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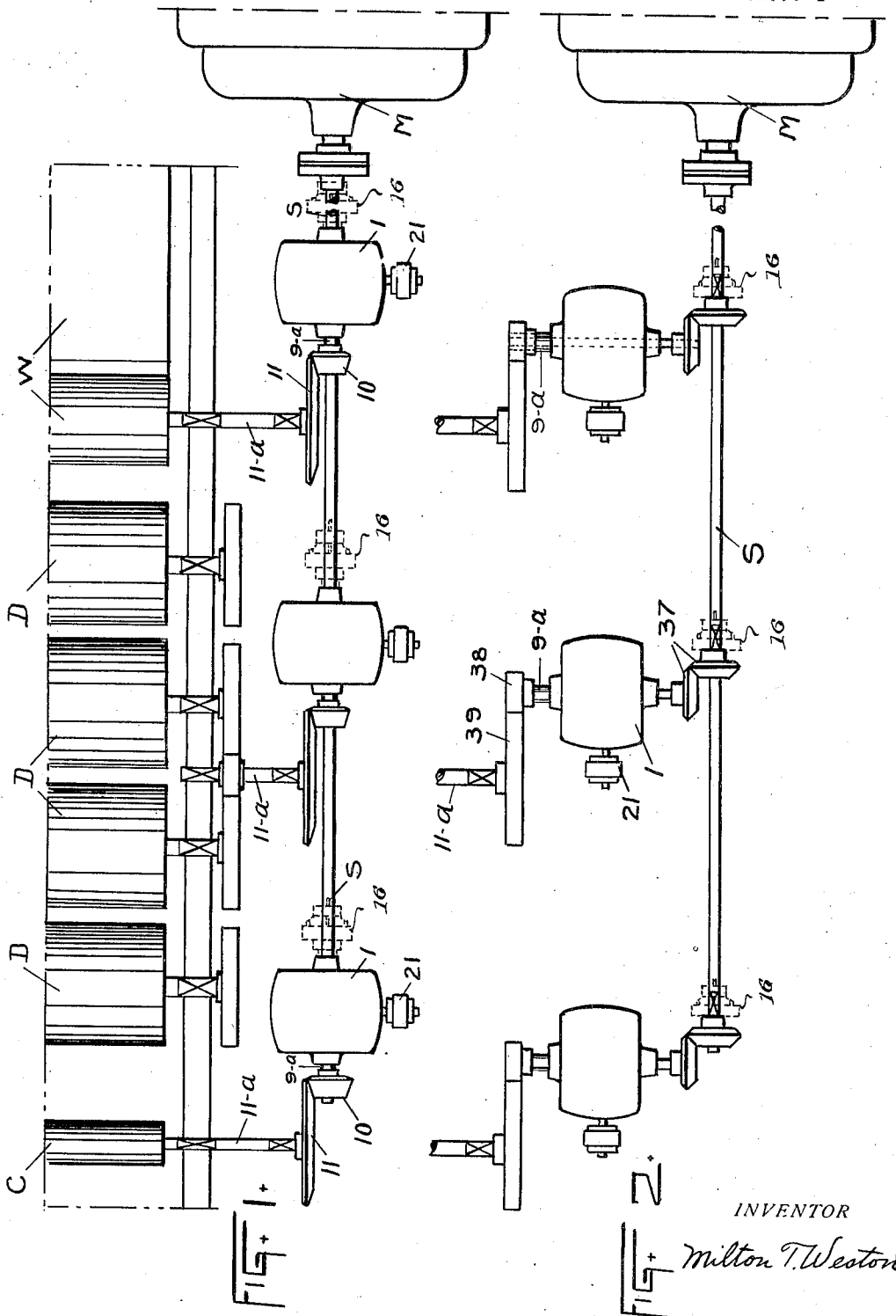
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M. T. WESTON

DRIVE FOR PAPER MACHINES

Filed July 6, 1923

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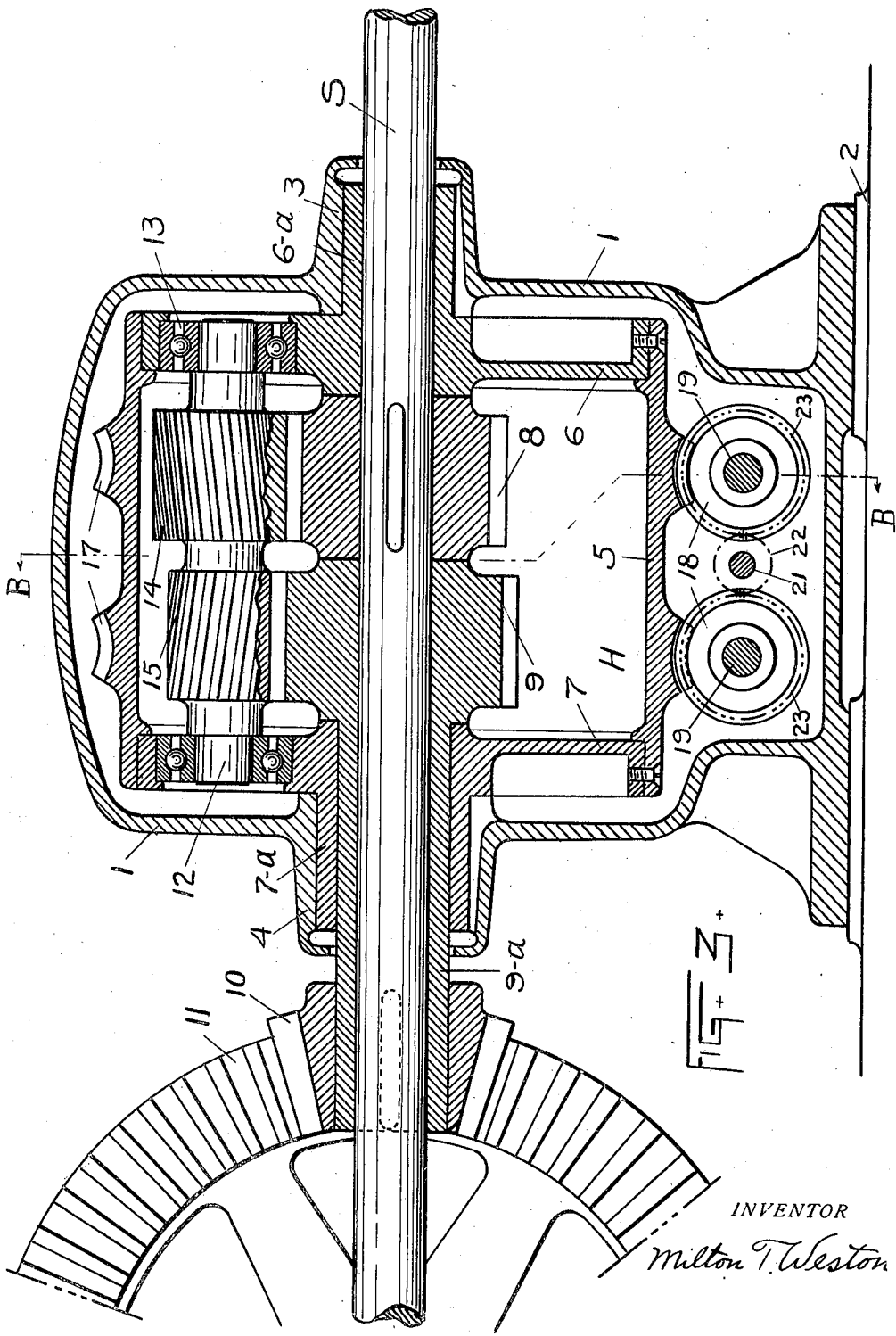
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Filed July 6, 1923

