

J. C. ANDERSON.
POWER TRANSMITTER.
APPLICATION FILED OCT. 25, 1906.

4 SHEETS—SHEET 1.

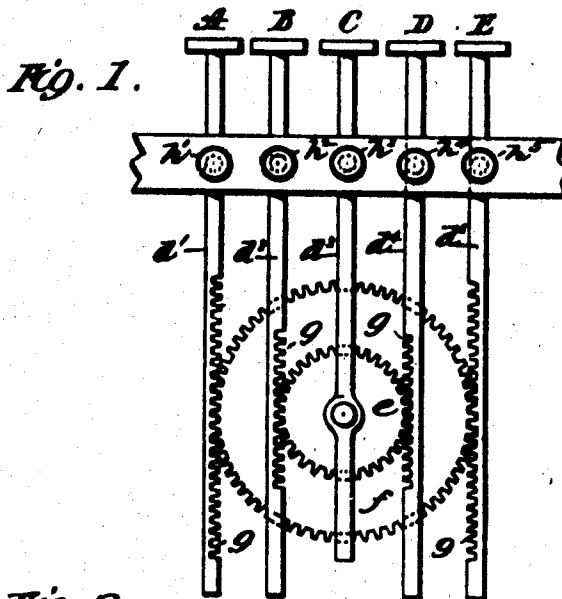
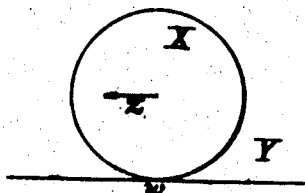


Fig. 2.

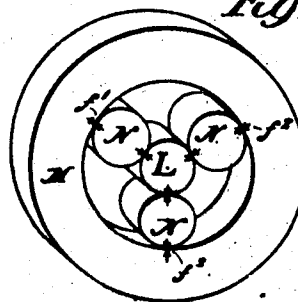
	REVERSE MOTION (FORCE DELIVERED UPWARD)					DIRECT MOTION (FORCE DELIVERED DOWNWARD)										
POWER FACTOR	$\frac{1}{3}$	$\frac{1}{2}$	1	2	3	4	3	2	$\frac{3}{2}$	$\frac{4}{3}$	1	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$
DRIVING (POWER)	E	B	A	A	A	A	E	A	B	A	C	B	D	C	C	D
FIXED	D	C	C	C	D	E	B	E	E	E		E	B	E	B	E
DRIVEN (WORK)	A	E	E	E	E	D	C	C	C	B	C	A	E	A	E	A

Fig. 3.



Witnesses
M. S. Ober
Waldo M. Chapin

Fig. 4.



