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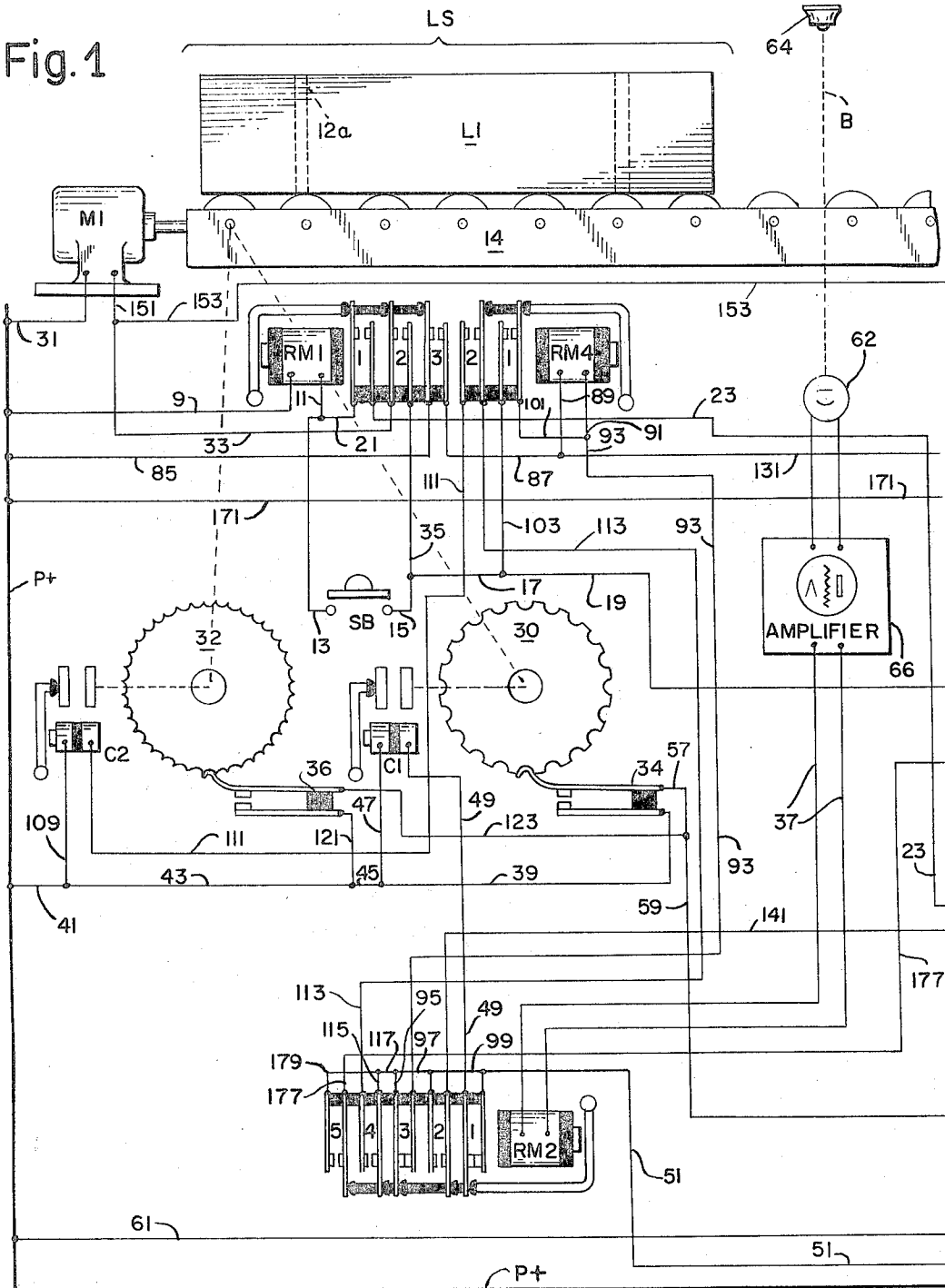
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LOAD POSITIONING DEVICE FOR STRAPPING MACHINES

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2 Sheets-Sheet 1

Fig. 1



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**LOAD POSITIONING DEVICE FOR STRAPPING MACHINES**

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The improved load positioning device comprising the present invention has been designed for use primarily in connection with the successive and automatic feeding of large packages or loads such as plywood or panel board stacks to a strapping station where they are bound with steel strap by a "Signode" or other conventional compression strapping machine, after which the bound packages or loads are removed from the strapping station for transportation to storage. In feeding such loads to the strapping station, it is customary to transfer each load from the stacking station to the strapping station on a live roll assembly and to arrest the forward movement of the load at such time as it assumes a predetermined position of register with the strap feeding chute or, in the case of relatively long loads, with a plurality of chutes associated with the machine, after which the strapping machine is set into operation to apply one or more straps to the stack at appropriate regions therearound. Ordinarily where a relatively short load is concerned, forward movement of the load will be arrested at such time as the load becomes centered with respect to a single machine chute. Where a relatively long load is concerned and plural chutes are employed, forward movement of the load will be arrested when the load becomes centered with respect to a preselected transverse plane where an optimum condition of strap placement will result, usually a mid-plane between adjacent chutes or chutes which are once removed from each other.

Where the successively fed loads are equal in length, no particular problem arises and the use of a limit switch or other load-sensing device, appropriately positioned along the path of travel of the load may be employed to arrest the forward movement of the load for proper load placement at the strapping station. Where loads of two or three predetermined known lengths are concerned, plural limit switches may be positioned appropriately along the path of travel of the loads and selectively rendered effective by the operator to bring the different length loads to their proper positions with respect to the strapping machine chute or chutes. However, where successive loads are indiscriminately of different lengths, measurement of the length of the successive loads is required. Actual measurement of the loads is a time-consuming operation and approximate measurement by eye gives rise to the chance of error in judgment. Furthermore, both of these load positioning methods requires the constant attention of an operator.

The present invention is designed to overcome the above-noted limitations that are attendant upon the feeding of loads to a strapping station and the centering thereof with respect to a strap feeding chute or chutes at such station and, toward this end, the invention contemplates the provision of a fully automatic mechanism by means of which successive loads which vary indiscriminately in length in a predetermined range of lengths may be fed to the strapping station and their forward movements arrested at such time as the medial transverse planes thereof move into register with a strap feeding chute.

Still further, according to the present invention, where successive loads vary indiscriminately in other ranges of lengths, means are provided for automatically arresting

their forward movement when their mid-planes move into register with respective points along the path of travel of the loads which will place the loads appropriately for strapping by selected combinations of chutes. Thus, regardless of the length of a given load, its forward motion will be arrested when it has arrived at the strapping station and is in a position at such station where the most judicious application of strapping thereto will result.

