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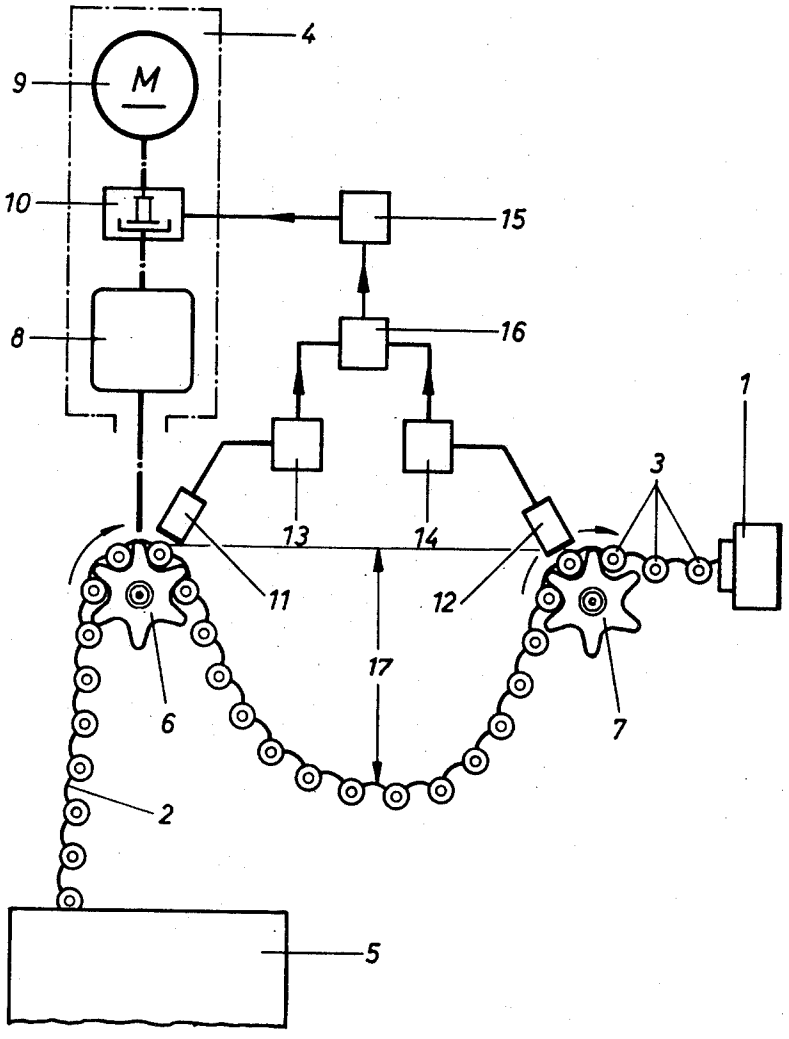

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APPARATUS FOR FEEDING AN AMMUNITION BELT TO A RAPID-FIRE CANNON

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This invention relates to apparatus for feeding an ammunition belt to a rapid-fire cannon by means of a belt feeding device controllable in dependence on the sag of the belt.

When such a rapid-fire cannon is installed in a mounting, there is often a long supply path between the ammunition container and the weapon. Consequently, there is sometimes the danger that the pulling force of the weapon may be insufficient to draw the ammunition belt properly from the container, due to the length, and hence the weight, of the belt along the supply path. This may result in a decrease in the efficiency of the weapon leading, in certain circumstances to a complete breakdown of the weapon.

In order to overcome this drawback, a belt feeder for a rapid-fire cannon has been developed and become known which is operated by an electric motor when the sag in the belt between the belt feeder and the weapon has reached a certain minimum value. The motor is operated by a switch actuated by the belt itself. This motor-operated belt feed results in an increased rate of feed and a simultaneous increase in the sag of the belt. When a certain maximum sag value is reached, the motor is switched off, again by a switch controlled by the belt itself.

Since the belt feeder is put into operation when the belt supply stored in the sag has been used up, a periodically controlled drive is required, the duration of the operative and inoperative periods of which depend exclusively on the time taken for the weapon to consume the belt supply stored in the sag. Since the motor, being a direct-current motor, requires a long starting time, the frequent switching on a full load eventually results in interference and difficulties in the supply of ammunition. On the other hand, the weapon has to feed the ammunition belt to itself within the limit of its maximum pulling force, both when the belt has a full sag and when it adopts an almost stretched position. These widely differing pulling forces, which are provided exclusively by the weapon, impair its reliability of operation and its life to an equal extent.

The problem on which the invention is based is to provide an apparatus which will enable the pulling force required to be provided by the weapon for feeding the ammunition belt to be kept constant within narrow limits and so to design the control system for the drive of the belt feeding device that the said system will permit delay-free operation wtih a high switching sequence and at the same time is little subject to wear and insensitive to environmental influences, such as vibration, gases, dust and moisture.