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James C. Anderson
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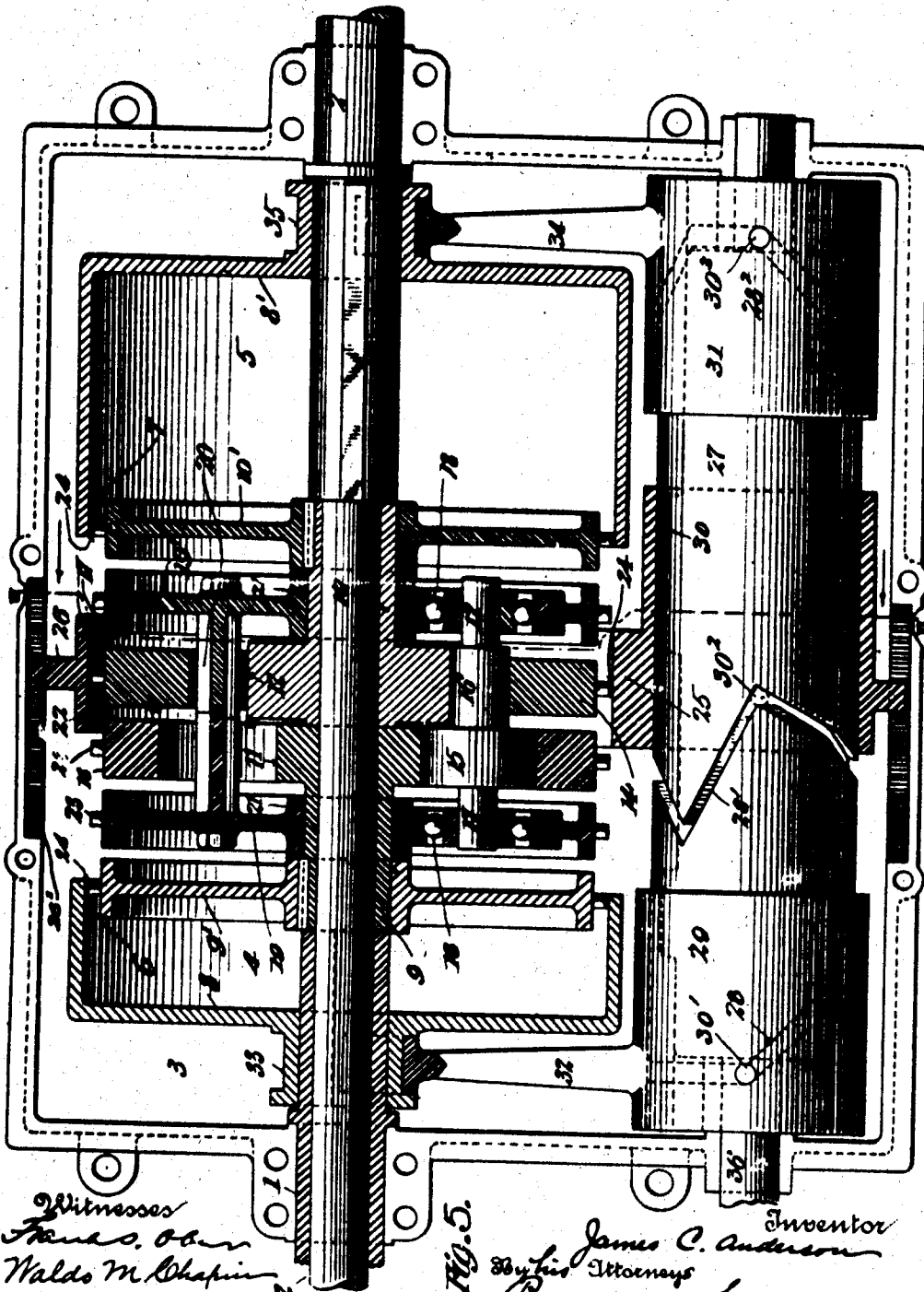
CANCELLED

No. 861,791.

PATENTED JULY 30, 1907.

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4 SHEETS—SHEET 2.