The invention is not necessarily limited to use in connection with the feeding of loads to a strapping station for treatment by a strapping machine inasmuch as load positioning mechanism embodying the principles of the present invention may, if desired, with or without suitable modification as required, be employed for feeding loads which vary in their length to operating stations for accurate register at such stations with operating instrumentalities other than strapping devices, as for example, a wide variety of machine tools which perform useful work upon the loads in localized regions thereof, as well as devices which perform localized abrading, coating, heating, handling and other operations too numerous to mention. Irrespective however of the particular use to which the invention may be put, the essential features thereof are at all times preserved.

The provision of a load positioning apparatus of the character briefly outlined above constituting one of the principal objects of the present invention, it is a further and important object to provide such an apparatus which is largely electrical in its nature and which, moreover is an extraneous adjunct to the load-impelling and the load-treating mechanism with which it may be associated and requires little or no alteration of such mechanism. Thus, in the case of a load-strapping machine, no appreciable modification of either the load-impelling mechanism which feeds successive loads into operative register with the strapping chutes or the strapping machine itself is required. The invention therefore is capable of use either as original equipment or as an addition to existing equipment and, in the latter instance, it is readily applicable to the equipment without requiring dismantling of such equipment or extensive alterations thereto.

Numerous other objects and advantages of the invention, not at this time enumerated, will readily suggest themselves as the nature of the invention is better understood.

In the accompanying two sheets of drawings, forming a part of this specification, the basic principle of the invention has been disclosed as well as one contemplated exemplary mode or applying that principle.

In these drawings:

FIGS. 1 and 1a, considered together and placed side-by-side, constitute a schematic block diagram showing the invention operatively applied to a compression strapping machine and a series of live rolls by means of which successive loads are fed to the machine.

**GENERAL CONSIDERATIONS**

Referring now to the drawings in detail, and with the two counterpart views thereof positioned in side-by-side relationship, the load positioning apparatus of the present invention has been shown in connection with the feeding of successive loads such as the loads L1 or L2 from a stacking or loading station LS to a strapping station SS where a conventional strapping machine 10 may be caused to apply one or more steel straps 12 to the loads at appropriate and predetermined longitudinal positions with respect to the loads. A live roll conveyor assembly 14 is employed for conducting the various loads from the loading station to the strapping station, the assembly being driven by an electric motor M1.

The strapping machine 10 which establishes the strapping station SS may be of any conventional construction, as for example a "Signode" compression strapping machine having multiple guideways or "chutes" through which the steel strapping is fed as it is wrapped about a load at the strapping station, after which the strapping is tensioned and the ends thereof fastened together and severed to produce the straps 12. While any desired number of chutes may be employed, in the exemplary form of strapping machine which has schematically been illustrated herein, three such chutes 16, 18 and 20 have been shown but it will be distinctly understood that a greater or lesser number of such chutes may be employed if desired. Ordinarily, the chutes will be selectively actuated to accommodate the different positioning of different loads at the strapping station. Assuming, for purposes of example, that each load, regardless of its length is to be bound by two of the straps 12, in each instance optimum strapping of the load will obtain when the two straps are applied to the load in spaced relationship so that they are spaced equally inwardly from the opposite ends of the load a predetermined distance. It will be understood, of course, that the regions of strap application will depend upon the fixed positions of the chutes at the strapping station and upon the position of rest assumed by a given load at the time the strapping machine 10 is set into operation. As shown in the drawings, a relatively short load such as the load L2 which has been operated upon by the strapping machine has a symmetrical arrangement of straps thereon, the straps 12 having been applied by the chutes 18 and 20 at a time when the load was at rest in the strapping station SS with its medial transverse plane coincident with an axis  $y-y$  disposed midway between these two chutes. Similarly, a relatively long load such as the load L1, when operated upon by the strapping machine 10 will assume a position of rest at the strapping station SS with its medial transverse plane coincident with an axis  $x-x$  disposed midway between the chutes 16 and 20. In such an instance the straps will be applied to the load L1 at the dotted line regions 12a.

Heretofore, limit switches have been positioned along the path of travel of the successive loads and rendered effective by suitable relay circuitry to stop the forward travel of each load at such time as the load arrives at its proper position in the strapping station. However the use and positioning of such limit switches has been predicated upon the strapping of loads of predetermined and known length. Selection of the particular limit switch for proper load positioning and of the particular chutes to be employed for strapping purposes has been a matter of manual selection requiring the full attention of an operator during any given run of loads. Alternatively, load positioning has been accomplished by eye, the operator opening the motor circuit for the load-impelling motor when, in his judgment, a given load has become centered with respect to a given chute or a combination of chutes to be used for strapping purposes. Such procedures are subject to human failure and require the constant services of a skilled operator if even approximately correct load positioning is to be attained.

#### BRIEF DESCRIPTION

Briefly, the present invention provides a fully automatic load positioning mechanism whereby proper and selective "centering" of successive loads at the strapping station SS in the manner briefly outlined above may be attained regardless of a variance in the length of successive loads and regardless of whether the lengths of the loads involved be known to the operator or not. Upon depression of a start button, a given load at the loading station LS will travel forwardly on the conveyor 14 towards the strapping station SS. If the length of the load falls within a predetermined given range of relatively long load lengths, certain relay control circuitry will become effective during travel of the load to the strapping station

whereby movement of the load will automatically be terminated at such time as the medial transverse plane of the load (hereinafter referred to as the mid-point of the load) moves into register with the chutes 16 and 20. If the length of the load falls within a given predetermined range of relatively short load lengths, such relay circuitry will become effective to terminate the forward movement of the load at such time as its mid-point moves into register with the chutes 18 and 20. In either instance, as soon as the load is thus properly positioned for strapping thereof, the particular chutes involved will automatically be set into operation and caused to perform their normal strapping machine functions whereby the straps 12 are operatively applied to the load.

In its broadest aspect and involving the use of a single strapping chute, the present invention contemplates the provision of a load sensing device which is positioned at a sensing station along the path of travel of the load from the loading station to the strapping station and at a distance from the transverse plane of a given chute which is equal to one-half the length of the longest load capable of being accommodated by the apparatus. At such time as the leading edge of a given load encounters the load sensing device, an impulse emitting device is set into operation and caused to transmit to an associated counter a series of electrical impulses in timed relation to the rate of travel of the load toward the strapping station. When a predetermined number of impulses has been received by the counter which is commensurate with the maximum load length, relay circuitry is set into motion under the control of the counter to terminate the forward movement of the load and to set the strapping machine into operation. Because the sensing device is positioned a distance from the strapping chute which is equal to one-half the length of the maximum load length, it follows that the load will, at the time its forward movement is terminated, assume a position wherein its mid-point is in register with the strapping chute.

