April 12, 1927. 1,624,223

W. D. EAKIN

FESTOONING RACK

Original Filed Dec. 22, 1924 3 Sheets-Sheet 1

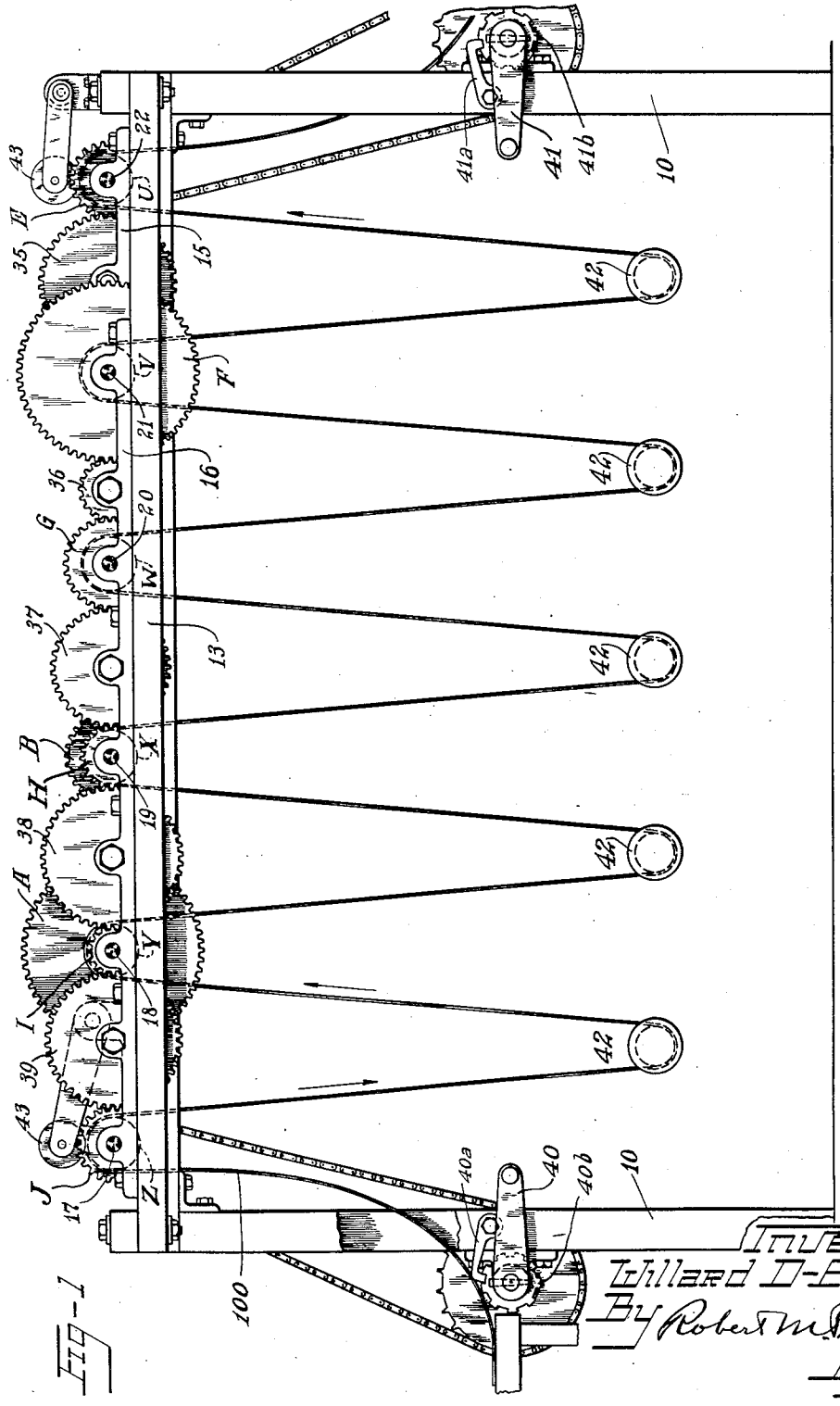


