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# RECIPROCATING TYPE PULL ROD DRIVING APPARATUS AND CURTAIN SYSTEM INCLUDING SAME


## Abstract

A reciprocating type pull rod driving apparatus, including a housing, a shaft rod, a driving wheel, a chain, and an operating assembly. One end of the shaft rod extends to the housing. The driving wheel is arranged on the shaft rod. The chain is meshed with multiple engagement teeth of the driving wheel. The operating assembly is connected to the chain and configured to operate the chain to drive the driving wheel to rotate. A distance between a radial outer end edge of the driving wheel and an inner wall of the housing is greater than or equal to a thickness of the chain, and a quantity of driving wheel teeth that the chain is meshed with is less than a half of a total quantity of teeth.



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## Background/Summary

REFERENCE TO RELATED APPLICATION [0001] This application is the National Phase of PCT International Application No. PCT/CN2023/083840, filed on Mar. 24, 2023, which claims priority under 35 U.S.C. 119(e) to U.S. Provisional Application No. 63/332,736, filed on Apr. 20, 2022, all of which are hereby expressly incorporated by reference into the present application.

BACKGROUND

Technical Field

[0002] The instant disclosure relates to a reciprocating type pull rod driving apparatus and a curtain system including same, and in particular to a manual pull rod driving apparatus applicable to the deployment or retraction of vertical lifting or horizontal sliding curtains, awnings, screens, or other soft materials.

Related Art

[0003] Most common curtain systems in the market, whether they are lifting roller curtains or horizontally sliding curtains, are mostly driven to open or close by a drawstring. However, due to the travel distance of the curtains, the pull cords must be long enough. Unfortunately, such long pull cords can sometimes lead to accidents, especially for young children, such as pull cords getting tangled around children's limbs or necks.

[0004] Taking a conventional roller blind as an example, referring to FIG. **1**, which is a cross-sectional view of a conventional roller blind drive assembly. As shown in FIG. **1**, a sprocket **91** is mounted on a roller **90**, and a bead chain **92** engages with the sprocket **91**. Therefore, the user can drive the roller **90** to rotate clockwise or counterclockwise by pulling the two ends of the bead chain **92**, thereby winding or releasing the roller blind.

[0005] Furthermore, still as shown in FIG. **1**, to ensure that the bead chain **92** is tightly engaged with the sprocket **91** so as to prevent the bead chain **92** from slipping off the sprocket **91**, the gap between the inner wall of the housing **93** and the radial outer end edge of the sprocket **91** is usually set to be very small, or even almost completely in contact. Therefore, in addition to driving the bead chain **92** to fully fall into the teeth of the sprocket **91**, the inner wall surface of the housing **93** can also keep the bead chain **92** in the teeth of the sprocket **91** throughout the entire driving process, preventing the bead chain **92** from coming off the teeth.

[0006] Therefore, conventional window curtain systems driven by pull cords cannot shorten the length of the pull cord, and the danger of window curtain pull cords to life safety always exists. Therefore, the new window curtain safety standard regulations passed by the Window Covering Manufacturers Association (WCMA) in the United States stipulate that all physical retail stores in the United States will be prohibited from selling pull cord window curtains starting in **2019**, and only “cordless” window curtains can be sold (online stores are exempt). However, existing “cordless” curtains still have shortcomings, such as the difficulty in adjusting the speed of rolling, the difficulty in accurately positioning the curtain covering, the unsuitability for installation at high heights, lower reliability and service life, and relatively high prices.

SUMMARY

[0007] A main object of the instant disclosure is to provide a reciprocating type pull rod driving apparatus and a curtain system including the same, so as to convert the conventional pull cord drive into a pull rod drive through an innovative mechanism, thereby driving the window curtain to rise or slide horizontally in a safer, more reliable, more convenient, and more cost-effective manner.

[0008] To achieve the above object, the reciprocating type pull rod driving apparatus of the instant disclosure mainly includes a housing, a shaft rod, a driving wheel, a chain, and an operating

assembly, where one end of the shaft rod extends to the housing; the driving wheel is arranged on the shaft rod and accommodated in the housing; the driving wheel includes a plurality of engagement teeth; the chain is engaged with the plurality of engagement teeth of the driving wheel; and the operating assembly is connected to the chain and suitable for operating the chain to rotate the driving wheel. A distance between a radial outer end edge of the driving wheel and an inner wall of the housing is greater than or equal to a thickness of the chain. A quantity of the plurality of engagement teeth of the driving wheel that the chain is engaged with is less than or equal to a half of a total quantity of the plurality of engagement teeth.