Where a given load having a length which is shorter than the predetermined maximum load length is involved, sensing of the leading edge of the load by the load sensing device will initiate the operation of the impulse-emitting device as heretofore described in connection with a maximum length load. However, since the length of the load is less than such maximum load length, the sensing device will sense the trailing edge of the load before the counter has accumulated its full quota of impulses. At this time a second impulse-emitting device is set into operation. This second device is likewise correlated with the rate of travel of the load toward the strapping station but its rate of impulse emission is twice that of the first impulse-emitting device and it is similarly associated with the counter so that the impulses emitted thereby are transmitted to the counter to complete its full quota of impulses, these impulses being merely added to those already stored in the counter and which were received from the first impulse emitting device. The counter is thus accelerated in its counting operation and, at such time as it has received its full quota of impulses, the previously mentioned relay circuitry is set into operation as heretofore described to terminate the movement of the load and actuate the strapping machine. The net effect of the load positioning mechanism is thus to establish a length differential between the maximum load length and the length of any given shorter load moving toward the strapping station, and to terminate the movement of the load when one-half of this length differential has been measured in point of time after the trailing edge of the short load has encountered the load sensing device. When these conditions have been fulfilled, the load, regardless of its length, will then have come to rest with its mid-point in accurate register with the strapping chute.

For automatic selection of individual chutes, or a combination of multiple chutes, to be employed for strapping loads having lengths which fall within different prede-

terminated ranges, means are provided whereby, in effect, time constants are involved which allow the load to continue its forward movement within the strapping zone for a predetermined period of time after the impulse accumulating counter has received its full quota of impulses to bring the mid-point of the load into register with a selected chute or a transverse plane representing an optimum load position for strapping by a combination of two or more chutes, all in a manner that will be made clear presently.

#### THE IMPULSE EMITTING DEVICES

The previously mentioned impulse emitting devices may assume various forms and they may be of either an electrical or a mechanical nature. For illustrative purposes herein they are shown as being in the form of conventional cogwheel emitters 30 and 32 having impulse-emitting contacts 34 and 36 respectively associated therewith. The cogwheel emitters are of equal diameter and each emitter is provided with a notched periphery by means of which the associated contacts 34 or 36, as the case may be, are actuated upon rotation of the emitter. The emitters 30 and 32 operatively connected through respective solenoid-actuated clutches C1 and C2 for rotation in timed relation to the operation of the conveyor 14, such rotation taking place when the normally deenergized clutches C1 and C2 become energized. The distance between adjacent notches in the periphery of the emitter 30 is such that the contacts 34 will become momentarily closed for impulse emitting purposes each time a load on the conveyor 14 progresses toward the strapping station SS a distance equal to a predetermined unit displacement, the maximum load length being an even multiple of such unit. For purposes of discussion herein it may be considered that during the time that the light beam B is intercepted by the load L1, the cogwheel emitter 30 produces fifty electrical impulses by reason of the opening and closing movements of the contacts 34. The distance between adjacent notches in the periphery of the emitter 32 is such that opening and closing of the associated contacts 36 will take place at a rate which is twice the rate of opening and closing of the contacts 34.

#### THE IMPULSE COUNTER

The previously mentioned impulse counter has been designated in its entirety at 40. This counter, like the emitters 30 and 32, may also be either of an electrical or a mechanical nature and in the exemplary form of the invention it is shown as embodying two counter disks or wheels 42 and 44 which are intermittently indexed or rotated in unison under the control of a common driver in the form of a solenoid actuated ratchet and pawl mechanism 46 which is actuated under the control of a solenoid or stepping magnet SM1. The disk 42 is provided with a pair of diametrically opposed peripheral notches 48 therein, such notches constituting drop-off notches for a follower finger 50 associated with a group of disk-actuated contacts including normally closed #1 contacts and normally open #2 and #3 contacts. The counter 40 is cyclic in its operation, each counter disk making a half-revolution during each counter cycle. The disk 42 and its associated contacts constitute an impulse receiving and storing section of the counter 40 and it operates at the end of each counter cycle when a predetermined number of impulses have been received by the counter to interrupt the forward movement of the load L1, as well as to perform other apparatus functions which will be made clear presently.

The disk 44 is provided with a pair of circumferentially elongated drop-off regions 52 for a follower finger 54 associated with a group of contacts including normally closed #1 contacts and normally open #2 contacts. The disk 44 and its associated contacts constitute a chute-switching section by means of which a load which falls within a predetermined range of short load lengths may automatically continue its forward movement in the strap-

ping station after the impulse receiving section of the counter has received its full quota of impulses so as to bring the load into operative register with a different selection of chutes, namely, in the illustrated form of the invention, the two chutes 18 and 20.

#### CIRCUIT DIAGRAM AND OPERATION

Considering now in greater detail the specific nature and the mode of operation of the various electrical and mechanical instrumentalities which cooperate to make up the present load positioning apparatus, the right hand edge of FIG. 1 coincides with the left hand edge of FIG. 1a so that when the two views are placed side by side along this line of coincidence, a complete schematic representation of the apparatus and a circuit diagram of its operation will result. Electric current leading from a suitable source of power S, which may be a commercial power line, is supplied to and disconnected from the apparatus by means of a manually operable master switch MS. Closing of the master switch, however, in itself does not initiate any machine functions or operations but merely serves to makes power available from the lines P+ and P- for further and automatic machine operations which are contingent upon the placement of a load on the live roll conveyor 14 at the loading station and upon the depression of a start button SB.

Assuming the master switch to be closed, depression of the start button SB will serve to energize a relay magnet RM1, the circuit for the magnet extending from the source S, to the line P+, and from thence through lead 9, the magnet RM1, leads 11, 13, start button SB, leads 15, 17, 19, line P-, and master switch MS, back to the source. Energization of the magnet RM1 serves to close the normally open #1, #2 and #3 contacts thereof. The #1 contact is a holding contact for the magnet and its circuit extends from the positive side of the line through lead 9, magnet RM1, leads 11, 21, #1 contacts of the magnet RM1 (now closed), lead 23, normally closed #1 contacts associated with the disk 42 of the impulse counter 40, and leads 25, 27, to the negative side of the line. Closure of the #2 contacts of the relay magnet RM1 serves to energize the motor M1, the circuit for the motor extending from the positive side of the line through lead 31, motor M1, leads 151, 33, #2 contacts of the magnet RM1 (now closed), and leads 35, 17, 19 to the negative side of the line. Closure of the #3 contacts of the magnet RM1 is without function at this time in the apparatus cycle.