Fig-1

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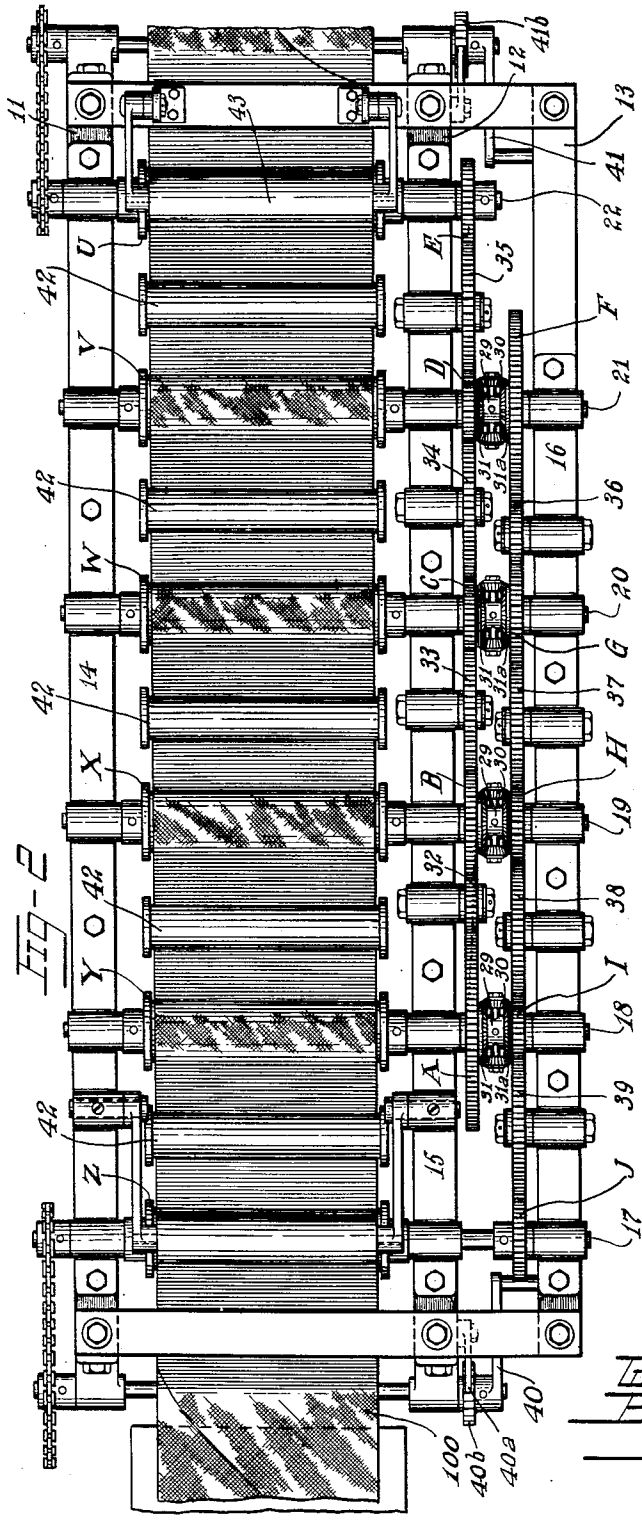