[0009] Therefore, in the instant disclosure, by setting the distance between the radial outer end edge of the drive wheel and the inner wall of the housing to be greater than or equal to the thickness of the chain, allows the chain to be easily disengaged from and re-engaged with the drive wheel. Moreover, in the instant disclosure, the quantity of the plurality of engagement teeth of the driving wheel that the chain is engaged with is set to be less than a half of the total quantity of the plurality of engagement teeth, thereby reducing the quantity of teeth of the drive wheel engaged by the chain. In this way, the chain can be entirely disengaged from the driving wheel more easily and can also be easily reset to again pull the driving wheel, so that the chain can perform a reciprocating action, changing the single-bite operation of the conventional long pull cord, thus significantly shortening the chain length and significantly improving the operating convenience and safety.

[0010] To achieve the above object, a curtain system including the reciprocating type pull rod driving apparatus of the instant disclosure mainly includes the reciprocating type pull rod driving apparatus and curtain cloth, where the curtain cloth is driven by the reciprocating type pull rod driving apparatus to be alternatively wound onto or unwound from the shaft rod. In other words, the aforementioned reciprocating type pull rod driving apparatus can be arranged on a vertically lifting roller blind. In addition, the instant disclosure is not limited to curtains, other rolling purdahs, tarpaulins, or other equivalent soft material parts are all applicable to the instant disclosure.

[0011] To achieve the above object, a curtain system including the reciprocating type pull rod driving apparatus of the instant disclosure mainly includes a horizontal guide rail, at least one sliding member, a drawstring, at least one piece of curtain cloth, and the reciprocating type pull rod driving apparatus, where the drawstring is wound around the shaft rod of the reciprocating type pull rod driving apparatus; and the reciprocating type pull rod driving apparatus is suitable for pulling the drawstring through the shaft rod, thereby driving the at least one sliding member to pull the at least one piece of curtain cloth to slide horizontally. In other words, the aforementioned reciprocating type pull rod driving apparatus can also be configured in a horizontally opening curtain, screen, or awning system, and is applicable to both single-opening and double-opening horizontal configurations.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a cross-sectional view of a conventional roller blind drive assembly.

[0013] FIG. **2** is a perspective view of a first embodiment of a reciprocating type pull rod driving apparatus of the instant disclosure applied to a roller curtain system.

[0014] FIG. **3**A is a cross-sectional view of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure in a static state.

[0015] FIG. **3**B is a cross-sectional view of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure in an operating state.

[0016] FIG. **4** is a side view of the limiting member and the stop member of the first embodiment

of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0017] FIG. **5** is a cross-sectional view of a second embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0018] FIG. **6** is a cross-sectional view of a third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0019] FIG. **7**A is a perspective view of the chain detachment mechanism and the driving wheel in the third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0020] FIG. **7**B is an exploded view of the chain detachment mechanism and the driving wheel in the third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0021] FIG. **8**A is a cross-sectional view taken along A-A of FIG. **7**A, in which the reciprocating type pull rod driving apparatus is in a static state.
[0022] FIG. **8**B is a cross-sectional view taken along A-A of FIG. **7**A, in which the reciprocating type pull rod driving apparatus is in an operating state.
[0023] FIG. **9**A is an enlarged cross-sectional view of a chain detachment mechanism and the driving wheel in a fourth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0024] FIG. **9**B is an enlarged cross-sectional view of a chain detachment mechanism and the driving wheel in a fifth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0025] FIG. **10**A is a perspective view of a sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0026] FIG. **10**B is a perspective view of a sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, with a housing removed.
[0027] FIG. **10**C is a perspective view of the chain detachment mechanism and the driving wheel in the sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0028] FIG. **11**A is a perspective view of the chain detachment mechanism and the driving wheel in a seventh embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure.
[0029] FIG. **11**B is a diagram of the seventh embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure applied to a curtain system that is horizontally opened in two opposite directions.
[0030] FIG. **12** is a diagram of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure applied to another roller curtain system.