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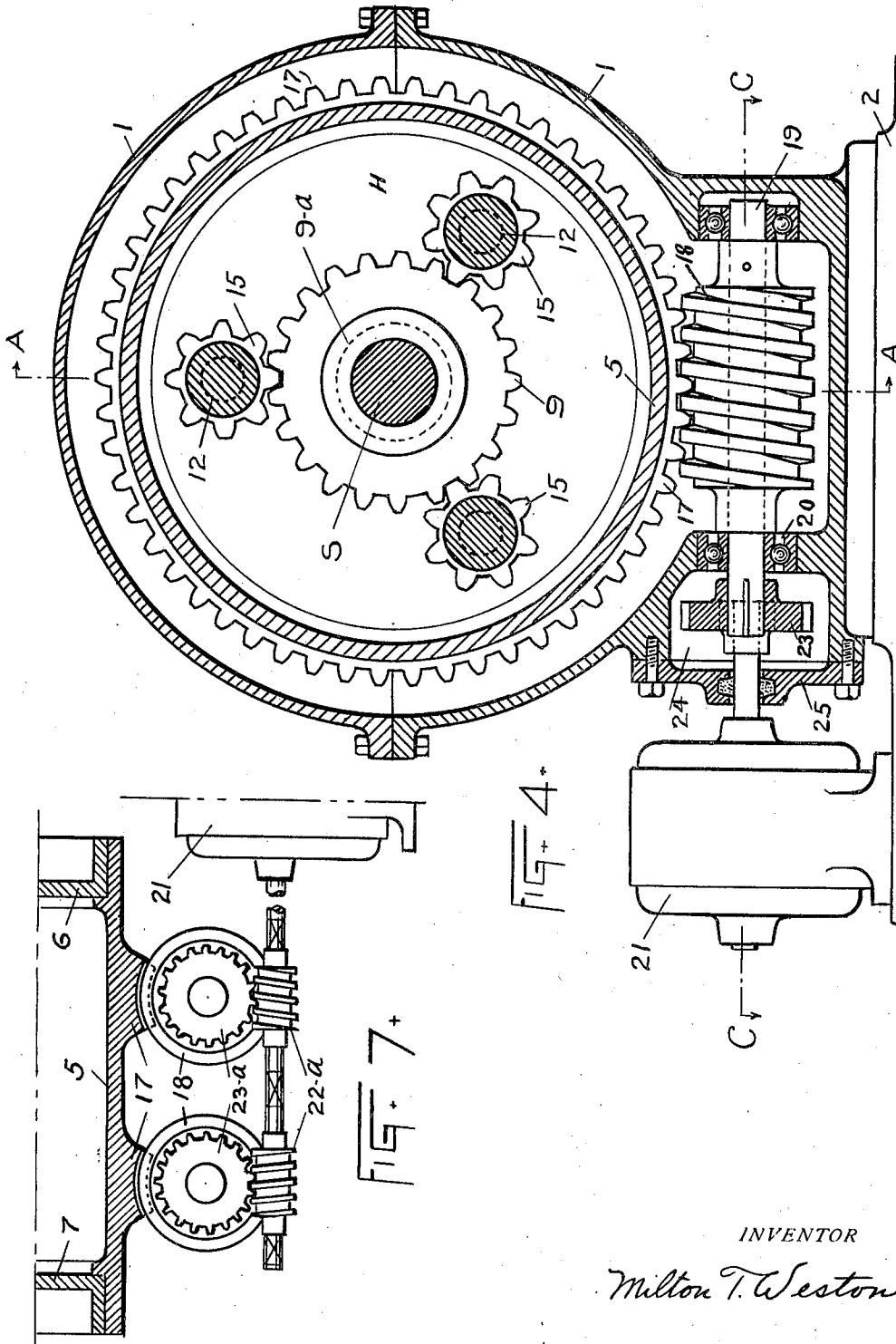
Aug. 3, 1926.

1,594,394

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Filed July 6, 1923

5 Sheets-Sheet 3



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Milton T. Weston

Aug. 3, 1926.