FIG-2

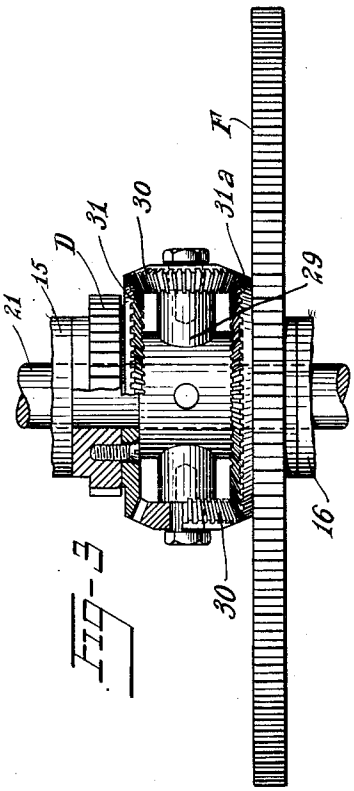


FIG-3

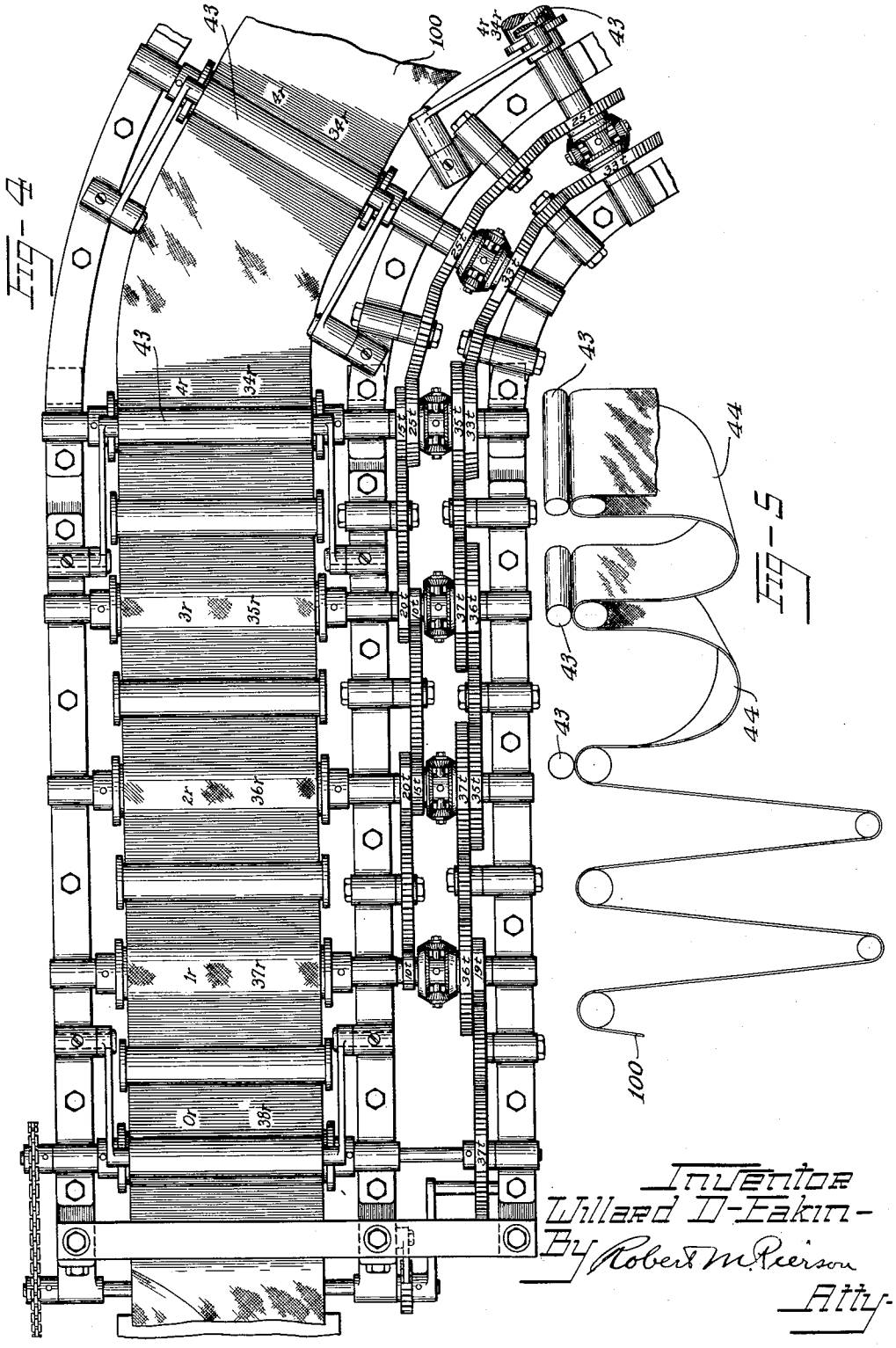
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FESTOONING RACK

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UNITED STATES PATENT OFFICE.