According to the invention, the problem is solved by means of two fixedly-mounted belt-feeding members forming a predetermined sag in the portion of the ammunition belt between them and with which are associated means for keeping the predetermined length of the sag in the belt constant by detection of the number of cartridges. To this end, the two belt-feeding members may be sprockets and with each there is associated a counter recording the cartridge throughput and a storage device for comparing the counts of the two counters and by means of which a driving assembly for correcting any throughput of one star wheel differing from the desired value can be controlled by way of a pulse transmitter.

The motor drive acting on one of the two sprockets thereby, on the one hand, keeps constant the belt pulling force exerted by the weapon, due to the constant length of belt between the two sprockets and, on the other hand, provides the different belt pulling forces required for the portion of the belt between the ammunition container and the driven sprocket.

By way of example, the invention will be described in greater detail with reference to the accompanying drawing which shows an apparatus, embodying the invention, for feeding an ammunition belt to a weapon.

The apparatus illustrated is operable to feed cartridges **3**, carried by an ammunition belt **2**, from an ammunition container **5** to a rapid-fire cannon **1**. Two sprockets **6** and **7**, rotatable about fixed axles and spaced apart from each other in the feed direction of the ammunition belt serve as feed and guide members for the belt **2**. In order to ensure efficient operation of the weapon **1**, there is a sag **17** in the belt **2** between the sprockets **6** and **7**.

The sprocket **7**, mounted directly in front of the weapon **1**, is rotated solely by the action of the weapon in feeding the ammunition belt to itself over the sprocket **7**. The sprocket **6**, which is located on the input side of the ammunition belt, i.e. between the sprocket **7** and the ammunition container **5**, is rotatable by the weight of the sagged portion of the belt **2** or by a drive assembly **4** which is connectable to the sprocket **6** when the sag **17** of the belt **2** departs from a desired value.

The drive assembly **4** comprises a gearing **8** connected to the sprocket **6**, a motor **9** and a clutch **10** operable to connect the motor and the gearing. Normally there is a D.C. voltage source available in the mounting of the weapon **1** and in that case the motor **9** may be a D.C. motor. Such a motor has a relatively long starting time and is therefore unsuitable for rapid sequential switching into and out of operation. This disadvantage may be overcome by running the motor **9** continuously and using for the clutch **10** a slip-ring-less electromagnetic disc clutch thereby enabling a high rate of switching the motor into and out of connection with the sprocket **6** to be obtained.

The clutch **10** is operated to drivably connect the motor **9** to the sprocket **6**, when the magnitude of the sag **17** in the belt **2** departs from a desired value, in order to restore the sag to the desired value. The clutch **10** is operated by switching pulses received via suitable amplifiers from a pulse transmitter **15** whose operation is controlled by the output from a storage comparator device **16**. The storage comparator **16** has two separate inputs, one from a counter device **13** which receives and counts pulses from a detector device **11** associated with the sprocket **6**, and the other input from a counter device **14** which receives and counts pulses from a detector device **12** associated with the sprocket **7**. The detectors **11** and **12**, which may be optical or magnetic detectors, generate a pulse each time a cartridge **3** travels past the sprockets **6** and **7** respectively and the outputs from the counters **13** and **14** are counts of the pulses generated by the respective detectors. The two counts are accumulated and compared by the comparator **16** which functions each time the counts from the counter devices differ, to produce an output pulse and actuate the pulse transmitter **15** to operate the clutch **10** and drivably connect the motor **9** and the sprocket **6**.

The operation of the apparatus is as follows. The weapon **1** feeds the requisite number of cartridges to itself via the sprocket **7**. Each cartridge **3** in the ammunition belt **2**, as it travels past the detector **12**, causes that detector to generate a pulse which immediately is fed to the counter **14**. Since the count of the counter **14** is identical with the actual consumption of ammunition by the weapon **1**, it can be described as the desired value.

The count of the counter **14** representing the desired value, is fed in the form of a pulse to the storage comparator **16**. The detector **11** detects the cartridges **3** as they travel over the sprocket **6** and generates pulses which are counted by the counter **13**. The count of the counter **13** is fed in the form of a pulse to the comparator **16** separately from the output from the counter **14**. The comparator **16** stores and compares the outputs from the counter devices **13** and **14** and, whenever there is a difference between the instantaneous values of those counts, the comparator **16** generates an ouptut pulse which actuates the pulse transmitter **15**. When so actuated the transmitter **15** produces a switching pulse which is fed via suitable amplifiers to the drive assembly **4** to actuate the clutch **10** and mechanically connect the motor **9** and the sprocket **6**. The drive assembly **4** positively drives the sprocket **6** in such manner that the rate of feed of the ammunition belt **2** over the sprocket **6** is so adjusted that the counts of the counter devices **13** and **14** are equalised when the comparator **16** ceases to generate an output. The pulse transmitter **15** is then no longer actuated, the clutch **10** is de-energised and the motor **9** is disconnected from the sprocket **6** which then continues to be rotated by the ammunition belt as it passes over the sprocket **6**. Thus, when the counts of the counter devices are equal the sag **17** of the belt is at the desired value and the drive assembly **4** is inoperative. When the count of the counter **13** differs from that of the counter **14**, the magnitude of the sag **17** has departed from the desired value and the drive assembly is operated to restore the sag to the desired value.