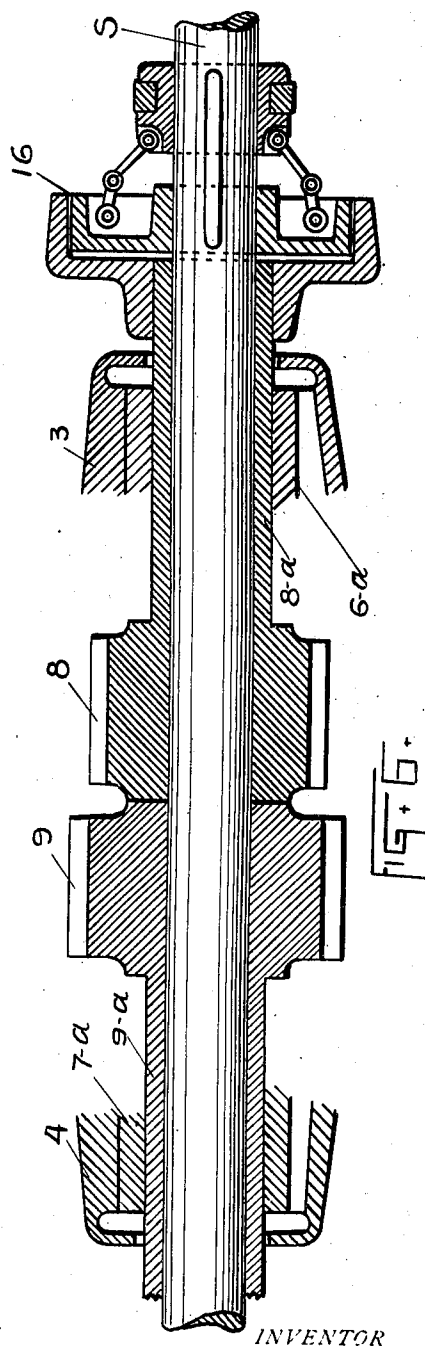
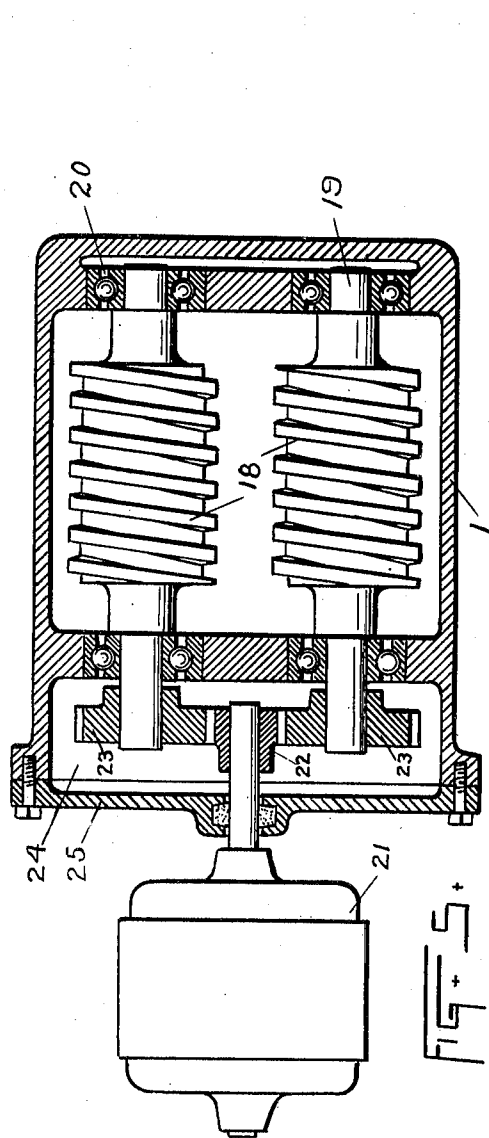
1,594,394

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Filed July 6, 1923

5 Sheets-Sheet 4



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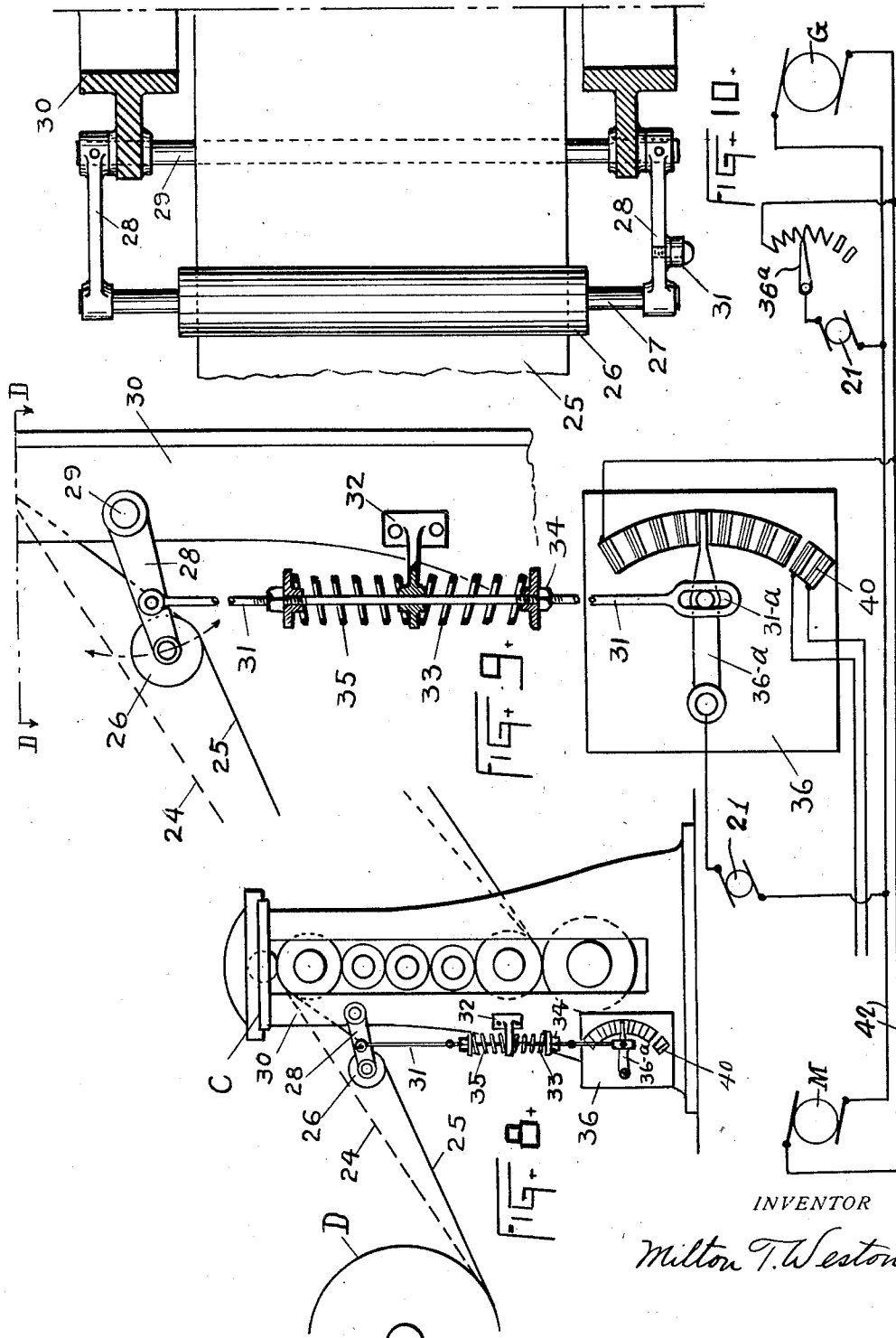
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M. T. WESTON