## DETAILED DESCRIPTION

[0031] Before a reciprocating type pull rod driving apparatus of the instant disclosure and a curtain system including such apparatus are described in detail in embodiments, it should be particularly noted that in the following description, similar components are denoted by the same reference numerals. In addition, the drawings of the instant disclosure are illustrative only, and are not necessarily drawn to scale, and all details are not necessarily presented in the drawings.
[0032] Reference is made to FIG. **2**, FIG. **3**A, and FIG. **3**B, where FIG. **2** is a perspective view of a first embodiment of a reciprocating type pull rod driving apparatus of the instant disclosure applied to a roller curtain system, FIG. **3**A is a cross-sectional view of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure in a static state, and FIG. **3**B is a cross-sectional view of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure in an operating state. As shown in the figures, the reciprocating type pull rod driving apparatus **1** of the instant disclosure mainly includes a fixed bracket F, a housing C, a shaft rod R, a driving wheel **2**, a chain **3**, and an operating assembly **4**.
[0033] The fixed bracket F is arranged on a wall (not shown in the figures). The housing C is arranged on the fixed bracket F. The housing C includes two openings C**1**, which are respectively provided on two corresponding sides. The shaft rod R is pivotally arranged on the fixed bracket F. One end of the shaft rod R extends into the housing C. A portion of the shaft rod R exposed outside

the housing C is configured to wind curtain cloth S. It is particularly noted that, the shaft rod R in this embodiment is a shaft rod R with rotational damping, that is, once the shaft rod R is rotated by an external force, the damping inside the shaft rod R can prevent the shaft rod R from rotating due to the gravity of the curtain cloth S. In addition, the driving wheel **2** is arranged at one end of the shaft rod R and accommodated in the housing C. The driving wheel **2** includes a plurality of engagement teeth **21**. The chain **3** is engaged with the plurality of engagement teeth **21** of the driving wheel **2**. The operating assembly **4** is connected to the chain **3** and suitable for operating the chain **3** to drive the driving wheel **2** to rotate.

[0034] The operating assembly **4** in this embodiment mainly includes two sleeves **41**, two pull rods **42**, two springs **43**, a connecting member **45**, an elastic restoring element **46**, and two blocking pieces **47**. The two pull rods **42** are respectively connected to two ends of the chain **3**. The two sleeves **41** also respectively sleeve the two ends of the chain **3**. The two springs **43** and the two blocking pieces **47** are respectively accommodated in the two sleeves **41**. Each of the sleeves **41** has a step portion **405**, the blocking pieces **47** are abut against the step portions **405** of the corresponding sleeves **41**, one end of each of the springs **43** abuts against the corresponding sleeve **41** and the other end abuts against the corresponding blocking piece **47**. Moreover, each of the blocking pieces **47** includes a bored hole **470**, and two ends of the chain **3** pass through the bored hole **470**. In addition, the connecting member **45** may be a plate or a rod, with two ends respectively connected to the two sleeves **41**, while two ends of the elastic restoring element **46** are respectively connected to the connecting member **45** and the housing C, and the elastic restoring element **46** is configured to apply bias to the connecting member **45** to drive it closer to the housing C. The chain **3** in this embodiment is a bead chain, but the instant disclosure is not limited thereto. For example, a belt or other equivalent power transmission components are all applicable to the instant disclosure.

[0035] The operation of this embodiment is described as follows: referring to FIG. **3**A, in a static state, that is, when the drive wheel **2** is not rotating, a quantity of the plurality of engagement teeth **21** of the driving wheel **2** that the chain **3** is engaged with is less than one third of a total quantity of the engagement teeth **21**; and a distance d between a radial outer end edge of the driving wheel **2** and an inner wall of a top surface of the housing C is greater than a thickness t of the chain **3**. When winding the curtain cloth S, a user only needs to pull the right pull rod **42**, as shown in FIG. **3**B. At this moment, the pull rod **42** pulls the chain **3**, the chain **3** moves down after passing through the bored hole **470** of the blocking piece **47**, the chain **3** in turn drives the driving wheel **2** to rotate clockwise, and the curtain cloth S is wound on the shaft rod R. Moreover, the other end of the chain **3** pulls the pull rod **42** on the other side, so that the pull rod **42**, together with the corresponding blocking piece **47**, moves up and compresses the corresponding spring **43**, thereby accumulating restoring force In addition, the two sleeves **41**, together with the connecting member **45**, will also be subjected to a force to descend, and at this moment, the quantity of the teeth of the driving wheel **2** that the chain **3** is engaged with is still less than a half of the total quantity of the engagement teeth **21**. In other words, since the quantity of the teeth of the driving wheel **2** that the chain **3** is engaged with is more than that in the static state, power is transmitted more reliable, and the chain **3** is less likely to slip off from the driving wheel **2**.