With the above described apparatus, when firing of the weapon **1** ceases or is interrupted, the sprocket **7** ceases to rotate but the sprocket **6** continues to rotate until the count of the counter **13** equals that of the counter **14** when the motor **9** immediately is disconnected from the sprocket **6**.

Apparatus constructed and operating as described above is advantageous since even the feeding of a single cartridge past the sprocket **7** can cause operation of the drive assembly to restore the sag **17** of the belt to the desired value.

The connection of the detectors **11** and **12** in front of the counters **13** and **14** has the advantage that a desired relationship between the sprockets **6** and **7**, and also between the detectors **11** and **12**, may be maintained without physical contact between them, even under difficult operating conditions. If such difficulties do not exist, the counter devices **13** and **14** can be connected directly to the sprockets **6** and **7** and the detectors **11** and **12** dispensed with.

I claim:

1. Apparatus for feeding an ammunition belt to a rapid fire cannon and for maintaining a predetermined sag in the ammunition belt between two belt feeding members spaced apart in the feed direction of the belt, the feed members each comprising a toothed wheel mounted for rotation about a fixed axle, rotary electric driving means controllably operable to drive the one of the said feed members on the input side of the ammunition belt, first and second detection means for detecting cartridges in the ammunition belt as they pass the respective feed members, first and second counting means connected to the respective first and second detection means for producing a counting pulse in response to each detection of a cartridge by the respective detection means, means connecting the first and second counting means to a comparator device adapted to produce an output when the counts of the respective first and second counting means differ, and a pulse transmitter device for receiving the output of the comparator device in response to such output transmitting a control signal to operate the said driving means to drive the said one feed member in such a sense to restore the sag in the ammunition belt to the predetermined sag.

2. Apparatus according to claim 1, in which the electric drive means is arranged for continuous rotation, and an electro-magnetic clutch device operable by control signals from the pulse transmitter device to drivably connect the electric drive means to the said one feeding member.

3. Apparatus for feeding an ammunition belt to a rapid fire cannon and for maintaining a predetermined sag in the ammunition belt between two belt feeding members spaced apart in the feed direction of the belt, comprising driving means controllably operable to drive the one of the said feeding members on the input side of the ammunition belt, first means for detecting and counting cartridges in the ammunition belt as they pass the said one feeding member, second means for detecting and counting cartridges in the ammunition belt as they pass the other one of the said feeding members, a comparator device responsive to the said first and second detecting and counting means for producing an output when the counts of the said counting means differ, means connecting the comparator to the driving means for operation thereof by the output of the comparator device to drive the said one feeding member in such manner that the sag in the ammunition belt between the two feeding members is restored to the said predetermined value, the belt feeding members being rotary devices mounted for rotation about fixed axles, the driving means including a rotary drive device and an electro-magnetic clutch device for drivably connecting the drive device and the said one feeding member, the said clutch device being actuable by the said comparator device output, means connecting the comparator device to the driving means as a pulse transmitter device operable to produce an output for actuation of the clutch device in response to an output from the comparator device, and said first and second counting and detection means each including a photo-electric detection device.

4. Apparatus for feeding an ammunition belt to a rapid fire cannon and for maintaining a predetermined sag in the ammunition belt between two belt feeding members spaced apart in the feed direction of the belt, comprising driving means controllably operable to drive the one of the said feeding members on the input side of the ammunition belt, first means for detecting and counting cartridges in the ammunition belt as they pass the said one feeding member, second means for detecting and counting cartridges in the ammunition belt as they pass the other one of the said feeding members, a comparator device responsive to the said first and second detecting and counting means for producing an output when the counts of the said counting means differ, means connecting the comparator to the driving means for operation thereof by the output of the comparator device to drive the said one feeding member in such manner that the sag in the ammunition belt between the two feeding members is restored to the said predetermined value, the belt feeding members being rotary devices mounted for rotation about fixed axles, the driving means including a rotary drive device and an electro-magnetic clutch device for drivably connecting the drive device and the said one feeding member, the said clutch device being actuable by the said comparator device output, means connecting the comparator device to the driving means as a pulse transmitter device operable to produce an output for actuation of the clutch device in response to an output from the comparator device, and the said first and second detection means each including an electro-magnetic detection device.

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