

DESCRIPTION

VALVE DRIVE DEVICE

TECHNICAL FIELD

The present invention relates to a valve drive device for providing drive power to a valve rod in a valve device constructed in such a way that the valve rod is rotated to open and close the valve, such as a butterfly valve or ball valve, and in particular to a valve drive device in which the valve drive can be switched between manual and automatic modes.

BACKGROUND

The valve drive of valve devices such as butterfly valves is generally divided into two types: manual and automatic types. Recent trends in plant and mechanical automation and new construction have led to increasing demand for, and the ever-increasing significance of, automatic types of devices or valve drive actuators which can be remotely operated or centrally controlled. The automation of plants, devices, and the like involves demand for the safety of the machinery itself, ease of maintenance, and the like, as well as the need for manual operation on the mechanical end of things for emergencies, inspection after maintenance, check ups, and trial runs.

To meet such demand, automated valve devices need to allow valves to be driven primarily electrically but also need to be able to be driven manually as necessary, and a variety of devices for switching between automatic and manual operation have thus been proposed in the past for that purpose. However, all of these structures suffer from problems such as a complex structure, short life, or inconvenient operation.

Applicant previously proposed the technique in Patent Document 1 to overcome such problems. According to the device disclosed in Patent Document 1, a valve can be driven both automatically and manually by a single actuator, and the device can be manually

operated as the electric operation is reliably blocked, thereby ensuring operator safety. However, when a valve drive device has a mechanism combining a manual mechanism component and automatic mechanism component, its use in locations requiring only manual operation results in higher costs and superfluous functions. It is actually safer in some plants and devices to incorporate only manual valve devices, not automated ones, in certain locations, and such cases require a manual type of valve drive device composed only of a manual mechanism component and no automatic mechanism component.

That is, despite the current ongoing automation of plants and devices as well as the increasing demand for automated types of valve devices, this demand is also accompanied by a growing need for manual types of valve devices, and there is presently demand for both.

During device automation or new construction, a predetermined number of manual and automatic actuators are generally ordered, but design modifications are often required on the construction site, with a resulting change in the number of actuators that are needed. This inevitably results in extra parts. When it becomes necessary to interchange areas where manual devices are to be set up and areas where automatic devices are to be set up after various types of actuators have been set up, all of the automatic and manual devices will have to be removed and then set up again and adjusted.

Patent Document 1: Japanese Unexamined Patent Application Publication No.
2787402

DISCLOSURE OF THE INVENTION

The present invention is intended to provide a valve drive device which is designed in such a way that an automatic mechanism can be detachably mounted on a manual-type valve drive mechanism without having to modify the internal mechanism of the valve drive mechanism, and the drive power from drive power generation means in the automatic mechanism can be transmitted to the manual-type valve drive mechanism, allowing the valve

to be driven either manually or automatically, the mounted automatic mechanism being capable of being detached as needed.

The means adopted by the present invention to solve the above problems comprises a basic unit having a drive shaft that is rotatably supported in a casing and that protrudes at one end thereof outside of the casing, and a drive power transmission mechanism that is interlocked with the drive shaft to transmit external drive power to a valve rod connector; and an independent additional unit having in a housing automatic drive power generation means and a decelerator transmission mechanism for transmitting the drive power of the automatic drive power generation mean, characterized in that a manual operation handle is detachably attached to the tip of the drive shaft extending outside of the casing of the basic unit, a key hole is provided in the drive shaft outside the casing, a gear connected to the deceleration transmission mechanism of the independent additional unit is connectable to the drive shaft by a key engaged with the key hole, the independent additional unit is separably connected to the basic unit, and the drive power of the automatic drive power generation means is transmitted to the drive shaft via the power transmission mechanism and gear so that the valve manually driven by the handle can be opened and closed as an automatically driven valve, without any modification of the manual valve drive mechanism, at any point in time during post-production storage and piping installation.

The device is characterized in that the automatic drive power generation means comprises electric drive means and is incorporated into a substantially L-shaped box housing along with drive transmission means for transmitting the drive power to the drive shaft, thereby forming the independent additional unit.