[0036] Subsequently, if it is still necessary to continue winding the curtain cloth S, the user only needs to release the corresponding pull rod **42**. At this moment, the elastic restoring element **46** assists in pulling the corresponding sleeve **41**, the corresponding pull rod **42** and the connecting member **45** to return to their original positions, and the chain **3** automatically slips off from the engagement teeth **21** of the driving wheel **2**, while the compressed spring **43** in the sleeve **41** releases its elastic force to push the chain **3** to return to its original position, as shown in FIG. **3**A. In other words, in this embodiment, after the pull rod **42** is pulled down and released, it will automatically return to its original position, and there is no need for the user to manually move the pull rod **42** upward to return it to its original position. Moreover, the user only needs to pull down

the pull rod **42** again, as described in the previous paragraph, to make the apparatus in a state shown in FIG. **3**B, so that the shaft rod R can be pulled again to wind the curtain cloth S. By continuously reciprocating in this way, the curtain cloth S can be continuously wound.

[0037] On the other hand, if it is necessary to unwind (release) the curtain cloth S, the user only needs to pull the pull rod **42** on the other side and perform the aforementioned operation to continuously release the curtain cloth S.

[0038] Overall, in this embodiment, since the distance d between the radial outer end edge of the driving wheel **2** and the inner wall of the top surface of the housing C is set to be greater than the thickness t of the chain **3**, the chain **3** can be entirely disengaged from the driving wheel **2**, thereby realizing reciprocating operation. Moreover, in a state of not driving the driving wheel **2**, in this embodiment, the quantity of the teeth of the driving wheel **2** that the chain **3** is engaged with is set to be less than one third of the total quantity of the engagement teeth, that is, reducing the number of teeth of the chain **3** engaged with the drive wheel **2**. According to this, the chain **3** can be more easily detached from the drive wheel **2** and can be easily returned to its original position and then pull the drive wheel **2** again, so that the chain **3** can form a reciprocating operation.

[0039] Reference is made to both FIG. **2** and FIG. **4**, where FIG. **4** is a side view of a limiting member and a stop member of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. As shown in the figure, the limiting member F**1** is provided on one side of the fixed bracket F, and the stop member S**1** is arranged on a lower side of the curtain cloth S. When the curtain cloth S is wound on the shaft rod R and the stop member S**1** abuts against the limiting member F**1**, the limiting member F**1** blocks the stop member S**1**, so that the curtain cloth S cannot be further wound on the shaft rod R, thereby preventing the curtain cloth S from being overwound and causing the shaft rod R to idle, or even preventing the curtain cloth S from being excessively wound so that the lower gravity rod RW jams the fixed bracket F, causing damage to the apparatus.

[0040] Reference is made to FIG. **5**, where FIG. **5** is a cross-sectional view of a second embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. The main difference between this embodiment and the aforementioned first embodiment is that this embodiment further comprises a support seat **5**, which is disposed below the drive wheel **2**; two ends of the support seat **5** are each provided with a through hole **50**; two ends of the chain **3** respectively pass through the through holes **50** in the two ends of the support seat **5**; while the operating assembly **4** is suspended below the support seat **5**. Accordingly, in this embodiment, the support seat **5** can be used to spread apart the chain **3** to reduce the number of teeth of the chain **3** engaged with the drive wheel **2**, so that the chain **3** can be more easily disengaged from the drive wheel **2** and can be easily returned to its original position and then pull the drive wheel **2** again. Moreover, the support seat **5** can also fix the operating assembly **4**, so that the operating assembly **4** will not swing during operation, and the connecting member **45** and the elastic restoring member **46** in the previous embodiment can be omitted.