WILLARD D. EAKIN, OF AKRON, OHIO, ASSIGNOR TO THE B. F. GOODRICH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FESTOONING RACK.

Application filed December 22, 1924, Serial No. 757,459. Renewed March 2, 1927.

This invention relates to devices, commonly called festooning racks, for supporting a variable surplus of continuous strip material between a source of supply, from which the material is fed into the rack, and a place of disposal, to which the material is drawn from the rack. Such devices may be used as drying or cooling racks, or for compensating irregularities or intermittence of supply or disposal of the strip material. An example is the case of tire-building material, produced in continuous strip form by splicing together short lengths at one point and building successive tires from the continuous strip at another point to which the strip is fed, through the festooning rack.

Heretofore racks have been employed in which festoon-supporting rolls are loosely journaled and are driven by the work, the festoons of the latter being so weighted by means of rolls mounted in their lower loops as to draw the strip material into the rack, upon the relieving of tension upon the incoming material and to shorten, against the force of the weighting means, in the withdrawal of material from the rack. The frictional resistance of the rolls and of the work in a rack of this type requires a considerable tension in the work for drawing it into and out of the rack, and especially in a rack adapted to support a large number of festoons, since the frictional resistance of the rolls and the resistance of the work to flexure in passing about the several rolls are cumulative in their tensioning effect. While such tension in the work is not objectionable in the case of strong and relatively inextensible material such as square-woven tire fabric, it may be so in the case of stretchable material such as cord-tire fabric or tubed or calendered stock having no reinforcement or backing.

Because of the cumulative or progressive character of such resistances, such racks require the provision of special means, such as a counter-weighted frame constituting a journal mounting for the floating rolls mounted in the festoons, for keeping the festoons at uniform length and thus providing for full capacity and smooth operation of the rack, and the counter-weight expedient is not well adapted for very extensive drying racks, for example, both because of the high tension necessarily imposed upon the work and the inconvenience of maintaining rigidity, and uniform rise and fall of the respective ends, of a very long floating frame.

I am aware that a rack heretofore has been employed comprising a series of festoon-supporting rolls having a train of gearing connecting the same for driving them at suitable relative speeds to keep the festoons of uniform length in an in-feeding movement, and another train of gearing for like effect in an out-feeding movement, each train of gearing being connected to the several rolls by one-way clutches so that either train may operate independently of the other to drive the rolls, this arrangement being adapted to avoid excessive strains upon the work.

Am imperfection of this type of rack, however, is that when the two trains of gearing inadvertently are simultaneously driven, for simultaneous in-feeding and out-feeding of material, each roll responds only to the one-way clutch which is adapted to drive it the faster, and this results in festoons becoming of unequal length and requiring to be readjusted with relation to each other.

My chief object is to provide a device of this character in which the festoon-supporting rolls may be driven by means other than the work, so as to avoid excessive strain upon the latter, and which will be adapted for simultaneous in-feeding and out-feeding without disparity in the lengths of the festoons. A further object is to provide a rack of the geared-roll type adapted for feeding the material through the rack in either direction with uniformity in the lengths of festoons. Another object is to provide for reversing either the in-feed or the out-feed, as for withdrawing material from the in-feed end of the rack for correction of imperfections, or to restore to the rack an overdraft of material at the out-feed end, without disparity in the lengths of festoons, and I provide means whereby this may be accomplished even though the feed at the other end of the rack be simultaneous and either positive or negative. Still other objects are to provide, in a device of this character, for supporting and handling, as described, a very large number of festoons, and for

feeding the material, through the series of festoons, in a sinuous general course, so as to obtain exposure of a large quantity of stock, as for drying, without requiring an excessively long room.