The device is characterized in that an opening degree display device allowing visualizing the extent to which the valve is open in conjunction with the rotation angle of the valve rod connector is provided outside the casing.

The device is characterized in that opening detection means is attached to the exterior of the basic unit, and that the automatic drive power generation means is controlled such that the valve is opened and closed, on the basis of opening/closing location signals output from the opening detection means.

The device is characterized in that the basic unit and additional unit are connected on one side thereof by a spring pin, and are secured on the other side thereof by a screw and retaining plate, so that the basic unit and additional unit are separably connected.

It has generally been necessary to replace the drive device when switching between manual and automatic modes, and in such cases it has been necessary to adjust the completely closed and completely open positions of the valves being replaced. By contrast, in the structure of the invention, the manual drive component is left as such and an automatic drive components is added thereto, so that there is no need to change the sealed points established in the manual drive component, and no need to re-inspect for leaks as a result of the addition of the automatic drive component.

In the past, when changing from a manual device to an automatic device, an automatic device would be purchased and the old device would be removed, a new device would have to be set up, resulting in high costs, and the removed device would be unused, but in the present invention, the additional unit, which is an automatic drive mechanism, can be attached, allowing a manual device to be automated at a far lower cost. Attaching the additional unit to the basic unit does not require the internal mechanism to be modified in any way, and thus eliminates the need for the conventional, tremendously cumbersome adjustment of all the open and closed locations. When it is necessary to change from the automated state to a manual state, the additional unit can be easily removed, with no need for any adjustment after the removal, dramatically reducing the work involved in the switchover.

Furthermore, the degree to which the valve is open can be detected by an opening detection mechanism, and the automatic drive mechanism can be controlled on the basis of opening detection signals to open and close the valve, enabling the remote control of the valve opening and closing operations or display and confirmation of the valve open/close

status.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an outline of the basic unit and additional unit connected to each other;

FIG. 2 is a cross section of the basic unit and additional unit connected to each other;

FIG. 3 is a perspective view of the basic unit;

FIG. 4 is a perspective view with the rear cover detached;

FIG. 5 is a plan of a variant;

FIG. 6 is a side view of the variant;

FIG. 7 is a perspective view of the variant;

FIG. 8 is an exploded view of the variant;

FIG. 9 is a cross section of a portion of the opening detection device in the variant;

and

FIG. 10 is a cross section in a different direction than in FIG. 9 of the opening detection device in the variant.

- | | |
|----|------------------------------------|
| 1 | basic unit |
| 2 | additional unit |
| 3 | casing |
| 4 | drive shaft |
| 5 | drive power transmission mechanism |
| 6 | valve rod connector |
| 7 | handle |
| 8 | key hole |
| 9 | gear |
| 10 | key |
| 11 | threading |

12	traveler nut
13	link arm
14	valve closing regulator
15	valve opening regulator
16	closing stopper
17	opening stopper
18	opening degree display device
19	cylinder
20	connecting hole
21	motor housing
22	electric motor
23	deceleration transmission mechanism
24	motor holding component
25	gear holding component
26	spring pin attachment hole
27	spring pin fitting hole
28	spring pin
29	retaining plate
30	screw
31	opening detection device
32	casing
33	output shaft
34	limiting cam
35	limit switch
36	indicator

- 37 connecting pin
- 38 connecting plate
- 39 screw

BEST MODE FOR CARRYING OUT THE INVENTION

Preferred embodiments of the present invention are described in detail below. With reference to FIGS. 1 to 4, (1) is the basic unit, and (2) is the additional unit that is attached as needed to the basic unit, wherein the additional unit is attached to the basic unit to allow the manual drive mechanism to be modified into an automatic drive mechanism. The basic unit (1) is rotatably supported inside a casing (3), and is equipped with a drive shaft (4) that extends at one end outside the casing (3), and a drive power transmission mechanism (5) that is interlocked with the drive shaft (4) and transmits external drive power to a valve rod connector (6). An operating handle (7) for providing power through manual operation is detachably attached to the tip of the drive shaft (4) extending outside of the casing (3). The drive shaft (4) is build in such a way that a key hole (8) is provided in the exterior of the casing (3), and a gear (9) for transmitting the power from the additional unit (2) to the drive shaft (6) can be connected by a key (10), where the key (10) and gear (9) can be disconnected to allow the automatic mechanism to be readily removed when the automatic mechanism is not needed.