[0041] Reference is made to FIG. **6**, FIG. **7**A, and FIG. **7**B, where FIG. **6** is a cross-sectional view of a third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, FIG. **7**A is a perspective view of a chain detachment mechanism and a driving wheel in the third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, and FIG. **7**B is an exploded view of the chain detachment mechanism and the driving wheel in the third embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. The main difference between this embodiment and the aforementioned first embodiment is that this embodiment further employs chain detachment mechanism **6**, which is configured to push the chain **3** out of the engagement teeth **21** of the driving wheel **2**, to assist in returning the pull rod (not shown in the figure) to its original position.

[0042] It is further noted that the chain detachment mechanism **6** in this embodiment includes a U-shaped baffle **61** and an elastic body **62**. The U-shaped baffle **61** includes a long slot **610**. The

driving wheel **2** includes an outer circumferential groove **22** in communication with the plurality of engagement teeth **21**. The U-shaped baffle **61** sleeves the outer circumferential groove **22** of the driving wheel **2**, and the U-shaped baffle **61** can slide relative to the driving wheel **2** through the long slot **610**. The elastic body **62** is a compression spring, but it can also be a leaf spring or other equivalent element that can provide elasticity or restoration, which is accommodated in the housing C, with one end abutting against the housing C and the other end abutting against the U-shaped baffle **61**, and constantly drives the U-shaped baffle **61** upward to push the chain **3** outward and at least partially separate from the plurality of engagement teeth **21**. Similarly, in this embodiment, the distance d between the radial outer end edge of the driving wheel **2** and the inner wall of the top surface of the housing C is greater than the thickness t of the chain **3**, so the chain **3** is allowed to be entirely disengaged from the plurality of engagement teeth **21** of the driving wheel **2**.

[0043] Reference is made to both FIG. **8**A and FIG. **8**B, where FIG. **8**A is a cross-sectional view taken along A-A of FIG. **7**A, in which the reciprocating type pull rod driving apparatus is in a static state, and FIG. **8**B is a cross-sectional view taken along A-A of FIG. **7**A, in which the reciprocating type pull rod driving apparatus is in an operating state. When the pull rod (not shown in the figures) is not pulled downward, the elastic body **62** stretched, causing the U-shaped baffle **61** to move upward and abut against the chain **3**, allowing the chain **3** to disengage from the engagement teeth **21**, as shown in FIG. **8**A. However, when a user pulls down the pull rod (not shown in the figures), a downward force exceeds the elastic force of the elastic body **62**, and the chain **3** makes the U-shaped baffle **61** move downward, allowing the chain **3** to engaged with the engagement teeth **21**, thereby driving the driving wheel **2** to rotate, as shown in FIG. **8**B.

[0044] As described above, in this embodiment, when the driving wheel **2** is driven to rotate by the chain **3**, the quantity of the engagement teeth **21** of the driving wheel **2** that the chain **3** is engaged with is less than or equal to a half of the total quantity of the engagement teeth **21**; and when the driving wheel is not rotating, the chain detachment mechanism **6** pushes out the chain **3** and causes the chain **3** be at least partially disengaged from the engagement teeth **21**. In other words, the chain detachment mechanism **6** of this embodiment acts as a clutch. When a user pulls down the pull rod, the chain detachment mechanism **6** can cause the chain **3** be engaged with the engagement teeth **21** of the driving wheel **2**; and when the user releases the pull rod, the chain detachment mechanism **6** can causes the chain **3** be disengaged from the engagement teeth **21** of the driving wheel **2**, while the pull rod (not shown in the figures) and the chain **3** can be automatically return to their original positions, which is convenient for the user to operate and can significantly reduce noise.

[0045] Reference is made to FIG. **9**A, where FIG. **9**A is an enlarged cross-sectional view

[0046] of a chain detachment mechanism and a driving wheel in a fourth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. The chain detachment mechanism **6** in this embodiment includes a plurality of convex leaf springs **65** that are respectively accommodated in accommodating grooves **210** in the plurality of engagement teeth **21**, and each of the convex leaf springs **65** constantly pushes the chain **3** outward and causes it be at least partially disengaged from the engagement teeth **21**.