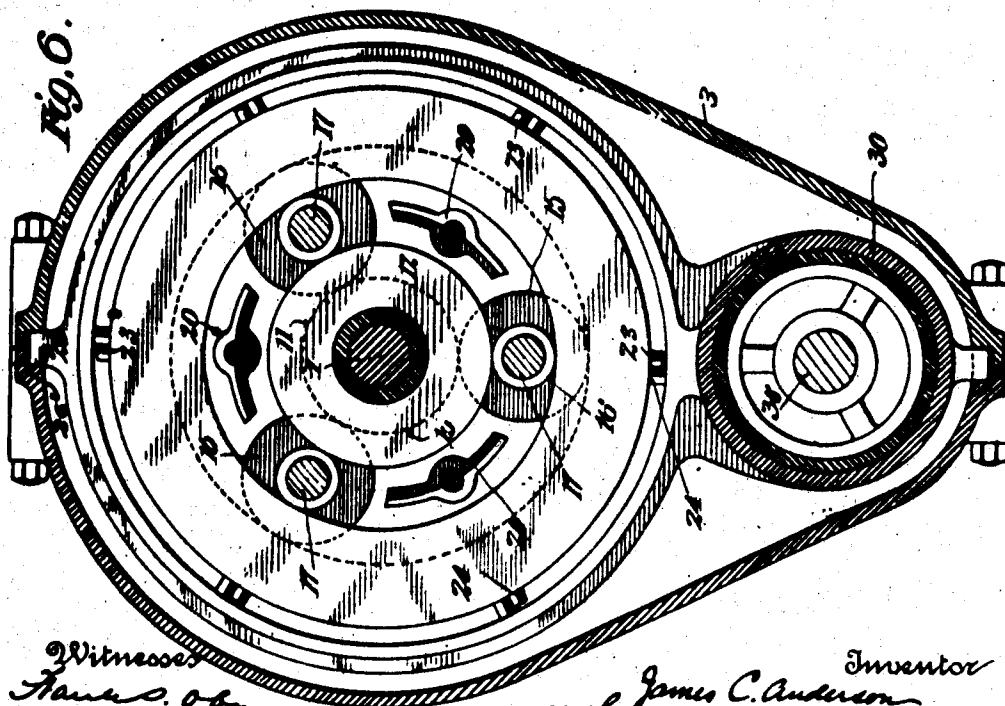
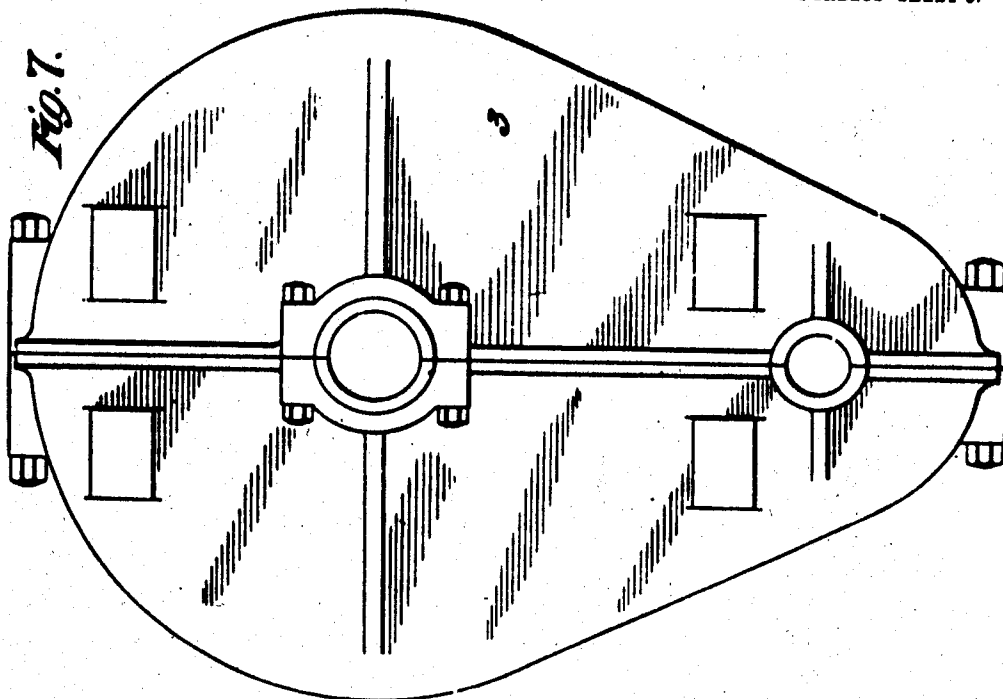
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4 SHEETS—SHEET 3.