DRIVE FOR PAPER MACHINES

Filed July 6, 1923

5 Sheets-Sheet 5



UNITED STATES PATENT OFFICE.

MILTON T. WESTON, OF NEW YORK, N. Y.

DRIVE FOR PAPER MACHINES.

Application filed July 6, 1923. Serial No. 649,938.

My invention relates more especially to paper machine drives and constitutes in part a continuation of my copending application on variable speed devices, Serial Number 550,041, and filed April 6, 1922.

with my improved web controlled speed-regulating mechanism;

Figure 9 is a fragmentary enlargement of the same, parts being broken away and parts shown in section; and

Figure 10 is a top plan view of the same substantially corresponding to the line D—D of Figure 9, portions of the frame being shown in section.

The principal improvements in my present application, which will be clearly pointed out hereinafter, are the following:

1. The use of a master shaft, which may itself be variable in speed, to which the several units of my drive are positively connected and by which they are positively driven at a constant speed relation to each other, each of the said units however, being subject to individual speed variation controlled from sources entirely separate and distinct from the master shaft. The master shaft, therefore, will have no influence whatever on the variable speed element in any unit of my invention.

2. Connecting the several sections of a paper machine by positive gearing to the several units of my drive in such a manner that the several sections of the paper machine will each have a slower speed than the preceding section in order to allow for a minimum shrinkage of the paper web as it progresses from the "wet end" to the "finishing end" of the machine.

3. The provision of a system of "change gears" whereby the range of the speed variation in any unit may be readily and conveniently changed thus making it possible to provide for a relatively small variable speed range with any one set of "change gears" and thereby get a very small increment of change in the variable speed for each step in the electrical control.

4. The provision of an adjustable tension device for the paper web whereby any increasing or diminishing tension in the paper web, as it passes from one section to another, will operate an electric controlling device for the variable speed motor which drives the variable speed element in any unit of my drive, to cause relatively small increments of change in the speed of said motor.

In the making of paper it will be understood that there is a progressive shrinkage

The primary object of my invention is to provide an improved construction, combination and arrangement of parts in a driving unit for machines of this character whereby the motive power can be delivered thereto by positively operating connections and whereby any particular part or section of the machine may be regulated and governed with a high degree of precision.

Another object of the present invention is to provide an improved paper machine drive which can be more economically constructed and operated than is possible with present well-known machines of this character.

Another object of invention is to provide means of improved construction whereby any particular unit of a paper making machine can be operated within variable limits under the control of the paper web at or near said unit.

Other and further objects will appear in the specification and be pointed out in the appended claims, reference being had to the accompanying drawings which exemplify my invention in certain preferred embodiments.

In the drawings—

Figure 1 is a top plan view of one embodiment of my invention;

Figure 2 is a similar top plan view showing a modified arrangement of the driving units as applied to a paper making machine;

Figure 3 is a longitudinal section of one of the driving units, said section corresponding substantially to the line A—A of Figure 4, parts being shown in elevation;

Figure 4 is a transverse section on the line B—B of Figure 3, parts being shown in elevation;

Figure 5 is a detailed section corresponding to the line C—C of Figure 4, parts being shown in plan;

Figure 6 is a fragmentary axial section of portions of one of the driving units shown in Figure 1;

Figure 7 is a partial front elevation of one form of change gears;

Figure 8 is a side elevation of a calendar section of a paper making machine provided

of the paper web as it passes through the paper machine, due to the elimination of the moisture. This shrinkage, however, is not uniform but varies with the thickness of the web, the temperature of the dryers and other causes, which make it necessary to vary the speed of the several sections of the paper machine while in operation to meet the changing conditions. There is a minimum shrinkage, however, which may be depended upon under any condition and I propose to provide for this basically by means of direct positive gearing between the several sections of the paper machine and a master driving shaft, through the several units of my invention. Each section of the paper machine will be positively geared to a slightly lower speed than the preceding section but the total difference in speed between the two extremes of the machine will be approximately equal to the predetermined minimum shrinkage or variation. The determination of this preliminary shrinkage or variation in speed is preferably made without considering the variable speed element in the several units. Any further variation in speed from the predetermined speed is automatically impressed upon the predetermined speed by the variable speed elements in each of the units of my drive in the manner to be described hereinafter. It is one of the very great advantages of my invention that the initial predetermined variation in speed between the several sections of a paper machine can be positively maintained without interference from or interfering with the variable element in the several units. Providing this initial variation in the speed of the several sections of the paper machine, reduces by that amount, the variation required in the units of my drive under operating conditions. I therefore require a correspondingly smaller range of speed variation to obtain the desired speed. By means of the "change gears" I am able to adapt the range to the conditions imposed.

Each variable speed unit of my drive consists essentially of a casing 1 mounted on a suitable foundation or base 2. In casing 1 is a cage or housing H which is revoluble on its trunnions in the bearings 3 and 4 at opposite ends of the casing 1.