The drive power transmission mechanism (5) is equipped with a traveler nut (12) that is screwed to the threading (11) of the drive shaft (4) and is movable in the axial direction of the drive shaft, and a link arm (13) connected to the traveler nut (12), wherein the link arm (13) is connected to the valve rod connector (6), and the valve rod connector (6) is rotated via the link arm (13) when the traveler nut (12) moves along the shaft through the rotation of the drive shaft (4). The valve rod is integrally connected in the rotating direction to the valve rod connector (6), and the valve is opened and closed by the rotation of the valve rod.

The drive power transmission mechanism (5) disposed inside the casing (3) may be constructed in such a way that the drive power provided to the drive shaft (4) through external manual drive power can be transmitted to the valve rod connector (6) in the casing (3), and a desired drive power transmission mechanism can be adopted without being limited to the traveler nut and link arm. For example, a worm gear mechanism may be adopted, wherein the rotating direction of the drive shaft (4) is changed by a worm secured to a certain part of the drive shaft (4) and a worm wheel engaged with the worm to transmit the rotating power to the valve rod connector (6). A scotch yoke mechanism may also be adopted, wherein the traveler nut is screwed to the threading of the drive shaft (6), and a scotch yoke is interlocked with the traveler nut to transmit the rotating power of the drive shaft (4) to the valve rod connector (6).

A valve closing regulator (14) and valve opening regulator (15) for regulating the rotation angle are secured to the valve rod connector (6), wherein the opening and closing of the valve are regulated through collision with either a closing stopper (16) having an adjustable length protruding outside the casing (3) and an opening stopper (17) formed inside the casing (3). In FIG. 2, the solid line represents the closed state, and the chain double-dashed line represents the open state. The degree to which the valve is open is displayed by an opening degree display device (18) disposed on an outside surface of the casing (3) so as to be viewed from outside the casing (3), and the degree to which the valve is open can be externally viewed. The opening degree display device has opening detection means described below, and may output electrical or pneumatic opening signals. The valve rod connector (6) has a cylinder (19) rotatably disposed in the casing (3) virtually perpendicular to the drive shaft (4), a valve rod connecting hole (20) is formed in the center of the cylinder (19), and the tip of the valve rod is inserted and integrally connected in the rotating direction to the cylinder. Here, the connecting hole (20) in the figure is rectangular but is, of course, not limited to that shape.

The additional unit (2) has, incorporated inside a generally L-shaped rectangular box motor housing (21), the gear (9), an electric motor (22) for providing drive power to the gear (9), and a deceleration transmission mechanism (23) for transmitting the power to the gear (9) while decelerating the rotation of the electric motor (22). The deceleration transmission mechanism (23) is composed of an assembly of a plurality of conventionally known gears, and transmits power while decelerating the rotation of the electric motor (22). The motor housing (21) is composed of a motor holding component (24) and a gear holding component (25) formed so as to protrude in an L shape from the motor holding component (24), being in the form of a generally L-shaped box overall.

A spring pin attachment hole (26) is formed in a certain location on the outside surface of the gear holding component (25), and a spring pin (28) inserted into a spring pin fitting hole (27) in the casing (3) of the basic unit (1) is fastened, allowing the basic unit (1) and additional unit (2) to be detachably connected. The additional unit (2) is secured with a screw (30) to a retaining plate (29) that is fixed to the basic unit (1) on the side opposite the spring pin (28) in order to secure the additional unit to the basic unit.

