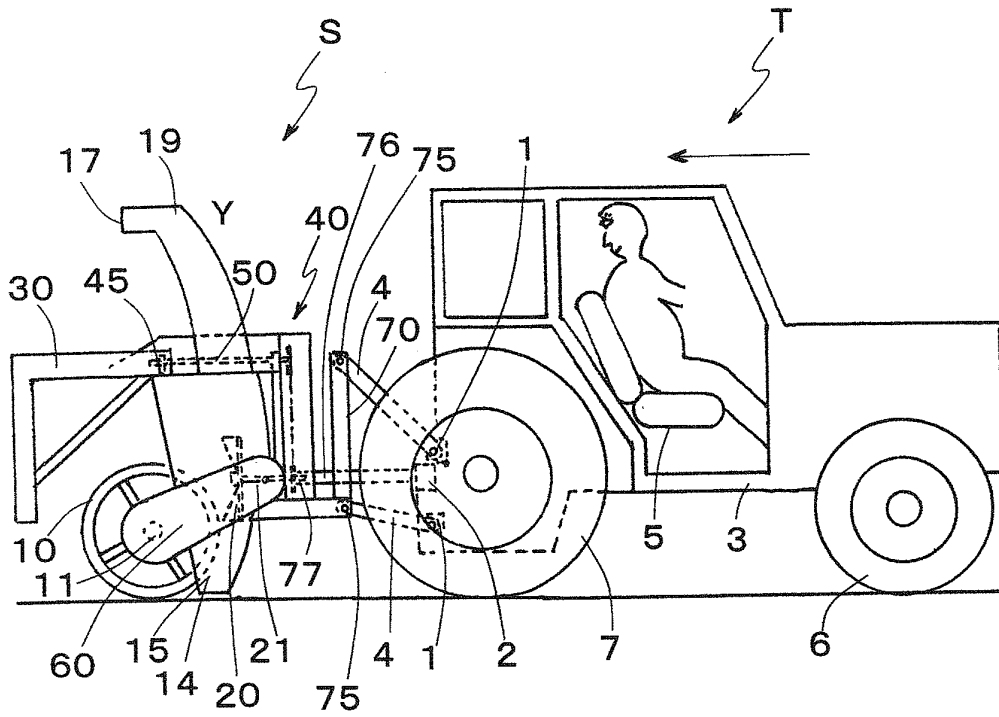


FIG. 7

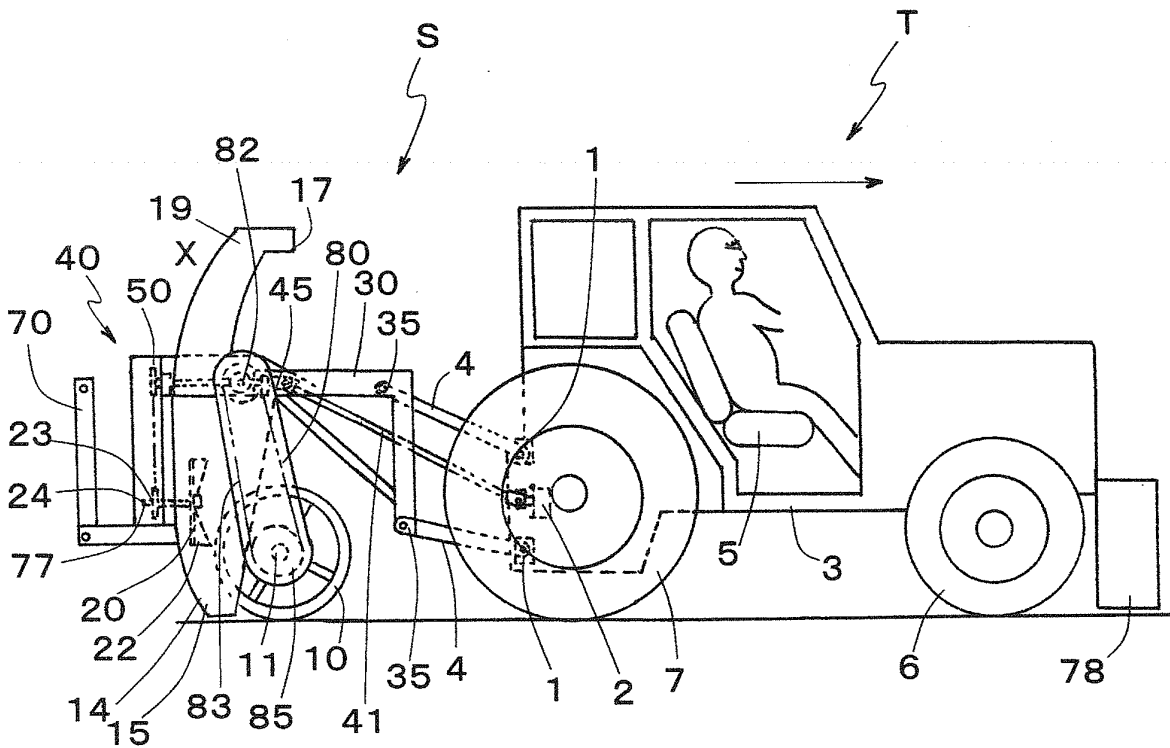


FIG. 8

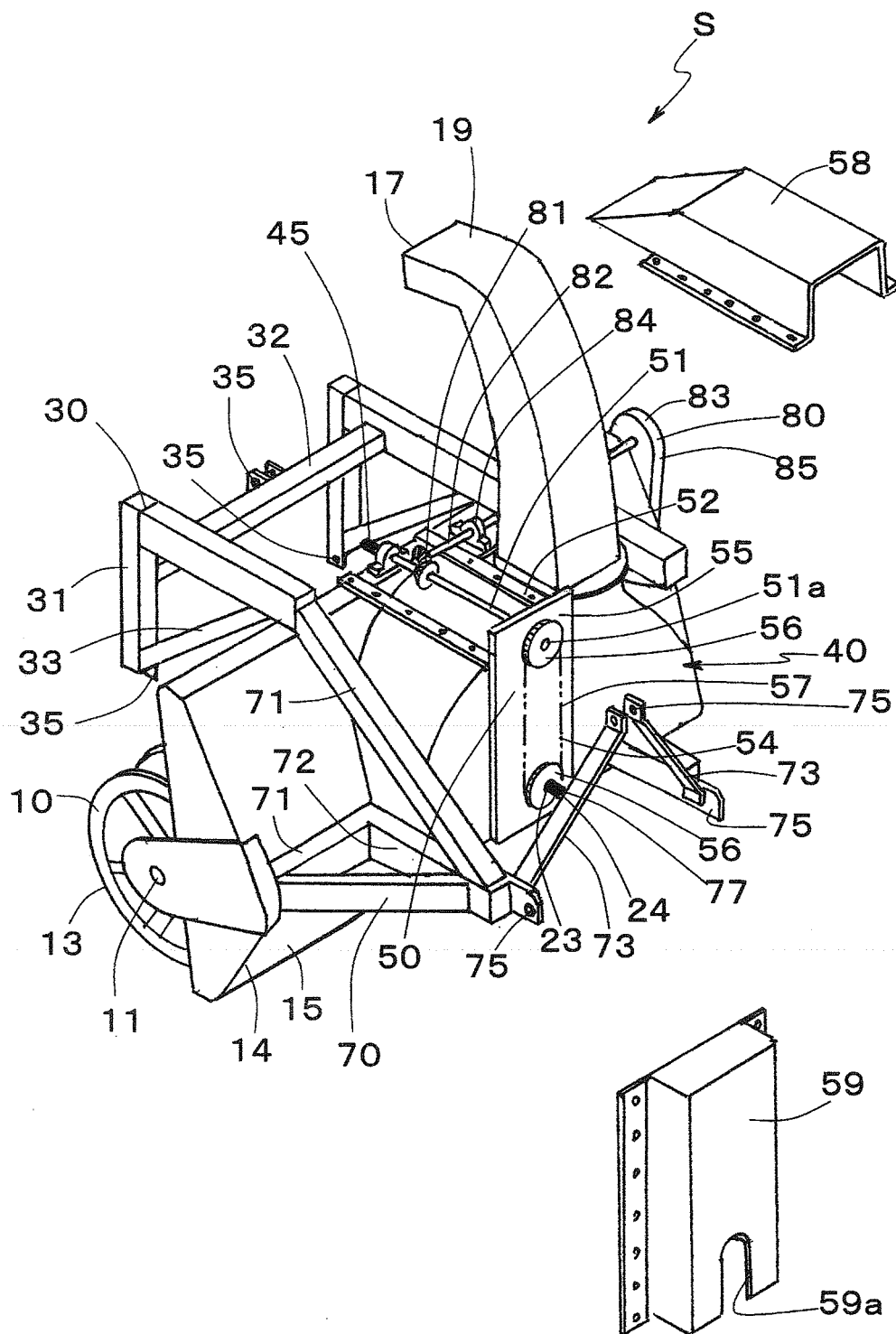


FIG. 9

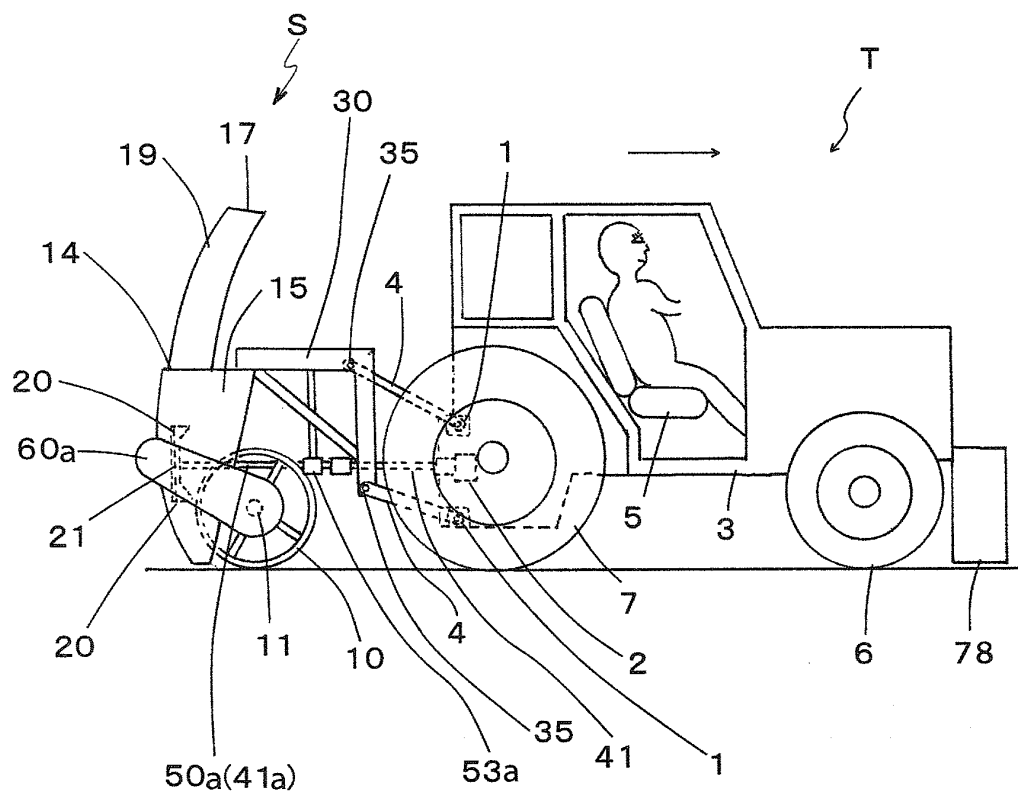


FIG. 10

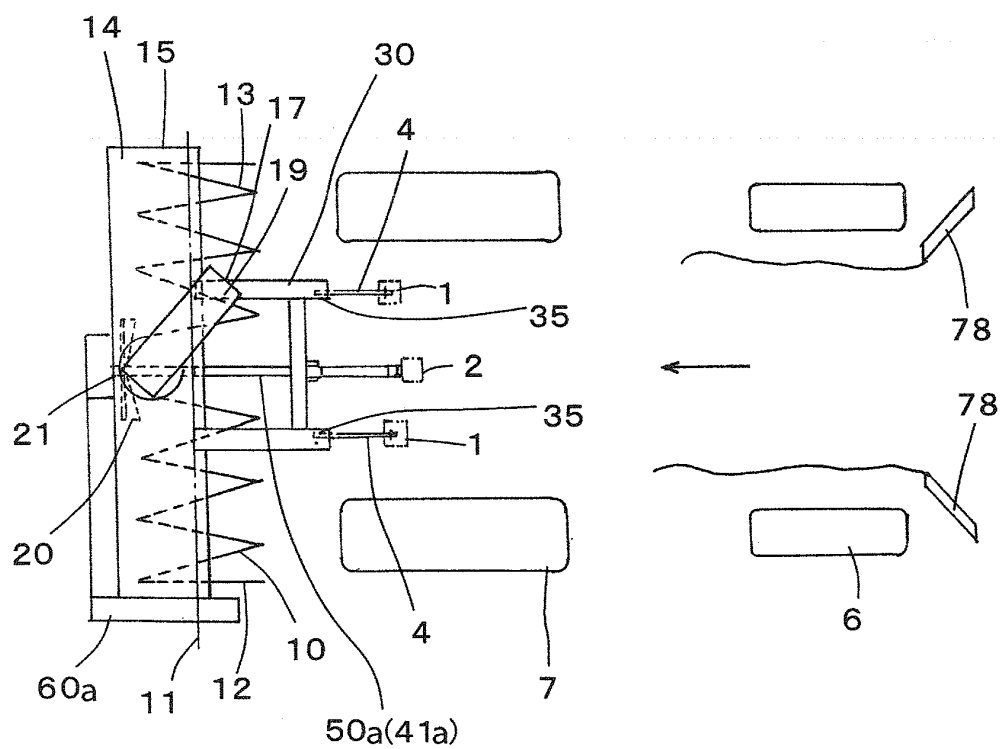


FIG. 11

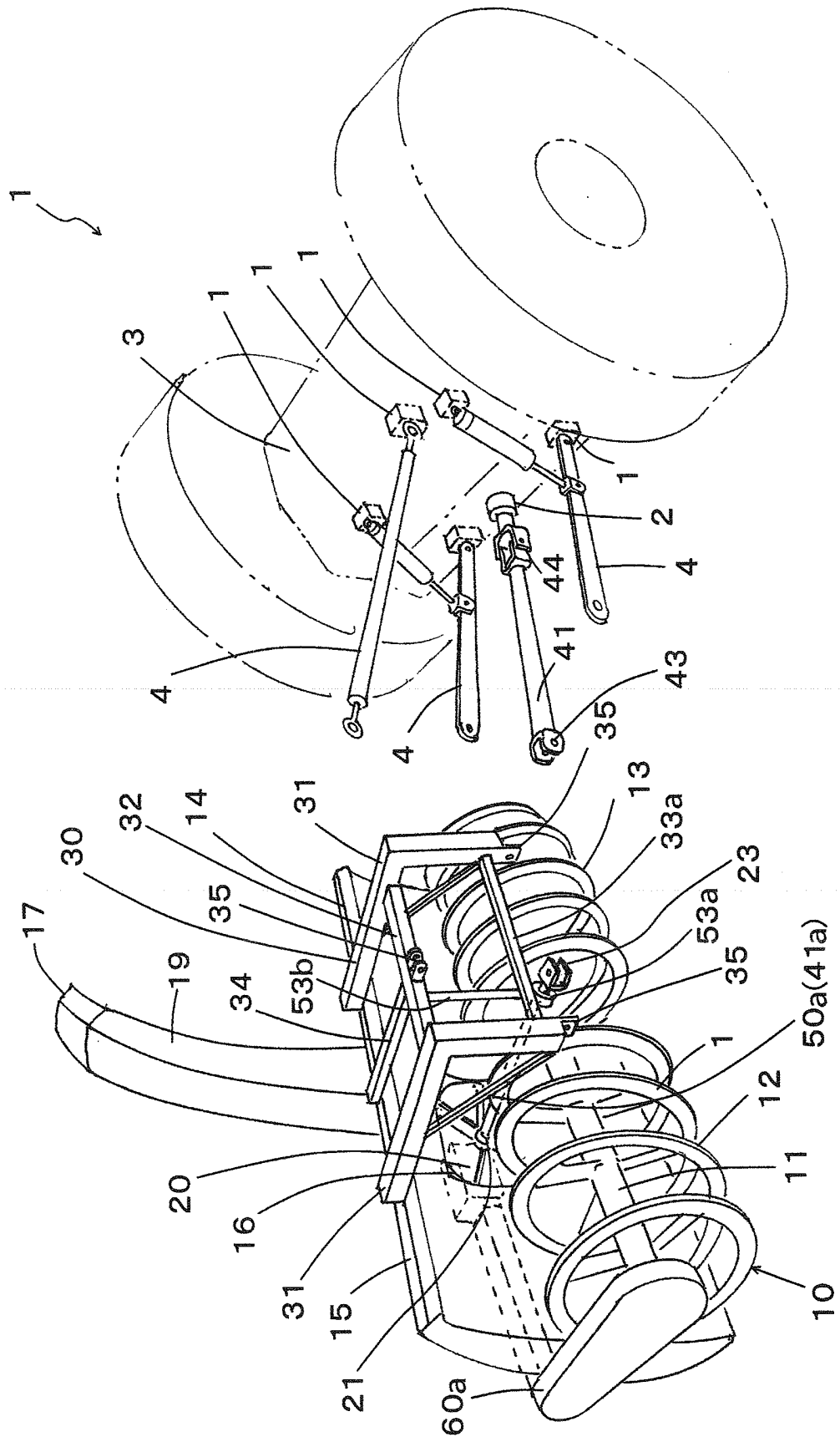


FIG.12

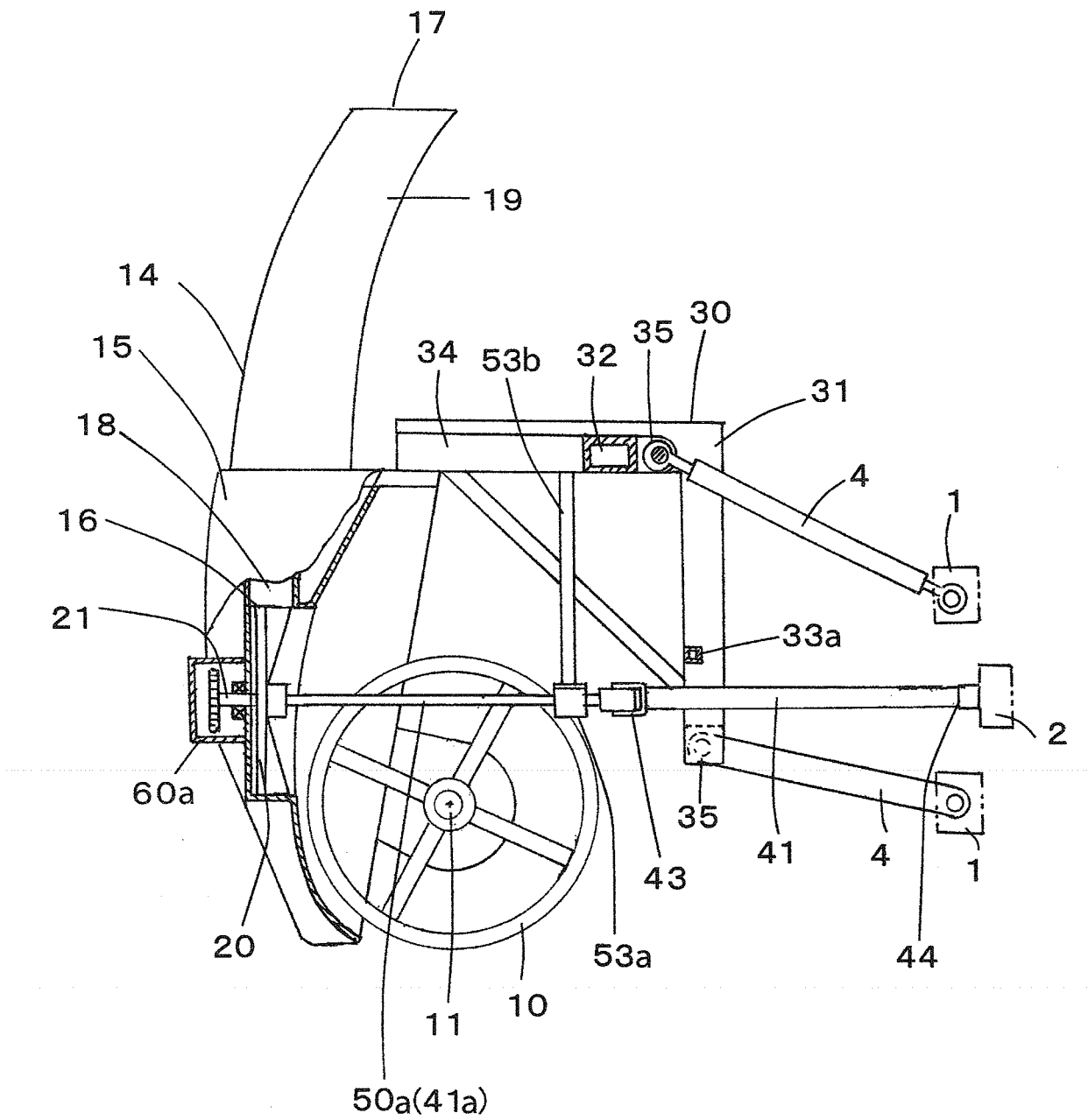


FIG. 13