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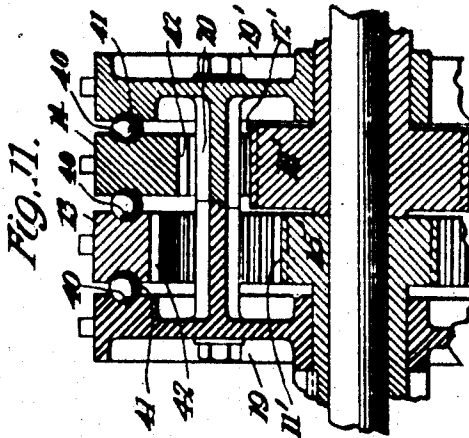
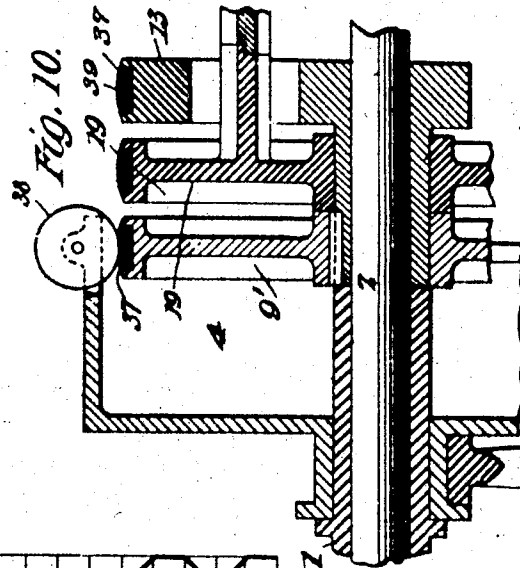
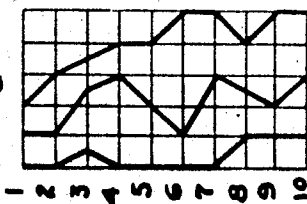
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4 SHEETS—SHEET 4.

POSITION OF CAM CYL.	DRIVING MEMBER	FIXED POSITION (Fig. 2a)	DRIVEN MEMBER (Fig. 2a)	RATIO OF DRIVEN TO DRIVEN	REMARKS.
1	9'	12	13	2.6-1	Fast Reverse
2	9'	12	14	4.4-1	Slow "
3	9'	14	15'	5.4-1	Disengaged
4	9'	13	15'	3.6-1	Slow Forward
5	9'	15	15'	2.8-1	"
6	9'	14	15'	2.0-1	"
7	15	13	15'	1.0-1	Direct Drive
8	15	13	15'	1.0-1.93	Fast Forward
9	15	14	15'	1.0-2.37	"
10	15	14	15'	1.0-2.37	"

Fig. 8.

Fig. 9.



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UNITED STATES PATENT OFFICE.

JAMES C. ANDERSON, OF RUTHERFORD, NEW JERSEY.

POWER-TRANSMITTER.

No. 861,791.

Specification of Letters Patent.

Patented July 30, 1907.

Application filed October 25, 1906. Serial No. 340,445.

To all whom it may concern:

Be it known that I, JAMES C. ANDERSON, a citizen of the United States, residing at Rutherford, in the county of Bergen and State of New Jersey, have invented certain new and useful Improvements in Power-Transmitters, of which the following is a full, clear, and exact description.

My invention relates to a transmission system or mechanism by which varying speed relations may be obtained between a driving shaft or member and any driven or operated part.

The principal object of the invention is to enable the speed ratio or power factor between the driving shaft and the driven part to be varied through a wide variety of values both for forward and reverse rotation, by a mechanism having high mechanical efficiency, and which permits of the changes being made easily and smoothly without material shock or jar, and without expert manipulation.

A further object of the invention is to provide a means by which the use of toothed gears of any form in such transmission mechanism may be avoided, thereby obviating the noise, wear, vibration, grease and expense always incident thereto.

The invention has finally for its object to provide a transmission mechanism which is light, strong, and built in accordance with the best engineering and mechanical principles with respect to wear, lubrication, strains, and general ease of action and freedom from vibration.

With these objects in view the invention consists in the features of construction hereinafter set forth and claimed.

In the drawings: Figure 1 is a diagrammatic view illustrating one of the principles of my invention; Fig. 2 is a tabular outline of certain results secured; Fig. 3 is a diagram illustrating another principle of the invention; Fig. 4 is a construction embodying such principle; Fig. 5 is a sectional view showing a transmission mechanism embodying the said principle; Fig. 6 is a section on the line VIII—VIII of Fig. 5; Fig. 7 is an end view; Fig. 8 is a tabular outline of results obtainable; Fig. 9 is a developed representation of the cam cylinder showing form of grooves; Fig. 10 is a detail view showing a very slight modification; Fig. 11 is a sectional view showing manner of supporting parts when gears are used instead of friction rolls.