Of the accompanying drawings:

Fig. 1 is a side elevation of the preferred embodiment of my invention as employed for moderate quantities of stock, a part being broken away.

Fig. 2 is a plan view of the same.

Fig. 3 is a detached plan view on a larger scale of drive gearing for one of the rolls, parts being sectioned and broken away.

Fig. 4 is a somewhat diagrammatic plan view of the preferred embodiment of my invention as employed for a large quantity of stock, one end portion thereof being omitted.

Fig. 5 is a side elevation of parts thereof showing the preferred construction and mode of operation for feeding the stock in a sinuous general course.

Referring to the drawings, the invention will best be understood by first referring to the embodiment of Figs. 1 to 3, wherein the rack comprises corner posts 10, 10 supporting at their tops a horizontal frame comprising three parallel beams 11, 12, 13, on the upper faces of which are mounted respective, horizontally elongated journal brackets 14, 15, 16.

Journaled in said brackets are parallel, preferably equally spaced, transverse shafts 17, 18, 19, 20, 21, 22 for a series of festoon-supporting rolls Z, Y, X, W, V, U, preferably of equal diameter, secured respectively upon said shafts between the journal brackets 14 and 15, and adapted to support and drive the work, here shown as a strip of tire fabric 100.

It will be understood that for a simple in-feed of material, if the festoons are to elongate equally, the roll at the delivery end of the series remaining still, the relative surface speeds or feed ratios of the other rolls, from the delivery end toward the receiving end of the rack, must be 1:2:3:4 etc. For a simple out-feed, conversely, the roll at the receiving end of the series remaining still, the feed ratios of the other rolls must be 1:2:3:4, etc., from the receiving end of the rack toward the delivery end.

For so driving the rolls each of the roll shafts except the two end ones of the series has a spider 29 secured thereon, between the journal brackets 15 and 16. Journaled on each arm of each spider, on a radial axis, is a gear 30, here shown as being of the bevel type, meshed with a pair of bevel gears 31, 31^a loosely journaled on the roll shaft, their hubs rotatably abutting the hub of the spider, said bevel gears being secured to respective spur gears which are loosely journaled on the roll shaft and at their hubs rotatably abut the journal brackets 15 and 16 respectively to maintain the bevel gears 31, 31^a in mesh with the gear 30, the assembly constituting a set of differential gears of the planetary type.

The spur gears on the inner side of the series of spiders are designated A, B, C, and D, and are operatively connected with each other and with a spur gear E secured on the shaft 22 of one end roll of the series by a set of idler gears 32, 33, 34, 35, journaled upon suitable stub shafts projecting from the journal bracket 15, so that the gears A, B, C, D and E are adapted to be driven in the same direction. The spur gears on the outer side of the series of spiders are designated F, G, H, and I, and are operatively connected with each other and with a spur gear J secured on the shaft 17 of the other end roll of the series by a set of idler gears 36, 37, 38, 39, journaled upon suitable stub shafts projecting from the journal bracket 16, so that the gears F, G, H, I, and J are adapted to be driven in the same direction.

Means such as the hand cranks 40, 41 and intermediate drive connections shown are provided for driving the respective end shafts 17 and 22 of the series, and flanged floating rolls 42, 42, which may be of very light weight, may be mounted in the respective lower loops of the festoons to prevent the latter from swinging into contact with each other and to assure sufficient driving pressure and contact of the work upon the supporting rolls when the festoons are of short length. Pinch rolls such as the rolls 43, 43 preferably are mounted as shown to press the work against the end rolls of the series, at least, to prevent slippage when the work outside of and adjacent the rack is not under tension. Means such as a ratchet 40^a or 41^a and a panel 40^b or 41^b may be provided for holding one crank and its train of gears while the other crank is turned to drive the other train of gears.