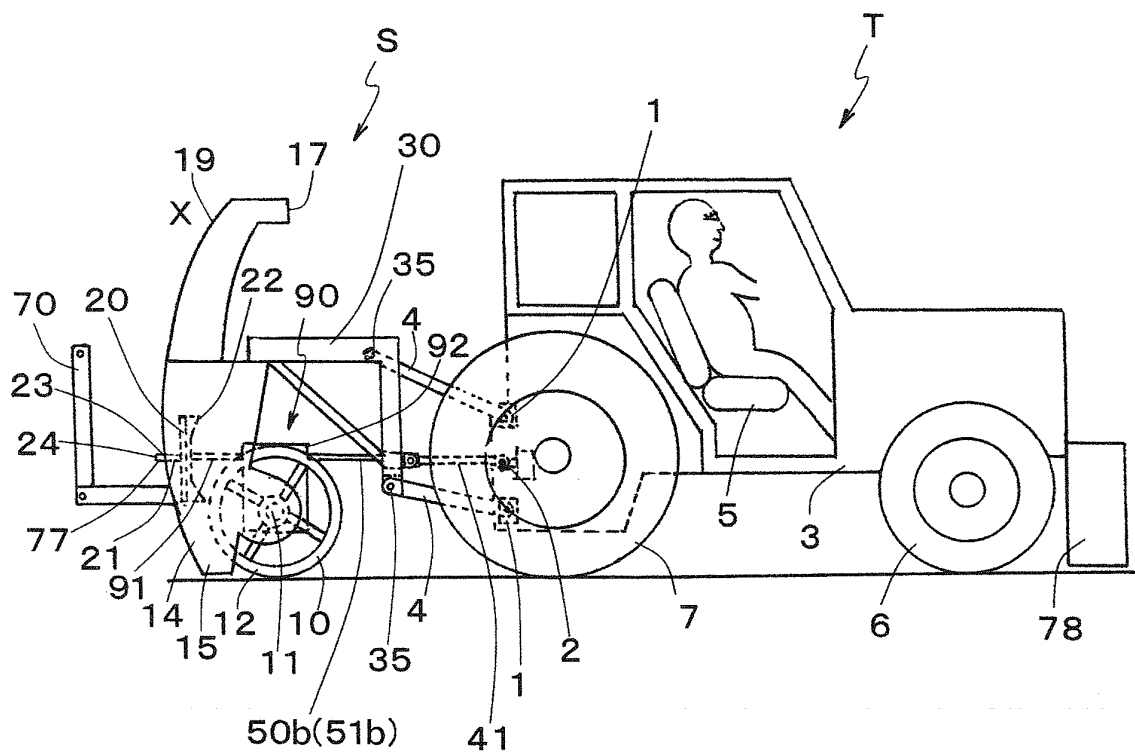


FIG. 14

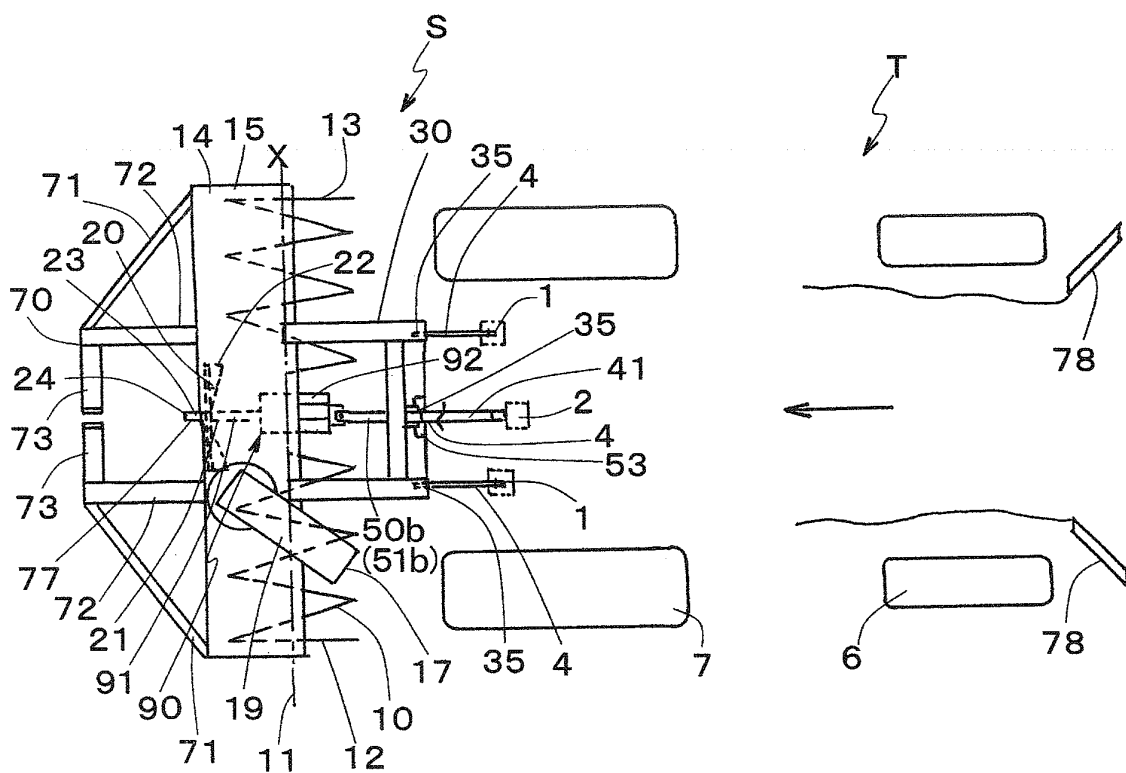


FIG. 15

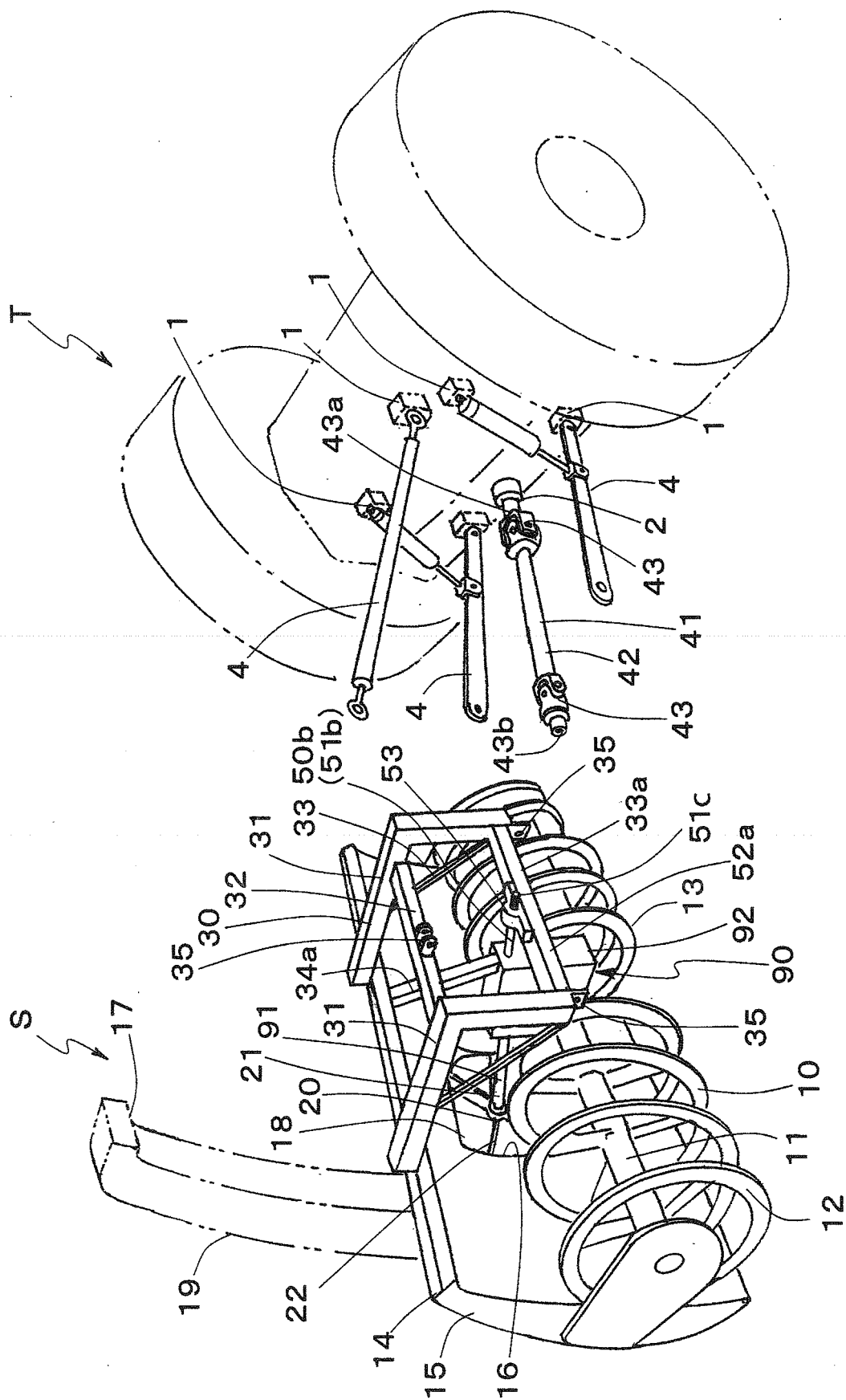


FIG. 16

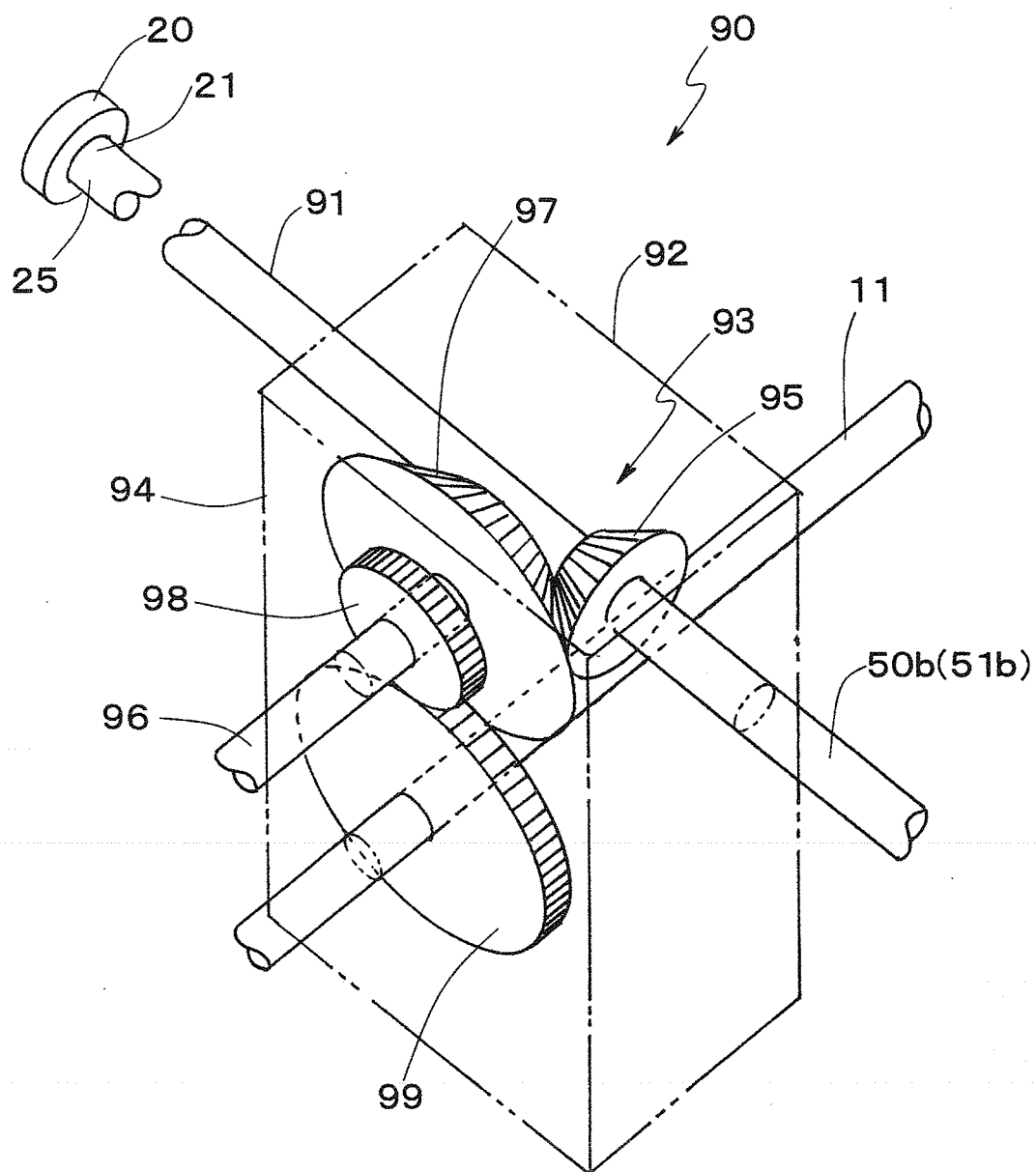


FIG.17

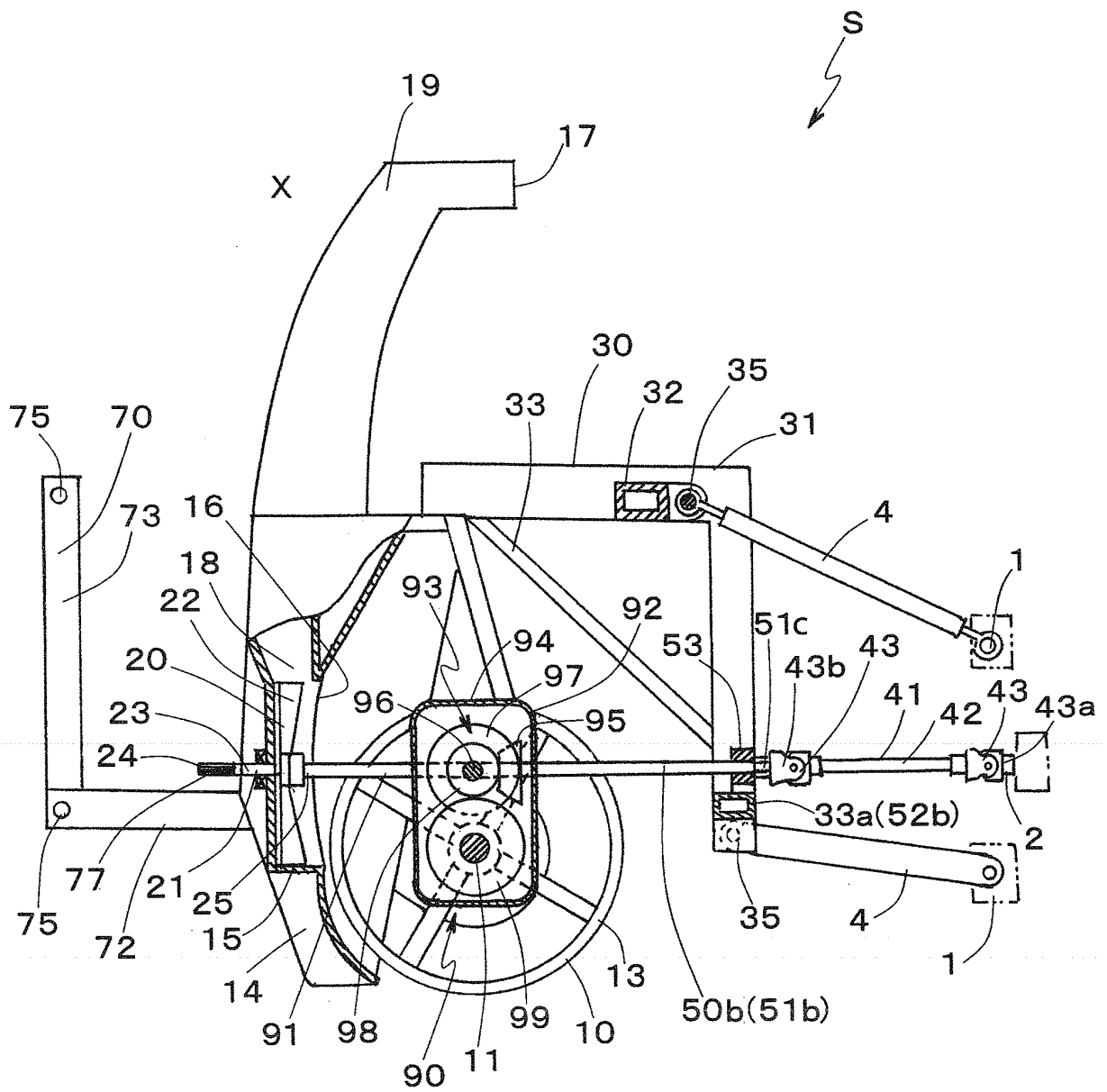


FIG. 18

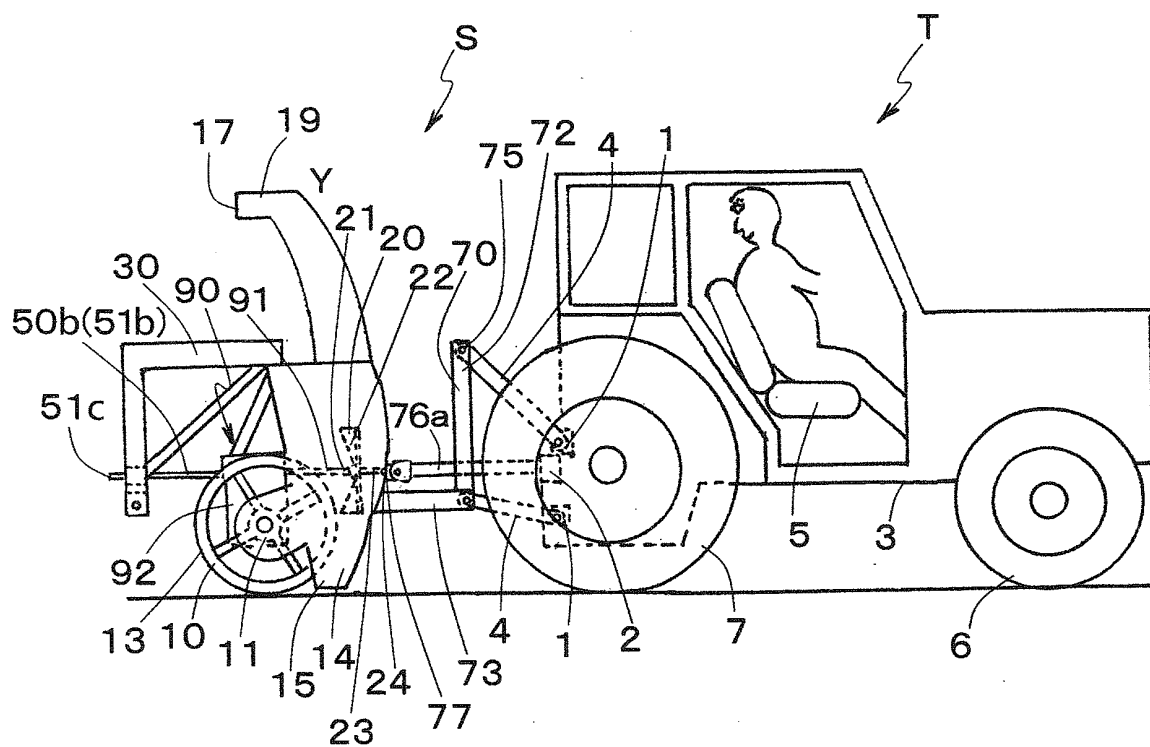


FIG. 19

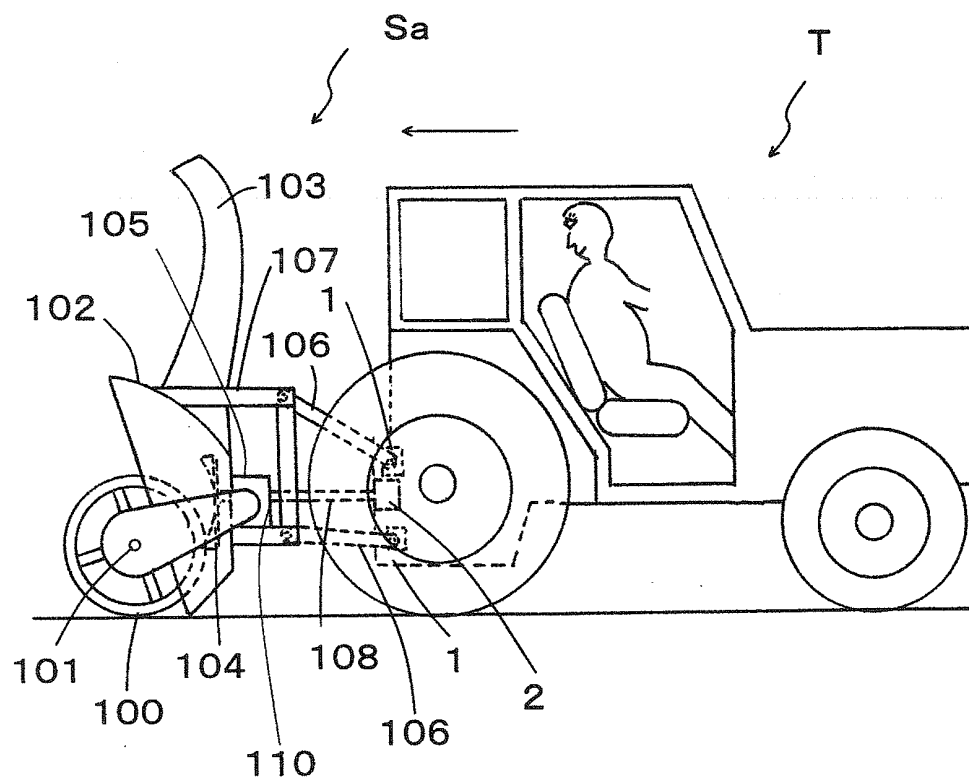