The revoluble cage H, has the same function as the revoluble housing in my pending application above referred to but its construction differs somewhat especially as regards the holding worm gear. The said cage H is preferably composed of a cylindrical shell 5, in the opposite ends of which are secured the discs 6 and 7. Disc 6 has a trunnion 6^a revoluble in the bearing 3 and disc 7 has a trunnion 7^a revoluble in bearing 4 of the casing 1. Passing through the trunnions 6^a and 7^a and concentric therewith is a driving shaft S, on which is keyed the

driving pinion 8. This driving pinion 8 is preferably loosely fitted on the shaft S to permit an endwise movement of same on account of expansion or inaccuracies in setting the several units. Adjacent to the driving pinion 8 and occupying the remaining space on the shaft S within the cage H, is a driven gear 9 free to revolve on the shaft S. The said driven gear 9 is provided with an extended sleeve hub 9^a which projects through the trunnion 7^a and is free to revolve with the driven gear 9. Bevel pinion 10 is keyed on the projecting end of the sleeve hub 9^a and meshes with a bevel gear 11 mounted a suitable driving shaft 11^a, of a corresponding section of a paper machine.

In the cage H, spaced at a distance from the driving shaft S and parallel to it, are the secondary shafts 12, three being shown to give a balanced construction, mounted in ball bearings 13, in the discs 6 and 7 of the revoluble cage H. On the shafts 12 and preferably integral therewith are gears 14 meshing with driving pinion 8, and pinions 15 meshing with driven gear 9.

It will be clear from the foregoing, therefore, that the driving shaft S is revoluble in the trunnion 6^a and in the driven gear 9 with its sleeve hub 9^a while the said sleeve hub 9^a is revoluble in the trunnion 7^a. The cage H, as before stated, is revoluble on its trunnions 6^a and 7^a in the bearings 3 and 4 respectively in the casing 1.

A slight modification in the mounting of the driving pinion 8 is shown in Fig. 6 wherein the said driving pinion 8 is provided with an extended sleeve hub 8^a projecting through the trunnion 6^a and revoluble therein. The shaft S is also revoluble in the driving pinion 8 and its sleeve hub 8^a. On the projecting end of the sleeve hub 8^a is secured one member of a friction or other clutch 16 while the mating member of the said clutch 16 is keyed to the driving shaft S adjacent to the first mentioned member. The engagement of the clutch 16 will cause the pinion 8 to be driven by the shaft S, while disengaging the said clutch will leave the driving shaft S free to revolve in the pinion 8 and that particular unit will become inoperative without effecting any other unit. In the embodiments of my invention shown in Figures 1 and 2, clutches 16 may be employed as indicated for releasably connecting the several variable speed mechanisms to the common drive shaft. According to the embodiment of my invention shown in Figure 1, these clutches may, if desired, be constructed according to the construction and arrangement of parts shown in Figure 6. According to the embodiment shown in Figure 2, the same form of clutch may be employed by securing the outer friction element to the shaft bevel gear 37.

Referring to Fig. 3 in the particular, it

will be seen that there is a positive gear train between the driving pinion 8 on driving shaft S and the driven machine shaft 11^a on a section of the paper machine. It will be obvious therefore that there can be no variation in the speed ratio between the driving shaft S and the machine shaft 11^a on which the bevel gear 11 is mounted, as long as the cage H is held so as not to revolve on its trunnions. Under these conditions each unit of my drive is a simple speed reducer and can be designed for any desired speed ratio between the driving shaft S and the driven machine shafts 11^a and this ratio will remain constant.

The variation in speed in any unit of my drive is brought about by revolving the cage H, or permitting same to revolve on its trunnions 6^a and 7^a. The gearing then becomes epicyclic and the speed of the driven machine shaft 11^a will vary with respect to the driving shaft S, to a degree depending upon the speed of rotation of the cage H.

The mechanical arrangement for holding the cage H, or limiting the revolution of same, is clearly shown in Figs. 3, 4 and 5 in which I show worm wheels 17 mounted directly on the shell 5 of the cage H. They are shown integral with the shell 5 but may be mounted in any approved manner. These worm wheels 17 engage respective mating worms 18, secured to shafts 19, revolvable in bearings 20, in the casing 1. This plural arrangement of the mechanical control of the cage H is especially advantageous for heavy duty work where the tooth pressure on the worm wheel and worm would be too great for a single worm wheel and worm of the relative size shown. Another advantage of the plural arrangement is that it permits the use of much smaller teeth than if a single worm and worm wheel were used which will give a correspondingly lower variation of speed in the unit for each unit of change in the speed of the controlling motor. The worm wheels 17 and worms 18 are preferably designed with a thread angle whose tangent is slightly less than the coefficient of friction, in which case the worms 18 can not be driven by the mating worm wheels 17. The cage H will therefore be positively held or locked by the worms 18 unless said worms are driven by some external power. It will be clear from the foregoing, that when all of the worms 18 of the several units of my drive are stationary all of the cages H are positively locked against any revolution whatsoever and therefore the predetermined speed relation between the several sections of the paper machine will be positively maintained. There can be no relative variation due to extraneous and undesirable causes such as belt slippage in belt controlled units, slippage between friction members of friction disc devices and elec-

trical slippage in separate electrically driven units.

It will be equally clear that if all of the worms 18 are revolved at the same speed there will be no relative variation in the speed of the several sections of the paper machine. The variation in speed which takes place will be the same in each unit. It is therefore necessary to provide an individual or separate control for each unit of my drive in order to secure the desired variation in any one or more of the several units. For this purpose I prefer to use a small variable speed motor 21, which need only be large enough to overcome the slight frictional resistance between the worms 18 and worm wheels 17. This variable speed motor 21 is shown mounted on the base 2 and is connected to worm shafts 19 by means of the spur "change gears" 22 and 23 shown in Figs. 3, 4 and 5. These change gears 22 and 23 are preferably located in a separate chamber 24 in the casing 1 so that a different set may be readily substituted without drawing off the oil in the cage chamber of the casing 1. A cover 25 gives easy access to the chamber 24.