The construction is such that when the gear train A, B, C, D, E remains still and the gear train F, G, H, I, J is driven, for an in-feed of strip material from the left of Fig. 1 or 2, for example, the feed ratios of the rolls from left to right, in the six roll rack here shown, will be 5:4:3:2:1:0. As the receiving end roll Z is non-rotatable with relation to its spur gear J, while the other rolls which turn in this simple in-feeding movement have only half the angular speed of their respective spur gears I, H, G and F, because of the interposition of the differential spiders 29, it results that the ratios of the outer set of spur gears, for a six roll rack, must be as shown in the following tabulation, which shows also the surface speeds or feed ratios of all six rolls for a simple in-feeding movement from the left,

the rolls as here shown being of equal diameter.

Roll	Z	Y	X	W	V	U
Surface speeds	5	4	3	2	1	0
Spur gears	J	I	H	G	F	
Gear ratios	$\frac{8}{5}$:	$\frac{4}{4}$:	$\frac{4}{3}$:	$\frac{4}{2}$:	$\frac{4}{1}$	

(24 : 15 : 20 : 30 : 60)

The surface speeds and spur gear ratios for a seven roll rack are as follows:

Surface speeds	6	5	4	3	2	1	0
Gear ratios	$\frac{10}{6}$:	$\frac{5}{5}$:	$\frac{5}{4}$:	$\frac{5}{3}$:	$\frac{5}{2}$:	$\frac{5}{1}$	

(20 : 12 : 15 : 20 : 30 : 60)

The ratios for the other set of spur gears, A, B, C, D, and E, are of course the reverse of those set out for the spur gears J, I, H, G, F. Thus the drive of each train of spur gears is adapted to drive the several festoon-supporting rolls, except the opposite end roll, at appropriate relative speeds to keep the festoons of equal length during either an in-feeding or an out-feeding movement imparted by that train of gears while the other train of spur gears remains still, and in fact to impart such speeds or components of speed to the several rolls as to keep the festoons of equal length although the other train of gears be simultaneously driven in either direction and at varying relative speeds.

First assume, for example, that a uniform out-feeding movement of five length-units, to the right, is to take place simultaneously with a uniform in-feeding movement of the same length from the left. The construction is such that the ratios of the components of speed imparted to the several rolls by the respective gear trains will be as follows:

Out-feed train	0	1	2	3	4	5
In-feed train	5	4	3	2	1	0
Total movement	5	5	5	5	5	5

Next assume, for example, that a uniform out-feeding movement of ten length-units, to the right, is to take place simultaneously with a uniform in-feeding movement, from the left, of five length-units. The two trains of spur gears are adapted to impart components of speed to the several rolls in ratio as follows:

Out-feed train	0	2	4	6	8	10
In-feed train	5	4	3	2	1	0
Net speed of roll	5	6	7	8	9	10
Net loss of material from each festoon	1	1	1	1	1	

Next assume that a uniform in-feeding movement of ten length-units from the right is to take place simultaneously with a uniform in-feeding movement of five length-units from the left. The ratios of the speed components imparted to the several rolls by the respective gear trains will be as follows:

In-feed from right	0	← 2	← 4	← 6	← 8	← 10
In feed from left	→ 5	→ 4	→ 3	→ 2	→ 1	0
Net speed of roll	→ 5	→ 2	← 1	← 4	← 7	← 10
Net gain of material in each festoon	3	3	3	3	3	

As the same principles hold good for varying speeds and for all combinations of in-feeding and out-feeding movements, it will be seen that the festoons will always remain of equal although changing length, the feeding movements of the two trains of gearing being so integrated by the differential gears as to produce this result.