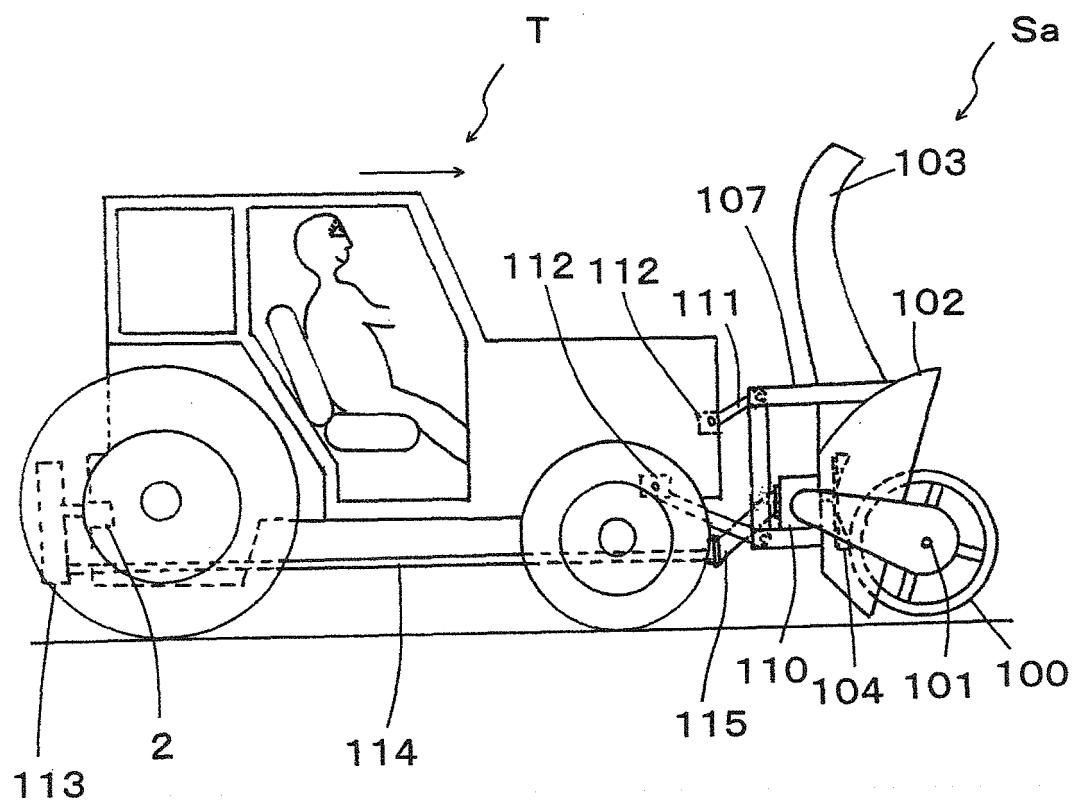


FIG. 20



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/003736

## A. CLASSIFICATION OF SUBJECT MATTER

E01H5/04(2006.01) i, E01H5/09(2006.01) i

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)

E01H5/00-5/12

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2015

Kokai Jitsuyo Shinan Koho 1971-2015 Toroku Jitsuyo Shinan Koho 1994-2015