Referring particularly to Fig. 5 it will appear that the ratio of the motor pinion 22 to the gears 23 is approximately 2 to 1 which will give a certain range of speed variation for a given speed range of the motor 21. Change gears of other ratios may be substituted for those shown to give different ranges of speed variation in the several units of my drive. In cases where a small speed variation with a greater degree of accuracy is required, I provide worm and worm wheel change gears 22^a and 23^a as illustrated in Fig. 7. It will be clear that the ratio of the speed of the motor 21 of the worm shafts 19 will be much higher with the worm and worm wheel change gears than with the spur gears shown in Figs. 4 and 5. The result will be a correspondingly lower number of revolutions of the cage H for the same number of revolutions of the motor 21 and a proportionately smaller variable speed range in the unit in which the worm and worm wheel change gears are used. It will also be clear that there will be a correspondingly smaller increment of change in the variable speed for each unit of variation in speed of the motor 21, as for example, the variation caused by one step in the electric controller to be referred to hereinafter.

In Figs. 8, 9 and 10 I show a spring controlled tension device for maintaining the desirable tension in the paper web as it passes from one section of a paper machine to another. The tension device is shown mounted on a calendar section C of a paper machine but it is to be adapted for mounting on each of the sections so that the de-

sirable tension in the paper web may be yieldingly maintained between the several sections. In these same views I show an electric controller for the motor 21, attached to the paper tension device.

Referring to Figs. 8 and 9 the dotted line 24 represents the path of the paper web from one section of the machine to another as in present practice. The full line 25 is the normal path of the paper web when deflected by the tension device which consists of a roller 26 extending across the face of the paper web 25 as shown clearly in Fig. 10. Roller 26 is mounted on a shaft 27 revolvable in bearings on the outer ends of arms 28 which are carried by the rocker shaft 29 mounted on the frame 30 of the calendar section C. Connected to one of the arms 28 is a rod 31 passing through a bracket 32 attached to the frame 30 as shown. Seated against the underside of the bracket 32 is a compression spring 33, the amount of compression being regulated by the nut 34 on the rod 31. It will be clear that the spring 33 may be made to exert a downward pull on the arm 28 and cause the roller 26 to bear against the paper web 25, the degree of pressure being governed by said compression spring 33. Above the bracket 32 is seated the compression spring 35 which is intended merely as a cushion for the tension device when the paper web breaks from any cause permitting the roller 26 to drop from its normal position in an obvious manner.

The rod 31 is shown extended downward and engaging the arm of an electric controller 36, illustrated diagrammatically in Figs. 8 and 9. The lower end of the rod 31 is preferably slotted at 31^a to allow a limited variation in the path of the paper web without effecting the controller 36. The tension device is set in practice approximately as illustrated in Figs. 8 and 9 in which the controller arm 36^a is shown in an intermediate position. Any increase in the tension in the paper web 25 will lift the roller 26 and the rod 31, which will shift the controller arm 36^a in an upward direction after the limit of the slot 31^a has been exceeded. This shifting of the controller arm 36^a in an upward direction will cause a change in speed in the variable speed motor 21 which will in turn cause a change in the variable speed of that particular drive unit. The direction of change in speed will be such as to cause the corresponding paper machine section to revolve at a slightly lower speed thus permitting slack to accumulate in the paper web and allowing the roller 26 to gradually move downward and return the controller arm 36^a to its normal position. The variable speed motor 21 will then resume its normal speed which will give the normal speed variation in the drive unit for that paper machine

section. It will be obvious that any decrease in tension in the paper web 25 will allow the roller 26 to swing below its normal position and operate the controller arm 36^a in the opposite direction. This will cause a change in speed in the variable speed motor 21 in a direction to vary the speed in the drive unit to increase the speed in the corresponding paper machine section to take up the excessive slack and return the roller 26 and controller arm 36^a to their normal intermediate positions. The adjustment of the speed of any one section of the paper machine will effect the adjustment of the other sections but the necessary re-adjustment among the several sections will take place simultaneously and automatically in the manner described for one section.

In Fig. 1 I have shown the preferred application of my drive units to the several sections of a paper machine. The paper machine in this view is shown as composed of three sections—the wet end W—the dryer section D and a calendar section C. This may be regarded as typical but in practice there are six, eight or more sections depending upon the speed and size of the paper machine. Each unit of my drive is shown positively geared to its corresponding machine section by means of the bevel pinion 10, fixed on the sleeve hub 9^a, and meshing with driven bevel gear 11 mounted on the driving shaft 11^a of the corresponding paper machine section as previously described. This form of geared connection may be changed, however, to any other form of positive gearing which may prove more suitable for any particular case.

In Fig. 1 the driving shaft S is shown continuous and is therefore a master shaft controlling all of the units of my drive by means of positive gearing in the manner fully described hereinbefore. The master shaft S is preferably driven by a variable speed motor M, but may be driven in any other approved manner.

In Fig. 2, I show the several units of my drive arranged in parallel instead of tandem as in Fig. 1. Each unit is connected to the master shaft S by the bevel gears 37 and to the several sections of the paper machine by means of the spur gears and pinions 38 and 39 by corresponding to the bevel gears 10 and 11 in Fig. 1.

At present when a break occurs in the paper web 25, there is a considerable loss of paper before the machine can be stopped on account of the momentum of the various rotating parts. In order to stop the machine as quickly as possible when a break occurs I employ the principle of dynamic braking by providing a resistance load for the driving motor M in the following manner. Additional segments 40 are provided on the controller 36 to which the said load resist-

ance is connected, the segments 40 being beyond the normal range of the controller arm 36^a which, as before explained, controls the small variable speed motor 21. The controller arm 36^a will therefore be brought into contact with the segments 40 only when there is a break in the paper web allowing the roller 26 to swing downward beyond its normal working range. For this purpose, contacts 40 may be suitably designed and arranged so as to be bridged by the contact arm 36^a which thereby completes an energizing circuit thru a circuit-opening relay (not shown) which causes the introduction of a braking resistance into the motor-energizing circuit in a manner well known to those skilled in the art. The position of the controller arm 36^a is regulated by the cushioning spring 35. The electric circuits for connecting up the controller 36 to the several motors are not shown but are regular and well known to any one skilled in the art.