For a very long rack the construction shown in Figs. 4 and 5 is preferred, the proper speed ratios of adjacent rolls being provided by the use of twin gears so as to avoid the use of very large gears which would be necessary if the type of gearing shown in the embodiment of Figs. 1 to 3 were used for a very long rack. The markings on the gears in Fig. 4, "37^t", "36^t", etc., designate the number of teeth required upon the respective gears to provide the proper ratios for a rack adapted to support 38 festoons of changing length, and the festoon-supporting rolls are marked in the drawing "0^r", "1^r", "2^r", etc., to indicate the relative number of revolutions imparted to them by the inner train of gearing while the outer train remains still, and "38^r", "37^r", "36^r", etc., to indicate the relative number of revolutions imparted to them when the outer train of gearing is driven and the inner train remains still.

Beveled gears, designated 25^t, 25^t, and 33^t, 33^t, are employed for carrying the drive about a turn in the general course of the rack, the gears in the turn and at the terminals of the turn preferably being of the same size so that the corresponding festoon-supporting rolls will have equal speed and the intervening festoons 44, 44, Fig. 5, will not change length but, being originally arranged at a suitable length to permit the strip to be fed through the turn without climbing the end-flanges of the rolls in the turn (designated "4^r, 34^r"), will remain at such length although the festoons in the straight reaches of the rack increase and decrease in length. The even speed rolls, interposed in the series of rolls of graduated speed, are also adapted to maintain the intervening festoons at short length to provide a passage-way thereunder. Pinch rolls 43, 43 are preferably mounted to coact with the even speed rolls, to prevent slippage of the work incident to the unequal length of festoons on opposite sides of the roll.

While I prefer to use the differential gears

or like gearing for integrating the effect of the two drives, because of their dependability of operation and economy of construction, I do not wholly limit my claims thereto, and I do not limit my invention to a construction in which the differential gears are mounted in the immediate vicinity of the festoon-supporting rolls.

The invention is susceptible of various modifications within the scope of the appended claims.

I claim:

1. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of a continuous strip of material to feed the same longitudinally through the succession of loops, means common to said rolls for driving them in a determinate speed ratio, means common to said rolls for driving them in a speed ratio differing from that of the first said means, and means for integrating the driving effects of the two said means upon the rolls.

2. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of a continuous strip of material to feed the same longitudinally through the succession of loops, two operatively overlapped trains of gearing each having rotary members pairing with rotary members of the other train, and means actuated by relative rotary movement of the members of each pair for driving one of the rolls.

3. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of a continuous strip of material to feed the same longitudinally through the succession of loops, means for driving the in-feeding end roll of the series, means operable independently thereof for driving the out-feeding end roll of the series, and means interposed operatively between the two end-roll-driving means and adapted to be driven thereby upon the differential principle for driving an intermediate roll of the series.

4. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of continuous strip material to feed the same longitudinally through the succession of loops, respective gears secured upon journals of the end rolls of the series, a spider member secured upon a journal of an intermediate roll, a pair of gears mounted upon said journal on opposite sides of said spider member for rotation with relation thereto, respective idler gears entraining the gears of the pair with the end-roll gears respectively, a planetary member journaled on said spider member, on an axis radial with relation to said intermediate roll, and operatively associated with the two gears of the pair, and separate means for driving the respective end-roll gear trains.

5. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of a continuous strip of material to feed the same longitudinally through the succession of loops, means for driving certain of said rolls at speeds graduated along the series, and separate means for driving the same at reversely graduated speeds, said rolls being so mounted as to feed the strip through a turn in its general course.

6. A festooning rack comprising a series of rolls adapted to engage respectively in successive loops of a continuous strip of material to feed the same longitudinally through the succession of loops, means for driving certain of said rolls at speeds graduated along the series, and separate means for driving the same at reversely graduated speeds, the said driving means being adapted to drive certain adjacent rolls of the series at even speed.

7. A festooning rack as defined in claim 5 in which the driving means is adapted to drive the rolls in the turn at even speed.

8. A festooning rack as defined in claim 2 in which each train of gearing comprises twin gears loosely journaled on the shafts of certain of the rolls and idler gears operatively connecting pairs of the said twin gears.

In witness whereof I have hereunto set my hand this 17th day of December, 1924.

WILLARD D. EAKIN.