[0047] Reference is made to FIG. **9**B, where FIG. **9**B is an enlarged cross-sectional view of a chain detachment mechanism and a driving wheel in a fifth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. The chain detachment mechanism **6** in this embodiment includes a plurality of top columns **66** and a plurality of springs **67** that are respectively accommodated in accommodating grooves **210** in the plurality of engagement teeth **21**, and each of the top columns **66** constantly pushes the chain **3** outward and causes it be at least partially disengaged from the engagement teeth **21** by the tension of the spring **67**. Accordingly, the chain detachment mechanism **6** of the instant disclosure is not limited to the aforementioned embodiments, and any mechanisms or assemblies that can push the chain **3** outward and causes it be at least partially disengaged from the engagement teeth **21** when the chain **3** is not subjected to a force is included in the scope of the instant disclosure.

[0048] Reference is made to FIG. **10**A, FIG. **10**B, and FIG. **10**C, where FIG. **10**A is a perspective view of a sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, FIG. **10**B is a perspective view of a sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, with a housing removed, and FIG. **10**C is a perspective view of a chain detachment mechanism and a driving wheel in the sixth embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure. In order to allow the pull rod **42** to return to its original position more smoothly, that is, as long as the user pulls down the pull rod **42** intermittently during operation, the curtain cloth S can be continuously wound on the shaft rod R or continuously unwound from the shaft rod R, the instant disclosure provides a configuration of double driving wheels in the sixth embodiment.

[0049] It is further noted that, in this embodiment, two sets of reciprocating type pull rod driving apparatuses such as the third embodiment described above are integrated, which include two driving wheels **2** and **20**, two chains **3** and **30**, two operating assemblies **4** and **40**, and two chain push-out assemblies **6**. The two driving wheels **2** and **20** are both arranged on the shaft rod R. The two chains **3** and **30** are respectively engaged with the two driving wheels **2** and **20**. The two operating assemblies **4** and **40** are hinged to a lower end surface of the housing C. Each of the chain push-out assemblies **6** includes U-shaped baffles **61** and **63** and elastic bodies **62** and **64**. The U-shaped baffles **61** and **63** are respectively fitted on the outer circumferential grooves **22** of the two driving wheels **2** and **20**. These U-shaped baffles **61** and **63** can slide relative to the two driving wheels **2** and **20**. One end of each of the elastic bodies **62** and **64** abuts against the housing C, and the other end of each of the elastic bodies respectively abuts against each of the two U-shaped baffles **61** and **63** and constantly drives each of the two U-shaped baffles **61** and **63** to respectively push the two chains **3** and **30** upward and cause the chains **3** and **30** be at least partially disengaged from the plurality of the engagement teeth **21** of the two driving wheels **2** and **20**.

[0050] Each the operating assemblies **4** and **40** includes two sleeves **41** and **401**, stop blocks **44** and **404**, pull rods **42** and **402**, and springs **43** and **403**. The two pull rods **42** and **402** are respectively connected to one end of each of the two chains **3** and **30** and are located at different sides. The two stop blocks **44** and **404** are respectively connected to the other end of each of the two chains **3** and **30** and also located at different sides. Two ends of each of the chains **3** and **30** are respectively sleeved with the sleeves **41** and **401**. The springs **43** and **403** are accommodated in the sleeves **41** and **401** that are on the same side as the stop blocks **44** and **404**, where one end of each of the springs **43** and **403** abuts against each of the sleeves **41** and **401** and the other end abuts against each of the stop blocks **44** and **404**.

[0051] Accordingly, in this embodiment, since the two pull rods **42** and **402** are arranged at different sides, that is, one on a front side and the other on a rear side, when the two pull rods **42** and **402** are pulled respectively, the shaft rod R can be driven to rotate in different directions. In other words, after the pull rod **42** is pulled, the shaft rod R rotates clockwise; and after the pull rod **402** is pulled, the shaft rod R rotates counterclockwise. In addition, with the help of the elastic force of the elastic bodies **62** and **64**, when the two pull rods **42** and **402** are pulled respectively, the reset action of the U-shaped baffles **61** and **63** will cause the chains **3** and **30** to be disengaged from the driving wheels **2** and **20**, while the springs **43** and **403** will push the stop blocks **44** and **404** to reset, thereby causing the pull rods **42** and **402** to be reset automatically. Therefore, during operation, the user only needs to pull down the pull rods **42** and **402** intermittently to continuously wind or unwind the curtain cloth.