Upon energization of the electric motor M1 in the manner previously described, the conveyor 14 is set into operation and such load as may be disposed at the loading station LS will commence to travel forwardly on the conveyor 14 toward the strapping station SS.

A load-sensing device 62, which is preferably, but not necessarily, in the form of a photoelectric light sensitive cell, is positioned to receive a light beam B emanating from a light source 64, the beam traversing the path of movement of successive loads on the conveyor 14 so that it will be intercepted by each load as the latter progresses toward the strapping station SS. The cell 62 has associated therewith an amplifier 66 and this amplifier, together with the light source 64 may receive their energizing current from the lines P+ and P- at the time the master switch MS is initially closed, the circuit wires leading to these lines being omitted in the interests of circuit simplicity.

#### Maximum length load operation

For purposes of discussion herein, the load L1 may be considered to have a length which is equal to the longest load length capable of being effectively positioned at the strapping station SS by the present load positioning apparatus. According to the invention, the cell 62 and the light source 64 are so disposed along the path of travel of the load that the beam B will traverse the

conveyor at a region which is removed from the medial plane  $x-x$  between the two chutes 16 and 20 by a distance equal to one-half the length of the load L1, these chutes being subsequently actuated for strapping purposes where relatively long loads are concerned as previously indicated.

Upon initial closure of the master switch MS and consequent energization of the light source 64 and amplifier 66, a second relay magnet RM2 will become energized through a local amplifier output circuit 37, thus opening the normally closed #1 and #3 contacts and closing the normally open #2, #4 and #5 contacts of this latter magnet. The relay magnet RM2 has no holding contacts, this magnet being energized only when the light sensitive cell 32 receives the light beam B and becoming deenergized when the beam is intercepted. Thus, with the #1 contacts of the magnet RM2 open the solenoid actuated clutch C1 is incapable of being energized so that no impulses will be emitted by the emitting contacts 34 of the cogwheel emitter 30 until such time as the load L1 intercepts the light beam B.

At such time as the leading end of the load L1 intercepts the light beam B during travel of the load toward the strapping station SS, the output circuit 37 of the amplifier 36 will become deenergized, thus deenergizing the relay magnet RM2 and reversing its various contacts. Consequent closure of the #1 contacts will now cause energization of the clutch C1, the circuit extending from the positive side of the line, through leads 41, 43, 45, 47, clutch C1, lead 49, #1 contacts of the relay magnet RM2, and leads 51, 53 to the negative side of the line. Energization of the clutch C1 will cause rotation of the cogwheel emitter 30 and consequent emission of impulses by the contacts 34 thereof.

The impulses which are emitted by the contacts 34 are transmitted to the winding of the solenoid or strapping magnet SM1, each impulse serving to index the ratchet and pawl mechanism 46 and advance the impulse receiving and storing section 42 of the counter in timed relation to the movement of the load L1 on the conveyor 14. The circuit for the strapping magnet SM extends from the positive side of the line through leads 41, 43, 45, 39, contacts 34, leads 57, 59, stepping magnet SM1, and leads 83, 53 to the negative side of the line. As soon as the first impulse has been received by the section 42 of the counter 40, the follower finger 50 moves out of the notch 48 within which it normally rests, thus opening the #1 and #3 contacts thereof and closing the #2 contacts of this counter section. The #1 contacts are delayed action contacts and they are effective to maintain the previously described holding circuit through the #1 contacts of the relay magnet RM1 until such time as the #2 contacts of the relay magnet RM2 become closed, at which time the holding action of the #1 contacts is transferred to the #2 contacts through a new holding circuit extending from the positive side of the line, through lead 9, magnet RM1, leads 11, 21, #1 contacts of the relay magnet RM1, lead 23, #2 contacts of the counter section 42 (now closed), the leads 55, 27 to the negative side of the line. The conveyor motor M1 will thus remain energized and the conveyor 14 will continue to advance the load toward the strapping station SS while at the same time the counter section 42 will continue to receive and store impulses until such time as the follower finger 50 encounters the notch 48 at the end of a half-revolution of the disk associated with the counter section 42. At this time a full quota of impulses will have been received by the counter section 42 and the trailing end of the load L1 will have moved into coincidence with the light beam B.

At such time as the follower finger 50 enters the notch 48 as set forth above, the #2 contacts of the counter section 42 will become open, thus momentarily opening the holding circuit for the relay magnet RM1 and causing this magnet to become deenergized, reverse its group

of contacts, and remain deenergized until such time as the start button SB is again depressed during the next apparatus cycle. Opening of the #2 contacts of the relay magnet RM1 serves to deenergize the previously described circuit for the motor M1, whereupon the forward movement of the load L1 is terminated.

Due to the previously described relationship between the length of the load L1, the distance between the light beam B and the axis  $x-x$ , and the fact that the total number of impulses received by the section 42 of the counter 40 during the time that the maximum length load L1 traverses the light beam B serves to advance the section 42 from one notch 48 to the other, it follows that at such time as the follower finger 50 enters a notch 48 at the end of an apparatus cycle, the load will terminate its movement in the strapping zone SS with its mid-point in accurate register with the axis  $x-x$  and thus assume an optimum position for strapping operations by the two chutes 16 and 20.

Strapping operations are effected automatically at such time as the load L1 becomes thus correctly positioned in the strapping station SS, such strapping operations being initiated by closure of the #3 contacts of the section 42. At such time as these #3 contacts become closed, a circuit will extend from the positive side of the line, through lead 61, #3 contacts of the counter section 42, lead 63, #1 contacts of a relay magnet RM3, lead 167, #1 contacts of a chute transfer switch CTS, lead 65, #1 contacts of the counter section 44 (now closed), lead 67, input terminal 60 of the chute 16, and leads 69, 71, 73, and 75 to the negative side of the line. Such application of current to the input terminal 60 will initiate operation of the chute 16. At the same time, current will be supplied to the input terminal 62 of the chute 20 through a parallel circuit extending from the chute transfer switch CTS through lead 77, input terminal 62 of the chute 20, and leads 81, 73, 75 to the negative side of the line. Such application of current to the input terminal 62 will initiate operation of the chute 20. With both chutes 16 and 20 thus actuated at the end of the apparatus cycle, straps 12 will be effectively applied to the load L1 in the regions 12a thereof as previously described.