Practically the only two forms of change speed gear transmission mechanism which are adapted for general use are the planetary gear and the sliding gear which predominates. With the sliding gear, weight and complication restrict the number of changes to a very unsatisfactory limit; its action is so crude, and its practical operation is so full of dangerous possibilities, that it is only satisfactory when used in connection with a

fairly flexible drive, and under at least semi-expert handling. It further necessitates the provision of a specially designed and operated clutch, the construction of which, under these conditions, becomes a problem in itself. The planetary gear transmission mechanism is not susceptible of general use, because only a very limited number of speeds is practical. Furthermore the planetary ordinarily requires a structural design which is liable to derangement and breakage due to wear. Finally the mechanical efficiency is very low on the slow speeds. In carrying out my invention I aim to very much increase the number of possible speed changes over any possible number obtainable with the ordinary planetary transmission mechanism, and also eliminate the other above named defects thereof. I also overcome the fundamental defect of the sliding gear which is the positive ultimate destruction of the gear teeth by the impact to which they are subjected in making a change. But in overcoming these defects of the sliding gear, I also aim to sacrifice none of its mechanical efficiency or its simplicity, but to actually increase both of these desiderata.

Before taking up a detailed description of a practical mechanical transmission mechanism embodying the principles of my invention, I will first elucidate the principles with the aid of diagrams, in order that the broadness of their applicability may be made clear, and their relation and action in the mechanical structure understood. The first principle lies in the possibilities of obtaining a wide variety of power factor changes by selecting one or another element of an epicyclic or differential system as the power element, as the work element and as the fixed position element. In Fig. 1 I have illustrated diagrammatically this principle. Suppose that A, B, C, D and E are scale pans or tables on stems d' , d'' , d''' , $d^{(4)}$, $d^{(5)}$, and that the stem $d^{(5)}$ has journaled thereon a pair of gears e and f , fixed to one another, and having diameters in the ratio of 1 to 2. The stems d' , d'' , $d^{(4)}$ and $d^{(5)}$ are considered to have rack teeth g meshing with said gears e , f . h' , h'' , $h^{(4)}$, $h^{(5)}$ are set screws, by which any selected stem d' , d'' , $d^{(4)}$, $d^{(5)}$ may be fixed against movement. With this mechanism many changes of speed ratio or power factor are obtainable by selecting different element for power, work and fixed position. For example, if the set screw h' is tightened, and power is applied to A, for instance a one pound force, the force delivered at D will be 2 pounds (upward). In other words, the power factor will be 2. If, however, the power, namely, the one pound force is applied to B, the force at E will be $\frac{1}{2}$ a pound (upward). In this case the power factor is $\frac{1}{2}$. These results are found respectively tabulated in the second and the fourth columns of the table in Fig. 2. The mechanism acts as a simple gear connection in this case. If, however, set screw D is

fixed and power is applied to A, a force of three pounds will be delivered (upward) at E. This is tabulated in the fifth column of the table, the power factor being 3. In this case the mechanism has a differential action.

5 In all, sixteen different speed ratios are tabulated, of which five correspond to upward or reverse motion, while the remaining eleven obtain motion in the same direction as the application of the power, merely varying the power factor. Supposing, therefore, that the

10 above principle could be adapted to a transmission system, it is evident that a large number of power factors are obtainable. As will later appear, I have applied the principle to a transmission system, and secured such result.

15 The second principle which I have utilized depends upon the great difference between the coefficients of tangential and rolling friction under favorable conditions. Referring to Fig. 3, X denotes a roller moving on a level surface Y. If the surfaces X and Y are not

20 perfectly hard and smooth, there will be a fairly high co-efficient of rolling friction. In other words, considerable force must be applied in the direction z to move roller X. If X and Y are, however, made hard and smooth, this rolling friction diminishes, and a much

25 less force is required in the direction z to move X. It is possible to now obtain materials so hard that X and Y may be made to roll on one another very easily, notwithstanding considerable weight of X. This fact is well known and is utilized in the ordinary roller bearing.