[0052] Reference is made to both FIG. **11**A and FIG. **11**B, where FIG. **11**A is a perspective view of a chain detachment mechanism and a driving wheel in a seventh embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure, and FIG. **11**B is a diagram of the seventh embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure applied to a curtain system that is horizontally opened in two opposite directions. The following embodiments are used to illustrate that the instant disclosure can also be applied to horizontal pull rod curtains.

As shown in FIG. **11**A, the main difference between this embodiment and the sixth embodiment is that this embodiment further includes a driven wheel **7**, and convex teeth **23** that can be engaged with the driven wheel **7** are arranged between the driving wheels **2** and **20**. Accordingly, when the driving wheels **2** and **20** are driven to rotate, the driven wheel **7** can be driven to rotate, and the speed can be increased or decreased by adjusting the ratio of the number of teeth between the driven wheel **7** and the drive wheels **2**, **20**.

[0053] In addition, as shown in FIG. **11**B, the curtain system in this embodiment includes a horizontal guide rail **51**, two sliding members **52**, a drawstring **53**, and two pieces of curtain cloth S, where the two sliding members **52** are coupled to the horizontal guide rail **51**, the drawstring **53** is connected to the two sliding members **52**, and the two pieces of curtain cloth S are coupled to the horizontal guide rail **51** and are respectively connected to the two sliding members **52**. Furthermore, the drawstring **53** is fitted into groove **71** of the driven wheel **7**. Accordingly, the reciprocating type pull rod driving apparatus **1** can pull the drawstring **53** through the pull rods **42** and **402**, thereby driving the sliding members **52** to pull the curtain cloth S to slide horizontally. In short, the reciprocating type pull rod driving apparatus **1** provided in the instant disclosure is also applicable to curtain systems that are horizontally opened in two opposite directions or other similar awning or screen systems. The instant disclosure is also not limited to a system that is horizontally opened in two opposite directions, and any horizontal sliding systems that are driven by a drawstring or a chain are applicable to the instant disclosure.

[0054] Reference is made to FIG. **12**, where FIG. **12** is a diagram of the first embodiment of the reciprocating type pull rod driving apparatus of the instant disclosure applied to another roller curtain system. The main difference between this embodiment and the aforementioned roller curtain system is that: the reciprocating type pull rod driving apparatus **1** on the right can be configured to control winding or unwinding of the curtain cloth S of a roller curtain module Mc, as described in the foregoing embodiment. The reciprocating type pull rod driving apparatus **10** on the left is configured to lift the entire roller curtain module Mc, that is, a hollow region T can be represented in an upper section of the curtain. A rolling bar Rs is pivotally connected to the fixed bracket F, the reciprocating type pull rod driving apparatus **10** is arranged at one end of the rolling bar Rs, two steel ropes W are wound on the rolling bar Rs, and one end of each of the steel ropes W is connected to the roller curtain module Mc. Accordingly, by operating the reciprocating type pull rod driving apparatus **10**, the rolling bar Rs can be driven to wind or release the steel ropes W, and thus the entire roller curtain module Mc can be raised or lowered.

[0055] The foregoing embodiments are merely examples for ease of description, and the scope of the claims in the instant disclosure should be based on the scope of the claims, and is not limited to the foregoing embodiments.

## Claims

**1**. A reciprocating type pull rod driving apparatus, comprising: a housing; a shaft rod, with one end extending to the housing; a driving wheel, kinematically connected with the shaft rod and accommodated in the housing, the driving wheel comprising a plurality of engagement teeth; a chain, engaged with the plurality of engagement teeth of the driving wheel; and an operating assembly, connected to the chain for operating the chain to rotate the driving wheel, wherein a distance between a radial outer end edge of the driving wheel and an inner wall of the housing is greater than or equal to a thickness of the chain, and a quantity of the plurality of engagement teeth of the driving wheel that the chain is engaged with is less than or equal to a half of a total quantity of the plurality of engagement teeth.

**2**. The reciprocating type pull rod driving apparatus according to claim 1, wherein the operating assembly comprises two sleeves, two blocking pieces, two pull rods, and two springs; the two sleeves respectively sleeve two ends of the chain; the two blocking pieces and the two springs are

respectively accommodated in the two sleeves; each of the sleeves comprises a step portion, the two blocking pieces are abut against the step portions of the corresponding sleeves, one end of each of the two springs abuts against the corresponding sleeve, and the other end abuts against the corresponding blocking piece; each of the two blocking pieces comprises a bored hole; and two ends of the chain respectively pass through the bored holes of the two blocking pieces to be connected to the two pull rods, respectively.