In the illustrated embodiment, an electric motor (22) was used as the drive power generation means incorporated into the additional unit (2), but other types of drive power generation means such as air driven types may also be used, and it need hardly be mentioned that other mechanisms may accordingly be used for transmitting the drive power from the drive power generation means to the drive shaft (6) of the basic unit (1).

FIGS. 5 to 10 illustrate a variant of the invention wherein, as an alternative to the opening degree display device (18) in FIGS. 1 and 2, an opening detection device (31) is attached to the outer surface of the casing (3) of the basic unit (1), and the rotation angle of the valve rod connector, that is, of the valve rod, is detected to output valve opening signals, and the operation of the drive power generation means of the additional unit is controlled on

the basis of the opening signals that have been output. The opening detection device (31) may be, but is not limited to, one that outputs electrical signals, pneumatic signals, or other desired signals. The degree to which the valve is open can be detected by the opening detection device, the automatic drive mechanism can be controlled on the basis of the opening signals, and the opening signals can be used as the basis for controlling the automatic drive mechanisms and for opening and closing the valve, thereby enabling the remote display and confirmation of the open and closed states or valve opening and closing operations.

With reference to FIGS. 5 to 10, the opening detection device (31) has a generally rectangular box casing (32), and a longitudinally extending output shaft (33) is rotatably supported inside the casing (32). The output shaft (33) is integrally connected in the rotating direction to the valve rod connector (6). Two limiting cams (34) on the closing and opening sides are secured to the output shaft (33), closing and opening limit switches (35) operated by the cams are disposed inside the casing (32), and the limiting cams (34) operate the limit switches (35) through the rotation of the output shaft (33) rotating in unison with the valve rod to output valve opening or closing signals. The output signals are displayed on a remotely connected opening degree display panel, allowing the extent to which the valve is open to be checked remotely. Furthermore, a valve operating panel may be operated to control the operation of the automatic drive power generation mechanism and remotely control the valve.

An indicator (36) is attached to the outer end of the output shaft (33) extending outside of the casing (32), allowing the degree to which the valve is open to be viewed from locations near the valve device. As illustrated in FIG. 9, the casing (32) is connected to the casing (3) by a screw (39) and connecting pin (37) such as a spring pin inserted between there and the casing (3) of the basic unit (1).

CLAIMS

1. A valve drive device comprising: a basic unit having a drive shaft that is rotatably supported in a casing and that protrudes at one end thereof outside of the casing, and a drive power transmission mechanism that is interlocked with the drive shaft to transmit external drive power to a valve rod connector; and an independent additional unit having in a housing automatic drive power generation means and a decelerator transmission mechanism for transmitting the drive power of the automatic drive power generation means, characterized in that a manual operation handle is detachably attached to the tip of the drive shaft extending outside of the casing of the basic unit, a key hole is provided in the drive shaft outside the casing, a gear connected to the deceleration transmission mechanism of the independent additional unit is connectable to the drive shaft by a key engaged with the key hole, the independent additional unit is separably connected to the basic unit, the drive power of the automatic drive power generation means is transmitted to the drive shaft via the power transmission mechanism and gear so that the valve manually driven by the handle can be opened and closed as an automatically driven valve, without any modification of the manual valve drive mechanism, at any point in time during post-production storage and piping installation, and the automatic drive power generation means comprises electric drive means and is incorporated into a substantially L-shaped box housing along with drive transmission means for transmitting the drive power to the drive shaft, thereby forming the independent additional unit.

2. The valve drive device according to claim 1, characterized in that an opening degree display device allowing visualizing the extent to which the valve is open in conjunction with the rotation angle of the valve rod connector is

provided outside the casing.

3. The valve drive device according to any of claims 1 or 2, characterized in that opening detection means is attached to the exterior of the basic unit, and that the automatic drive power generation means is controlled such that the valve is opened and closed, on the basis of opening/closing location signals output from the opening detection means.

4. The valve drive device according to any of claims 1 to 3, characterized in that the basic unit and additional unit are connected on one side thereof by a spring pin, and are secured on the other side thereof by a screw and retaining plate, so that the basic unit and additional unit are separably connected.