30 But notwithstanding the fact that X may be made to roll very easily on Y regardless of great weight or downward pressure of X, the tangential friction co-efficient at the point w is large and increases directly with the weight or downward pressure of X. Supposing X were the wheel of a locomotive for example, the

35 tangential friction at w may easily amount to many tons. The principle thus diagrammatically outlined may be stated to be that there is no definite relation between the tangential friction and the rolling friction of two bodies, and that while the tangential friction may be made as large as desired, the rolling friction may be reduced by the use of exactly formed resilient material to figures limited only by the skill of the workmanship obtainable, and the hardness to which

45 it is possible to make steels at this day. As the workmanship and the hardness of steels now obtainable are both very excellent, it is apparent that enormous tangential friction values can be secured with very slight rolling friction co-efficients.

50 In Fig. 4 I have shown a special structure embodying the above principle. L is a hardened steel roll. M is a hardened steel ring. N are hardened steel rollers which are positioned between L and M by the expedient of heating M and shrinking it about L and N. As

55 M may be quite heavy and strong, the normal force at each point of contact in the direction of the various arrows would be enormous under such circumstances. The tangential force created may be very high for the reasons above given. But although the tangential

60 forces are high, the rolling friction at each point of contact, assuming the rolls to be nicely machined and properly hardened, is low. And not only is the rolling friction low at each point of contact, but the nature of the organization is such that there is no unbalanced

65 force on any roll or member in any direction. In other

words, all of the enormous forces at the points of contact, however great, are in such directions that they wholly balance one another. For example, the ring M has three different forces at the points f' , f'' and f^3 , but these forces all act symmetrically outward from 70 the center. In like manner, the rollers N are freely balanced by the forces of reaction against the ring M and against the central roll L. The roll L is likewise perfectly balanced by the forces of reaction centrally directed from the contact points of the various rollers 75 N. The result is that if L is kept stationary, M may be easily spun around in the manner of a roller bearing, but in this motion the rollers N travel in a planetary way with all the force of the tangential friction, which as above stated, is very great. The rollers N act, 80 therefore, exactly like planetary gears, but at the same time they act like roller bearings, giving a free and noiseless action. The essential feature is to have parts with surfaces of revolution rolling upon one another and which are powerfully pressed together, all of the 85 forces and reactions being self contained within the system.

Having now made clear the nature of the two important principles which I have utilized, I will specifically describe the details of the actual transmission 90 in which I have used them.

Referring particularly to Figs. 5, 6 and 7, 1 denotes a driving, and 2 a driven, shaft, and 3 indicates a frame or casing in which is contained the transmission mechanism. For greater convenience of construction, 95 the driving shaft 1 is made hollow and sleeved on to the shaft 2, which is extended completely through the casing 3. Upon each of the shafts 1 and 2 are slidably splined the shells 4 and 5, the essential characteristic of which is an annular surface on each denominated by 100 characters 6 and 7. The supporting webs 8, 8', of the two shells are sufficiently distant from the annular surfaces 6 and 7 to permit a considerable range of movement of the two shells as will hereinafter more fully appear. 105

By the above construction, the shaft 2 extends axially through the two shells 4 and 5, and serves as a support for two sleeves 9, 10, each of which is enlarged to form peripheral surfaces 11, 12.

9' and 10' denote wheels respectively keyed to the 110 sleeves 9 and 10.

In the planes of the respective parts 11 and 12, which may be termed rolls, are a pair of annular parts or rings 13 and 14. The annular space which separates each 115 of the rings 13 and 14 from the rolls 11 and 12 is occupied by a plurality of rollers. These rollers have exactly the relation in the structure as has been described in connection with Fig. 4, with reference to the rollers diagrammatically referred to as N.

15 indicate the rollers coöperating with rolls 11 and 120 ring 13.

16 designate the rollers coöperating with roll 12 and ring 14. The rollers 15 and 16 are integral and co-axial with one another. They are of different sizes to correspond to the different dimensions of the rings 13, 14, 125 and the central rolls 11, 12.