Recent developments in paper making machines have been toward higher speeds necessitating a corresponding development in the method of driving them. With my invention I am able to control the variation in speed between any two sections of a paper machine by increments of speed changes as small as 1/1000 of 1% and to automatically change the direction of these increment changes to prevent an accumulated variation which would cause breakage in the paper web.

Having thus described my invention I claim as new and desire to secure by Letters Patent:—

1. In a paper-making machine, a section of said machine which is to be variably driven with respect to another section of said machine, positively geared variable speed mechanism having positively geared driving connections with said paper-machine section, and automatically variable speed means connected to said variable speed driving mechanism for accelerating or retarding the speed of said machine section between changing speed limits.

2. In a paper-making machine, a section of said machine which is to be variably driven with respect to another section of said machine, positively geared variable speed mechanism having positively geared driving connections with said paper-machine section, a variable speed motor positively geared to said variable speed driving mechanism and means for accelerating or retarding the speed of said motor for varying the speed of said machine-section between changing speed limits.

3. In a paper-making machine, a section of said machine which is to be variably driven with respect to another section of said machine, positively geared variable speed mechanism having positively geared

driving connections with said paper-machine section, and positively operating variable speed means connected to said variably speed driving mechanism for accelerating or retarding the speed of said machine section between changing speed limits.

4. In a paper-making machine, a plurality of paper-machine sections, power driven positively geared variable speed mechanism positively geared to each of said paper-machine sections and variable positively-operating means positively connected to and accelerating or retarding each variable speed mechanism.

5. In a machine of the character described, the combination with a plurality of sections, of said machine, of a power shaft common to said sections, variable speed mechanism constituting a positive connection between each machine section and said shaft, and web-controlled means for separately operating each variable speed mechanism to vary the speed of that section relatively to that of other sections.

6. In a machine of the character described, the combination with a plurality of paper machine sections, of variable speed mechanisms constituting a power transmitting unit positively connected to each of said paper machine sections, an individual motor connected to each of said sections thru the variable speed mechanism corresponding thereto, and web controlled means for controlling the operation of said individual motor.

7. The combination with a plurality of paper machine sections, of a power shaft common to all of said sections, variable speed mechanism positively connecting said power shaft to each of said paper machine sections, said variable speed mechanism being adapted under a normal tension in the web to transmit a normal fixed speed to the corresponding paper machine section, and web controlled means for operating said variable speed mechanism for varying the speed of said paper machine section relatively to the speeds of other paper machine sections.

8. A paper machine comprising a plurality of sections operating successively upon a paper-forming web, a positively geared differential mechanism thru which each of said sections is driven, means for driving said differential mechanisms, and means subject to variations in tension in said web for varying the operation of each differential mechanism independently of the others.

9. The combination with a plurality of paper machine sections, of a power shaft common to all of said sections, a fixed casing for each paper machine section and thru which said power shaft extends, a gear cage revolvable about the axis of said shaft, means within said fixed casing for revolving said revolvable cage independently of said shaft,

and a gear train connecting said power shaft to each of said paper machine sections, said gear train including gears journaled in said revolvable cage on axes eccentric to the rotary axis of said gear cage and having geared connections with said power shaft and said paper machine sections respectively.

10. The combination with a plurality of paper machine sections, of a power shaft common to said paper machine sections, a drive gear for each paper machine section, said drive gear being keyed to said power shaft, a driven gear for each paper machine section, said driven gear being rotatable relatively to said power shaft, and other gears rotatable in unison and meshing respectively with said drive and driven gears, said other gears being movable around the axis of said shaft to vary the speed of said paper machine section.

11. The combination with a plurality of paper machine sections, of a fixed gear casing for each section of the paper machine, a drive shaft journaled in all of said fixed casings and movable axially therein, variable speed mechanism for connecting said drive shaft to each of said sections of the paper machine, said variable speed mechanism comprising a gear cage journaled in said fixed casing, gears journaled in said gear cage on axes eccentric to the axis of said drive shaft, drive and driven gears having connections with said power shaft and the corresponding paper machine section respectively, said drive and driven gears meshing respectively with said eccentrically journaled gears, and web controlled means for locking said gear cage or imparting thereto a movement for controlling the speed of said paper machine section.

12. The combination with a plurality of paper machine sections, of a fixed gear casing in each section of the paper machine, a drive shaft journaled in all of said fixed casings and movable axially therein, variable speed mechanism for connecting said drive shaft to each of said sections of the paper machine, said variable speed mechanism comprising a gear cage, journaled in said fixed casing, gears journaled in said gear cage and adapted thereby to form a variable speed connection between said drive shaft and the corresponding paper machine section, and web controlled means for locking said gear cage or imparting thereto a movement for controlling the speed of said paper machine section, said web controlled means including a power operated gear train embodying change speed gears whereby the range of speed variation may be changed.

13. The combination with a paper machine comprising a plurality of variably driven sections, a power shaft common to

all of said paper machine sections, fixed casings corresponding respectively to said paper machine sections, said power shaft being rotatably mounted in all of said fixed casings, a revolvable cage having its journaled axis coincident with the axis of said power shaft, a gear non-rotatably connected to said power shaft within said cage, a gear freely journaled on said shaft within said cage and having a concentric sleeve extending outwardly from said cage and casing, means for positively gearing said sleeve to the corresponding paper machine section, and web controlled means for controlling the revolution of said cage.

14. The combination with a plurality of paper machine sections operating in succession upon a paper forming web, of a power shaft common to all of said paper machine sections, variable speed mechanism constituting a positive drive connection between said power shaft and each of said paper machine sections, an electric motor for operating said variable speed mechanism, and web controlled means for controlling the operation of said motor.

15. The combination with a plurality of paper machine sections operating in succession upon a paper forming web, of a power shaft common to all of said paper machine sections, variable speed mechanism constituting a positive drive connection between said power shaft and each of said paper machine sections, an electric motor for operating said variable speed mechanism, and web controlled means for controlling the operation of said motor, said web controlled means comprising a motor circuit, and circuit controlling means operated by variations in the tension of the web operated upon by that section of the paper machine.