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

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                 | Relevant to claim No. |
|-----------|--------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 59-17937 Y2 (Hidemi SAITO),<br>24 May 1984 (24.05.1984),<br>entire text<br>& JP 58-94714 U                      | 1-22                  |
| A         | JP 6-19611 Y2 (Nichijo Manufacturing Co.,<br>Ltd.),<br>25 May 1994 (25.05.1994),<br>entire text<br>& JP 64-24124 U | 1-22                  |
| A         | JP 2529454 Y2 (Yoshiaki MIKUNI),<br>20 December 1996 (20.12.1996),<br>entire text<br>& JP 5-54622 U                | 1-22                  |

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

\* Special categories of cited documents:

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Date of the actual completion of the international search  
11 September 2015 (11.09.15)Date of mailing of the international search report  
29 September 2015 (29.09.15)Name and mailing address of the ISA/  
Japan Patent Office  
3-4-3, Kasumigaseki, Chiyoda-ku,  
Tokyo 100-8915, Japan

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## INTERNATIONAL SEARCH REPORT

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PCT/JP2015/003736

| C (Continuation). | DOCUMENTS CONSIDERED TO BE RELEVANT                                                                |                       |
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| P, A              | JP 3193425 U (Hisashi MOMOSE),<br>10 September 2014 (10.09.2014),<br>entire text<br>(Family: none) | 1-22                  |

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**REFERENCES CITED IN THE DESCRIPTION**

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