It will be understood that simultaneous application of energizing current to the chute terminals 60 and 62 will set the compression strapping machine 10 into its normal cyclic operation and that this operation involves numerous machine functions which bear no direct relation to the present load positioning apparatus and which consequently need not be described in detail herein. For example, the strapping machine 10 has associated therewith a load compressing member or platen and its movement serves to actuate certain limit switch and other control devices by means of which relay circuitry is set into operation to feed the strapping through the selected chutes 16 and 20, pass the strapping about the load L1, tension the strapping, unite the overlapping ends thereof to establish the two straps 12, sever the straps 12 from the source of strapping, reenergize the motor M1 and maintain the same energized for a short period of time to conduct the thus bound load from the strapping station, and finally reset the strapping machine for a subsequent operation.

#### *Long load range operation below maximum length*

In the case of a load having an effective length which is somewhat shorter than the maximum length load L1, but which still remains within a predetermined range of relatively long loads, the load positioning apparatus of the present invention will continue to position such a load with its mid-point in register with the axis  $x-x$  so that the load will receive strapping from the two chutes 16 and 20. Assuming such a load to be positioned at the loading station LS, depression of the start button will cause energization of the relay magnet RM1 and consequent energization of the conveyor motor M1 as heretofore described in connection with the positioning of the

maximum length load L1. As also described in connection with the maximum length load L1, the relay magnet RM2 will prevent energization of the clutch C1 and consequent operation of the impulse emitting device 30 until such time as the leading edge of the load encounters the light beam B.

Inasmuch as the light sensitive cell 62 is unable to distinguish whether an oncoming load is a maximum length load or a shorter load, as soon as the leading edge of the shorter load intercepts the light beam B, the relay magnet RM2 will reverse its contacts as heretofore described and the cogwheel emitter 30 will commence to actuate the contacts 34 under the control of the #1 contacts of the relay magnet RM2 and forward impulses to the counter 40 for storage in the section 42 thereof, the relay circuitry involved being identical with that previously described in connection with the passage of a maximum length load across the light beam B. The counter section 42 will continue to receive and store electrical impulses in this manner until such time as the trailing edge of the shorter load passes through the light beam B and restores the energization of the light sensitive cell 62. At this time, the section 42 of the counter 40 will not have received its full quota of electrical impulses and the oncoming notch 48 will not have reached the follower finger 50 so that the group of contacts associated with the section 42 will be reversed from the positions in which they are shown in the drawings.

At the time that the leading edge of any load, whether the same be a maximum length load or a short length load, encounters the light beam B, a relay magnet RM4 will become energized by reason of a circuit which extends from the positive side of the line through lead 85, #3 contacts of the relay magnet RM1 (now closed by initial actuation of the start button SB) leads 87, 89, relay magnet RM4, leads 91, 93, #3 contacts of the relay magnet RM2 (now closed by reason of interruption of the light beam B), and leads 95, 97, 99, 51, 53 to the negative side of the line. Such energization of the relay magnet RM4 causes closure of the #1 and #2 contacts thereof. A holding circuit for the relay magnet RM4 is established, this circuit extending from the positive side of the line, through lead 85, #3 contacts of the relay magnet RM1, leads 87, 89, relay magnet RM4, leads 91, 101, #1 holding contacts of the magnet RM4, and leads 103, 19 to the negative side of the line. With the magnet RM2 deenergized by reason of interception of the light beam B, this circuit for the relay magnet RM4 is without function inasmuch as the #4 contacts of the magnet RM2 remain open and any potential circuit through the clutch C2 of the impulse emitting device 32 involves closure of these #4 contacts. However, restoration of the light beam B by passage of the trailing edge of the shorter load thereacross now restores the light beam B, thus reenergizing the relay magnet RM2 and closing the #4 contacts thereof. Where a maximum length load such as the load L1 is concerned, restoration of the light beam B does not take place before the section 42 of the counter 40 receives its full quota of impulses and therefore it was considered unnecessary previously to describe the closing of the circuit for the relay magnet at the time the leading edge of the maximum length load intercepted the light beam B.

With the light beam B restored by reason of the passage of the trailing edge of the shorter load beyond the light beam B, and consequent closure of the #4 contacts of the relay magnet RM2 and opening of the #1 contacts thereof, the previously described circuit through the clutch C1 is opened and a new circuit through the clutch C2 is established. This latter clutch circuit extends from the positive side of the line through leads 41, 109, clutch C2, lead 111, #2 contacts of the relay magnet RM4 (now closed) lead 113, #4 contacts of the relay magnet RM2, and leads 115, 117, 97, 99, 51, 53 to the negative side of the line.

Energization of the clutch C2 serves to cause rotation of the cogwheel emitter 32 thus causing impulses to be forwarded to the counter 40 through a circuit extending from the positive side of the line through leads 41, 43, 121, contacts 36, leads 123, 59, stepping magnet SM1, and leads 83, 53 to the negative side of the line. Inasmuch as the rate of emission of electrical impulses by the contacts 34 of the cogwheel emitter 32 is twice the rate of emission of impulses by the contacts 34 of the cogwheel emitter 30, the rate of indexing of the section 42 of the counter 40 under the influence of the emitter 32 will be twice its rate of indexing under the influence of the emitter 30 so that the balance of the full quota of impulses capable of being received by the section 42 will be rapidly supplied to the latter section.

Since the transmission of impulses to the counter 40 at a relatively slow rate by the cogwheel emitter 30 commences at such time as the leading edge of the short load intercepts the light beam and terminates at such time as the trailing edge of the load restores the light beam, the net effect of the emitter 30 is to measure the length of the short load. Since the transmission of impulses to the counter 42 at a relatively fast rate by the cogwheel emitter 32 commences at such time as the trailing edge of the short load restores the light beam and continues only until such time as the counter section 42 has received its full predetermined quota of impulses, the net effect of the emitter 32 is to establish the length differential between a full length load and the shorter load, and then accelerate the counter section 42 to twice its normal or original speed, thus cutting in half the length of time the conveyor 14 would continue to operate when impelling a maximum length load. The emitter 30 may thus be regarded as a measuring emitter while the emitter 32 may be regarded as a dividing emitter since, in terms of time it limits the duration of conveyor actuation to one-half its normal duration with a maximum length load, considering only such conveyor operation as takes place after the light beam B has been restored by the trailing edge of the short load. The net effect of the accelerated feeding of impulses to the counter 40 of the cogwheel emitter 32 is to cause the counter to complete its full predetermined quota of impulses and open the #2 contacts of the counter section 42 while closing the #3 contacts at a time when the mid-point of the short load moves into coincidence with the axis  $x-x$ . Opening of the #2 contacts causes opening of the circuit for the motor M1 while closing of the #3 contacts initiates strapping machine operations as previously described and involving the two chutes 16 and 20.