**3**. The reciprocating type pull rod driving apparatus according to claim 2, wherein the operating assembly further comprises a connecting member and an elastic restoring element; the two sleeves are connected to each other through the connecting member; and two ends of the elastic restoring element are respectively connected to the connecting member and the housing.

**4**. The reciprocating type pull rod driving apparatus according to claim 1, further comprising a chain detachment mechanism disposed in the housing, wherein when the driving wheel is driven to rotate by the chain, the quantity of the plurality of engagement teeth of the driving wheel that the chain is engaged with is less than or equal to a half of the total quantity of the plurality of engagement teeth; and when the driving wheel is not rotating, the chain detachment mechanism pushes out the chain and makes the chain be at least partially disengaged from the plurality of engagement teeth.

**5**. The reciprocating type pull rod driving apparatus according to claim 4, wherein the chain detachment mechanism comprises a U-shaped baffle and an elastic body; the driving wheel comprises an outer circumferential groove in communication with the plurality of engagement teeth; the U-shaped baffle is sleeved in the outer circumferential groove of the driving wheel and configured to slide relative to the driving wheel; the elastic body is accommodated in the housing, with one end abutting against the housing and the other end abutting against the U-shaped baffle; and the elastic body constantly drives the U-shaped baffle to push out the chain and makes the chain be at least partially disengaged from the plurality of engagement teeth.

**6**. The reciprocating type pull rod driving apparatus according to claim 5, further comprising another driving wheel, another chain, another operating assembly, another U-shaped baffle, and another elastic body, wherein the another driving wheel is kinematically connected to the shaft rod; the another driving wheel comprises a plurality of engagement teeth and an outer circumferential groove; the another chain is engaged with the plurality of engagement teeth of the another driving wheel; the another operating assembly is connected to the another chain and suitable for operating the another chain to drive the another driving wheel to rotate; the another U-shaped baffle is sleeved in the outer circumferential groove of the another driving wheel and configured to slide relative to the another driving wheel; the another elastic body is accommodated in the housing, with one end abutting against the housing and the other end abutting against the another U-shaped baffle; wherein a distance between a radial outer end edge of the another driving wheel and an inner wall of the housing is greater than or equal to a thickness of the another chain; when the another driving wheel is driven to rotate by the another chain, a quantity of the plurality of engagement teeth of the another driving wheel that the another chain is engaged with is less than or equal to a half of a total quantity of the plurality of engagement teeth; and when the another driving wheel is not rotating, the another chain detachment mechanism pushes the another chain out of the plurality of engagement teeth of the another driving wheel, so that the another chain is at least partially disengaged from the plurality of engagement teeth.

**7**. The reciprocating type pull rod driving apparatus according to claim 6, wherein each of the operating assemblies comprises two sleeves, stop blocks, pull rods, and springs; the pull rods are respectively connected to one end of the chains; each of the stop blocks is respectively connected to the other end of the chains; the sleeves respectively sleeve two ends of the chains; the springs are respectively accommodated in the sleeves; one end of the springs respectively abuts against the sleeves, and the other end abuts against the stop blocks or the pull rods; the pull rods of the operating assembly are configured to drive the driving wheel to rotate clockwise; and the pull rods

of the another operating assembly are configured to drive the another driving wheel to rotate anticlockwise.

**8**. The reciprocating type pull rod driving apparatus according to claim 6, further comprising a driven wheel arranged on the shaft rod and kinematically connected to at least one of the driving wheel and the another driving wheel, wherein when at least one of the driving wheel and the another driving wheel rotates, the driven wheel is driven to rotate.

**9**. A curtain system, comprising: the reciprocating type pull rod driving apparatus according to claim 1; and curtain cloth, wound onto or unwound from the shaft rod by being driven by the reciprocating type pull rod driving apparatus.

**10**. The curtain system according to claim 9, further comprising a fixed bracket, wherein the reciprocating type pull rod driving apparatus is arranged on the fixed bracket; the fixed bracket comprises a limiting member; the curtain cloth is provided with a stop member; and when the curtain cloth is wound onto the shaft rod and the stop member abuts against the limiting member, the shaft rod is incapable of further winding the curtain cloth.