16. In a driving mechanism for paper machines, the combination with a plurality of paper machine sections, of a power shaft common to all of said paper machine sections, variable speed mechanism for positively gearing each of said paper machine sections to said power shaft, and means for operating said variable speed mechanism for each section, including change speed gears for varying the range of speed variation.

17. A paper machine comprising a plurality of sections performing successive operations on a paper-making web, a main motor for driving one of said sections, variable positively geared means interposed between said main motor and the section which it drives, a variable speed motor for operating said variable positively geared means, and means for controlling the operation of said variable speed motor to vary the speed of that section relatively to the other sections.

18. A paper machine comprising a plu-

ality of sections over which the paper web travels, a shaft which drives one of said sections, a variable positively geared connection interposed between said shaft and the section which it drives, and means for varying the speed transmitted by said variable geared connection to correspond to changes in tension in said web as it approaches said section.

19. A paper machine comprising a plurality of sections over which the paper web travels, a device responsive to a change of tension in said web as it approaches one of said sections, a shaft which drives said section, a variable positively geared connection interposed between said shaft and that particular section of the paper machine, and means under the control of said tension-responsive device for varying the speed of transmission between said shaft and the section connected thereto by said variable geared connection.

20. A paper machine comprising a plurality of sections performing successive operations on a paper-making web, a main motor for driving one of said sections, variable positively geared means interposed between said main motor and the section which it drives, a variable speed motor for operating said variable positively geared means, and web controlled means for controlling the operation of said variable speed motor to vary the speed of that section relatively to the other sections.

21. The combination with a machine adapted to operate upon a paper web, a main motor, a drive gear receiving power from said main motor, a driven gear having power connections with said machine, planetary gears rotating in unison and meshing with said drive and driven gears respectively, a revoluble cage within which said planetary gears are journaled, an auxiliary motor for revolving said cage and moving said planetary gears around said drive and driven gears, and web controlled means for controlling the operation, of said auxiliary motor.

22. The combination with a plurality of paper machine sections, of a drive shaft common to all of said paper machine sections, a variable speed gear train connecting each of said paper machine sections to said common drive shaft, said gear train including a drive gear non-rotatably connected to said drive shaft, a driven gear, and planetary gears meshing with said drive and driven gears respectively and means variable in its action to correspond to the amount of slack of the web adjacent each of said paper machine sections for revolving said planetary gears around said drive and driven gears.

23. The combination with a plurality of paper machine sections, of a variable speed positively geared train driving each of said

paper machine sections said gear train including a drive gear, a driven gear and planetary gears meshing with said drive and driven gears respectively and movable around the peripheries of said drive and driven gears, and means variable in proportion to the amount of slack in the web adjacent each of said paper machine sections for controlling the movements of said planetary gears around the peripheries of said drive and driven gears.

24. In a machine of the character described, paper feeding rolls adapted to operate upon a web, a driven gear geared to said paper feeding rolls, a drive gear, planetary gears meshing respectively with said drive and driven gears and transmitting power from the former to the latter, means under the control of said web for revolving said planetary gears, and means for supplying power to said drive gear.

25. The combination with a plurality of paper machine sections, of a drive shaft common to all of said paper machine sections, a variable speed gear train connecting each of said paper machine sections to said common drive shaft, said gear train including a drive gear non-rotatably connected to said drive shaft, a driven gear freely journaled on said drive shaft, and planetary gears meshing with said drive and driven gears respectively and revoluble around the axis of said drive shaft, and means variable in proportion to the amount of slack in the web adjacent each paper machine section for revolving said planetary gears about the axis of said drive shaft.

26. The combination with a plurality of paper machine sections, of a drive shaft common to all of said paper machine sections, a variable speed gear train connecting each of said paper machine sections to said common drive shaft, said gear train including a drive gear non-rotatably connected to said drive shaft, a driven gear freely journaled on said drive shaft, and a compound planetary gear comprising gears meshing with said drive and driven gears respectively and revoluble around the axis of said drive shaft, and means variable in its action to correspond to the amount of slack of the web adjacent each of said paper machine sections for revolving said planetary gears around said drive shaft.

27. In a machine of the character described, paper feeding rolls adapted to operate upon a web, a driven gear geared to said paper feeding rolls, a drive gear coaxial with said driven gear, planetary gears rotating as a unit and meshing respectively with said drive and driven gears and transmitting power from the former to the latter, means under the control of said web for revolving said planetary gears, and means for supplying power to said drive gear.

28. In a paper making machine, a plurality of paper machine sections, positively geared variable speed mechanism positively geared to each of said paper machine sections for variably driving said paper machine sections to impart variable feeds to different portions of a paper forming web, and means for controlling the variation in speed of each variable speed mechanism, said means being under the control of a corresponding portion of said paper forming web.

29. The combination with a paper making machine comprising a plurality of successively arranged sections in series, of power transmission connections for driving said paper making machine sections, said power transmission connections including variable speed mechanism positively geared to one of said sections, and means operable in one direction only for accelerating or retarding the speed transmission of said variable speed mechanism.

30. The combination with a plurality of paper machine sections, of a power shaft common to all of said sections and variable speed means positively geared to and accelerating or retarding each of said paper machine sections from said common power shaft independently of the other sections.

31. In a paper machine drive, the combination with a plurality of paper machine sections, of positively geared variable speed mechanisms geared to and driving said paper machine sections respectively, and means for varying the speeds transmitted by said mechanisms to correspond to the changes in condition of the paper web at the respective paper machine sections.

32. In a machine of the character described, the combination with a plurality of paper machine sections respectively adapted to be operated at individually variable speeds, of a power shaft common to said sections, variable speed mechanisms positively connecting said power shaft to the respective paper machine sections and means variable in position depending upon the amount of slack in the web adjacent each section of the paper machine, said means being operatably connected to said positively connected variable speed mechanism of the corresponding paper machine section for varying the speed of said section to correspond to the amount of slack in said web.

Signed at New York, in the county of New York, and State of New York, this 11th day of June A. D. 1923.

MILTON T. WESTON.