#### *Short load range operation*

In the case of a load such as the load L2 which has an effective length which falls within a predetermined range of short load lengths wherein the distance between the chutes 16 and 20 is either wider than a load length so that such a load, if positioned with its mid-point in register with the axis  $x-x$  would present no strapping area whatsoever to these chutes, or is of insufficient width to enable strapping of any part of the load other than the extreme end regions thereof, means are provided whereby terminal operation of the counter 40 at the time it receives its full quota of impulses from the two impulse emitting devices 30 and 32 will fail to terminate the forward movement of the load L2 by disabling the effect of the contact group associated with the counter section 42 and allowing the conveyor to continue its load advancing operation for a short predetermined length of time so that the mid-point of the load will move into register with the axis  $y-y$  wherein the load is centered with respect to the two chutes 18 and 20. This disabling of the contact group of the counter section 42 is effected largely by the action of the counter section 44, its contact group, and the relay magnet RM3.

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As previously stated, the two counter sections 42 and 44 are correlated in their rotational movements so that during traverse of the follower finger 50 on the periphery of the counter section 42 between successive drop-off notches 48, the follower finger 54 will ride upon the outer periphery of the counter section 44, enter the arcuate depression 52, and then, if a given load falls within the predetermined range of long load lengths, ride out of the depression 52 and back on the outer periphery of the section 44. If however a given load such as the load L2 is of such length that it falls within the predetermined range of short load lengths, the trailing edge of such load will restore the light beam B at a time when the follower finger 54 is within the arcuate depression 52 and at this time the #1 contacts of the associated contact group will be open while the #2 contacts will be closed. Restoration of the light beam B will, as previously described, reenergize the relay magnet RM2 and cause closure of the #2 contacts of this magnet, whereupon a circuit will extend from the positive side of the line through leads 85, #3 contacts of the relay magnet RM1 (now closed), leads 87, 131, relay magnet RM3, leads 133, 135, #2 contacts of the counter section 44 (now closed with the follower finger 54 in the depression 52), lead 141, #2 contacts of the relay magnet RM2 (now closed), and leads 99, 51, 53 to the negative side of the line. Energization of the relay magnet RM3 will cause opening of the #1 and #2 contacts thereof and closure of the #3 and #4 contacts thereof. Closure of the #3 contacts of the relay magnet RM3 will establish a holding circuit for this magnet, the circuit extending from the positive side of the line through lead 85, #3 contacts of the relay magnet RM1 (now closed), leads 87, 131, magnet RM3, leads 133, 145, #3 contacts of the relay magnet RM3, and leads 147, 75 to the negative side of the line.

Closure of the #4 contacts of the relay magnet RM3 establishes an overriding circuit for the conveyor motor M1, this circuit extending from the positive side of the line, through lead 31, motor M1, leads 151, 153, #4 contacts of the relay magnet RM3, and leads 155, 147, 75 to the negative side of the line. This overriding motor circuit will remain in effect until such time as the holding circuit for the relay magnet RM3 is broken. The relay magnet RM3 is however a delayed action magnet, it being quick to energize and slow to deenergize. Thus, when the holding circuit for this magnet is broken by deenergization of the relay magnet RM1 and consequent opening of its #3 contacts when the follower finger 50 enters one of the peripheral notches 48 in the counter section 42 near the end of the apparatus cycle, the #4 contacts of the relay magnet RM3 are slow to open and the conveyor motor M1 will continue to operate for a predetermined period of time after the counter section 42 has received its full quota of impulses. This delayed action of the magnet RM3 establishes the position of the axis  $y-y$  and the time constant which is thus added to the normal period of operation of the conveyor motor M1 is such that the short load L2 will come to rest with its mid-point in approximate register with the axis  $y-y$ .

It is pointed out that where a load length is encountered which does not fall within the predetermined short load length range but rather falls within the long load length range, the follower finger 54 will be disposed within the depression 52 at a time when the light beam B is continuously interrupted and thus the position of the group of contacts associated with the relay magnet RM2 will be such that the #2 contacts are open and the circuit for the relay magnet RM3 will not be available for energization.

With the mid-point of the short load L2 in register with the axis  $y-y$ , it is essential that the chutes 18 and 20, rather than the chutes 16 and 20 be energized for strapping purposes at the end of the apparatus cycle. Accordingly, a chute transfer solenoid or switching magnet SM2 is operatively connected to the chute transfer switch CTS and functions, when energized, to open the #1 contacts

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and close the #2 contacts of this switch, thereby disabling the previously described input circuit to the input terminal 60 of the chute 16 and replacing it with a similar circuit for the input terminal 64 of the chute 18, this latter circuit however passing through the #1 contacts of the relay magnet RM3 to obtain the benefit of the delayed action of the magnet which is necessary not only to add a time constant to the duration of conveyor motor operation, but also to hold the #1 contacts of the relay magnet RM3 open for a short period of time and delay the operation of the strapping machine chutes 18 and 20 until the load has travelled the additional distance required to bring its mid-point into register with the axis  $y-y$ . The circuit for the input terminal 64 extends from the positive side of the line, through lead 61, #3 contacts of the counter section 42, lead 63, #1 contacts of the relay magnet RM3, lead 167, #2 contact of the chute transfer switch CTS, lead 173, chute terminal 64, and leads 169, 71, 73, 75 to the negative side of the line.

Transfer of the contacts of the chute transfer switch CTS is effected under the control of the #5 contacts of the relay magnet RM2, these latter contacts being closed after the trailing edge of the load L2 has moved forwardly past the light beam B and the latter has been restored and the amplifier circuit 37 thus energized to cause consequent energization of the relay magnet RM2.

Reversing of the chute transfer switch CTS is effected by energization of the solenoid SM2, the circuit for this solenoid extending from the positive side of the line, through leads 171, #2 contacts of the delayed action relay magnet RM3, lead 175, solenoid SM2, lead 177, #5 contacts of the relay magnet RM2 (now closed by reason of the energization of the magnet), and leads 179, 117, 97, 99, 53 to the negative side of the line. Because this last mentioned chute transfer circuit includes the #2 contacts of the delayed action relay magnet RM3, the #2 contacts of the strapping station SS with its mid-point in register with the axis  $y-y$  whereupon the chutes 18 and 20 will be energized simultaneously upon delayed closure of the #1 contacts of the relay magnet RM3 as previously described. Such energization of the chutes 18 and 20 will, of course, initiate a complete strapping machine cycle which when carried to completion, will result in the application of the two steel straps 12 to the load L2, automatic resetting of the machine, and movement of the load out of the strapping station.

From the above description it is believed that the nature and advantages of the present load positioning apparatus will be readily understood and that adaptations other than those specifically disclosed herein for exemplary purposes will readily suggest themselves. For example, the axes  $x-x$  and  $y-y$  at the strapping station SS do not necessarily represent a mid-plane between two respective spaced apart chutes inasmuch as it is contemplated that under certain circumstances the load positioning apparatus of the present invention may be effective to position successive indiscriminate length loads so that their mid-points will automatically and selectively be brought into register with transverse planes which represent the planes of operation of single chutes or planes of operation which represent optimum load-placement for strapping operations involving two or more chutes. Selective single chute strapping in different zones at the strapping station may be desirable in cases where plastic strapping is required for certain loads and steel strapping is required for certain other loads. It is further contemplated that the present load positioning apparatus may be employed for the selective placement of loads which fall within three or more ranges of load lengths so that their mid-points will register with a commensurate number of axes, each representing a load position where optimum strapping conditions for a particular load length range will obtain.

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In the foregoing description and in the claims, the term "mid-point," as applied to a load, is to be construed as meaning a point which lies on a transverse plane passing through a load substantially mid-way or centrally of the load so that it is equally spaced from the leading and trailing edges of the load. Furthermore, in the claims, where it is specified that such a mid-point move into register with an operating instrumentality it is not necessarily implied that such operating instrumentality shall perform its useful work directly at said mid-point. The operating instrumentality may be in the form of a gang of operating tools or devices which, when considered collectively, have a common effective operating point or region which, when in register with the mid-point of the load, affords optimum placement of the load for operation thereon by the operating instrumentality. Thus, in the case of a multi-chute strapping machine, where it is specified that the mid-point of a load be positioned in effective register with a strapping chute, it will be understood that the position attained by the mid-point of the load need not necessarily be a position of actual physical register with the vertical transverse plane of the chute since it may be some offset position in either the leading or trailing direction of the load, such position being an "effective" position of register with the specified chute by reason of the existence of some other chute, or combination of chutes which, when coupled with the specified chute, afford a mid-point location for the load where optimum strapping conditions will obtain when the strapping machine is energized.

By way of further definition, it is pointed out that the terms "leading edge" and "trailing edge" as applied to a given load do not necessarily imply the foremost or rearmost point or edge on the moving load. A shoulder or projection on a load, or even a visible marking applied to a load for sensing purposes, may constitute the leading or trailing edge of such load. Generally speaking, such portions of a given load as serve initially and terminally to energize or deenergize the load sensing means may be regarded as the leading and trailing edges respectively. By the same token, where the length of a load is referred to, it is implied that such length be considered as the distance between the leading and the trailing points on the load which are effectively sensed by the sensing means or device, whether or not this distance represents the true linear length of the load.

It should be further distinctly understood that the invention is not to be limited to the specific electrical or mechanical components shown in the accompanying drawings and described in this specification as various changes in the details of construction and substitution of components are contemplated. For example, the impulse emitting devices 30 and 32 need not necessarily be in the form of cogwheel emitters since any form of mechanism which will cause the emission of electrical impulses in timed relation to the rate of movement of the loads from a loading station to a strapping station may be employed. Similarly, the use of mechanical impulse-receiving and storing devices or counters such as the devices 42 and 44 which are in the form of peripherally notched disks and are indexed under the control of a stepping magnet represents only the presently preferred form of counter. It is possible to substitute electronic counters for the counters 42 and 44, there being available upon the market Sylvania and other so-called glow counters which are capable of receiving and storing electrical impulses and which, when a predetermined number of impulses have been received, are capable of, themselves, emitting an impulse for the performance of useful work as, for example, the initiation of strapping machine operations. Finally, the photoelectric cell 62 for sensing the leading and trailing edges of the load may, if desired, be replaced by other suitable sensing means such as a limit switch or the like. Regardless of the nature of the particular sensing means employed,

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such sensing means may, if desired, be made responsive to predetermined markings on, or portions of, the load during travel thereof through the sensing station, whether these portions represent the leading or trailing edges of the load or other fixed portions. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. The combination with a strapping machine establishing a strapping station, a strapping chute disposed at said strapping station for applying a strap to successive indiscriminate length loads positioned at said strapping station, said loads varying in length with respect to a predetermined maximum length load, a conveyor for transporting the loads successively from a loading station to the strapping station, and a motor operatively connected to the conveyor in driving relationship, of a load positioning apparatus for controlling the terminal position of each load at the strapping station with respect to the strapping chute and a leading and trailing edge of the load, said load positioning apparatus comprising a sensing device positioned along the path of travel of the loads and effective to sense said leading and trailing edges thereof, the effective distance between said sensing device and the strapping chute being substantially equal to one-half said maximum length, a first impulse-emitting device effective when energized to emit electrical impulses in timed relation to the rate of movement of the load along said path and at a rate which is such that during passage of a maximum length load past the sensing device a predetermined quota of impulses will be emitted, a second impulse-emitting device effective when energized to emit electrical impulses at a rate equal to twice the rate of emission of impulses by the first impulse-emitting device, means operable upon sensing of the leading edge of a load by said sensing device for energizing said first impulse-emitting device to the exclusion of the other impulse-emitting device, means operable upon sensing of the trailing edge of a load by said sensing device for actuating the second impulse-emitting device to the exclusion of the first impulse-emitting device, an impulse-receiving counter operatively connected to said impulse-emitting devices and means effective when said predetermined quota of impulses have been received by said counter for disabling said motor.

2. The combination with a strapping machine establishing a strapping station, a strapping chute disposed at said strapping station for applying a strap to successive indiscriminate length loads positioned at said strapping station, said loads varying in length with respect to a predetermined maximum length load, a conveyor for transporting the loads successively from a loading station to the strapping station and an electric motor operatively connected to the conveyor in driving relationship, of a load positioning apparatus for controlling the terminal position of each load at the strapping station with respect to the strapping chute and a leading and trailing edge of the load, said load positioning apparatus comprising a sensing device positioned along the path of travel of the loads and effective to sense said leading and trailing edges thereof, the effective distance between said sensing device and the operating instrumentality being substantially equal to one-half said maximum length, an impulse-receiving counter effective when a predetermined number of impulses have been received thereby to disable said electric motor, means operable upon sensing of the leading edge of each load by said sensing device for initially transmitting electrical impulses to said counter at a rate which is such that said predetermined number of impulses will be received by the counter during passage of a maximum length load past said sensing device, and means operable upon sensing of the trailing edge of a load for doubling the rate of transmission of electrical impulses to said counter whereby, when said predeter-

mined number of impulses has been received by the counter, the load will be so positioned that its mid-point will be in register with said strapping chute.

3. The combination with a strapping machine establishing a strapping station, a strapping chute disposed at said strapping station for applying a strap to successive indiscriminate length loads positioned at said strapping station, said loads varying in length with respect to a predetermined maximum length load, a conveyor for transporting the loads successively from a loading station to the strapping station, an electric motor operatively connected to the conveyor in driving relationship, and an electric circuit for said motor, of a load positioning apparatus for controlling the terminal position of each load at the strapping station with respect to the strapping chute and a leading and trailing edge of the load, said load positioning apparatus comprising a sensing device positioned along the path of travel of the loads and effective to sense said leading and trailing edges thereof, the effective distance between said sensing device and the strapping chute being substantially equal to one-half said maximum length, a first impulse-emitting device effective when energized to emit electric impulses in timed relation to the rate of movement of the load along said path and at a rate which is such that during passage of a maximum length load past the sensing device a predetermined quota of impulses will be emitted, a second impulse-emitting device effective when energized to emit electrical impulses at a rate equal to twice the rate of emission of impulses by the first impulse-emitting device, means operable upon sensing of the leading edge of a load by said sensing device for energizing said first impulse-emitting device to the exclusion of the other impulse-emitting device, means operable upon sensing of the trailing edge of a load by said sensing device for actuating the second impulse-emitting device to the exclusion of the first impulse-emitting device, relay means operable upon energization and deenergization to close and open said electric circuit respectively, a holding circuit for said relay means and including a pair of holding contacts, an impulse-receiving counter operatively connected to said impulse-emitting devices and normally effective to maintain said holding contacts closed, said counter being effective when said predetermined quota of impulses have been received thereby to open said holding contacts and thus deenergize said relay means and consequently said electric circuit for the motor.

4. The combination with a strapping machine for applying strapping to successive indiscriminate length loads at a strapping station and which vary in length in relation to a predetermined maximum length load, a strapping chute at said strapping station and effective upon energization of the strapping machine to feed the strapping to a load positioned at said station, a conveyor for transporting the loads successively from a loading station to the strapping station, and an electric motor operatively connected to the conveyor in driving relationship, of a load positioning apparatus for controlling the terminal position of each load at the strapping station with respect to the chute and the leading and trailing edges of the load, said load positioning apparatus comprising a sensing device positioned along the path of travel of the loads and effective to sense said leading and trailing edges thereof, the effective distance between said sensing device and a predetermined transverse plane passing through the strapping station being substantially equal to one-half said maximum length, an impulse-receiving counter effective when a predetermined number of impulses have been received thereby to disable said electric motor and energize said strapping machine, means operable upon sensing of the leading edge of each load by said sensing device for initially transmitting electrical impulses to said counter at a rate which is such that said predetermined number of impulses will be received by the counter during passage of a maximum length load

past the sensing device, and means operable upon sensing of the trailing edge of a load for doubling the rate of transmission of electrical impulses to said counter.

5. The combination with a strapping machine for applying strapping to successive indiscriminate length loads at a strapping station and which vary in length in relation to a predetermined maximum length load and within a first range of relatively long load lengths above a predetermined intermediate load length and a second range of relatively short load lengths below such intermediate load length, a plurality of longitudinally spaced strapping chutes at said strapping station and effective upon selective energization thereof to apply strapping to the loads at said strapping station, a conveyor for transporting the loads successively from a loading station to the strapping station for selective register with said chutes, an electric motor operatively connected to the conveyor in driving relationship, and an electric circuit for the motor, of a load positioning apparatus for controlling the terminal position of each load at the strapping station with respect to said chutes and the leading and trailing edges of the loads, said load positioning apparatus comprising a sensing device positioned along the path of travel of the loads and effective to sense said leading and trailing edges thereof, the effective distance between said sensing device and a predetermined transverse plane passing through said strapping station being substantially equal to one-half said maximum length, a first impulse-emitting device effective when energized to emit electrical impulses in timed relation to the rate of movement of the load along said path and at a rate which is such that during passage of a maximum length load past the sensing device a predetermined quota of impulses will be emitted, a second impulse-emitting device effective when energized to emit electrical impulses at a rate equal to twice the rate of emission of impulses by the first impulse-emitting device, means operable upon sensing of the leading edge of a load by said sensing device for energizing said first impulse-emitting device to the exclusion of the second impulse-emitting device, means operable upon sensing of the trailing edge of a load by said sensing device for actuating the second impulse-emitting device to the exclusion of the first impulse emitting device, relay means operable upon energization and deenergization to close and open said motor circuit respectively, a holding circuit for said relay means and including a pair of holding contacts, an impulse-receiving counter operatively connected to said impulse-emitting devices and normally effective to maintain said holding circuit closed, said counter being effective when said predetermined quota of impulses have been received thereby and said sensing device is out of load-sensing relationship to open said holding contacts and thus deenergize said relay means and consequently the motor circuit to terminate the movement of the load at said strapping station so that its mid-point registers with said transverse plane and the load is in effective register with certain selected chutes, and also to energize said selected chutes for application of strapping to the load, second relay means effective upon energization to override said holding contacts and maintain said holding circuit effective, said counter also being effective when said predetermined quota of impulses have been received thereby and said sensing device is in load-sensing relationship with a load which falls within said first range of relatively long load lengths to energize said second relay means and also to energize other selected chutes for application of strapping to the load, said second relay means being self-deenergizing and effective to maintain said holding circuit energized for a predetermined length of time to allow mid-point to become displaced from said transverse plane and bring the load into register with said other selected chutes.

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References Cited by the Examiner

UNITED STATES PATENTS

2,818,795	1/1958	Gustafson	-----	100—4
2,976,657	3/1961	Cloud	-----	53—75
2,982,064	5/1961	Hopkinson	-----	53—76
2,987,162	6/1961	Griffin	-----	198—21

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18

3,019,577	2/1962	Slamar et al.	-----	53—74
3,045,402	7/1962	Keely et al.	-----	53—75
3,225,683	12/1965	Rhea	-----	100—4
3,225,684	12/1965	Smith	-----	100—14 X

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