For the purpose of insuring the continued alinement of the rollers 15 and 16, they have axes 17 in ball bearing raceways 18, supported by wheels 19, 19', tied together by the tie rods 20. These wheels 19 are really 130

carried by the various rollers 15 and 16, but in order to absolutely insure permanent alignment, the wheels 19 are sleeved on the respective sleeves 9 and 10, at 21.

All of the wheels 9', 10', 19, 19', and the rings 13, 14, 5 have the same external diameter and lie in a row, preferably equally spaced from one another. They constitute, therefore, a series of elements co-related to have a predetermined relative movement. The annular surfaces 6 and 7 of the two shells, and a certain other annular surface 22 lie slightly outside the peripheries of these wheels and rings, and are all axially movable into the planes of different wheels or rings. All these surfaces constitute members for engaging the various elements. Means are provided for engaging these members 6, 7 and 22, with selected elements, namely the various wheels and rings 9', 19, 13, 14, 19', 10'. The means which I have illustrated for this purpose comprises pins 23 on the various wheels and rings, and corresponding pins 24 on the various annular surfaces 6, 7 and 22. When these annular surfaces are moved into the planes of the various wheels and rings, the pins engage one another, so that the parts are locked together. The shell 4 constitutes the driving or power member, as above stated. The shell 5 constitutes the driven or work member, and the annular surface 22 is a member fixed against rotation. This is readily secured by having it in the form of a ring 25, guided by a lug 26, working in a slot 26', and certain other means hereinafter described, to have an axial movement in the casing 30 but no rotation.

The analogy between the above construction and the diagrammatic representation in Fig. 1 will now be apparent. In Fig. 1 five movable elements A, B, C, D and E, co-related to have a predetermined relative movement by the pair of connected gears c, f, were capable of being selected for the application of power, work and fixed position. By the structure of Figs. 5, 6 and 7, five movable elements 9', 19 (with 19'), 13, 14 and 10', co-related to have a predetermined relative movement by the pairs of connected friction gears 15, 16, are capable of being selectively engaged for power, work and fixed position by being selectively engaged by the power member 4, the work member 5 or the fixed position member 20. As a result of different selections, a wide variety of different power factors are obtained. With this particular mechanism, it is possible to obtain a large number of power factors; in fact, a greater number than is ordinarily necessary, and it is best to adopt only a few of the best values of power factors. In the table (Fig. 8) various desirable power factors are listed, together with the engagement of the members 4, 5 and 25, by which they are attained. On the first line is given a power factor of 2.6 which is obtained by moving the shell 4, so that its pins engage the wheel 9', moving the fixed position ring 20, so that its pins engage the wheel 19 and moving the driven shell 5, so that its pins engage the ring or element 13. The other power factors are obtained by longitudinally sliding the shells 4 and 5 and the ring 20 to different positions as indicated. A practical means for shifting the parts successively to obtain these power factors is illustrated, and comprises a cam cylinder 27, having grooves 28, 28' and 28" thereon. 29, 30 and 31 denote sleeves surrounding the cam cylinder 27 and having pins 30', 30" and 30³ engaged in the grooves. The

sleeve 29 has an arm 32 engaged in a groove 33 of the shell 4. The sleeve 31 has an arm 34 engaged in a groove 35 of the shell 5. The sleeve 30 forms part of the ring 20. By having the cam grooves formed generally as indicated diagrammatically in Fig. 9, which represents the developed periphery of the cam cylinder 27, it is possible to have all the elements of the transmission mechanism automatically take the positions to secure all the power factors given in Fig. 8, by merely turning the cam cylinder through successive equal angular spaces or movements. Thus if the cam cylinder is supported on a shaft 36, and this shaft has a handle (not shown) the handle may be stepped around through ten equal angular divisions to secure ten different gradations of power factor, or speed ratio, varying between fast reverse to fast ahead, supposing the transmission to be used on a motor vehicle.

I have described the annular surfaces 6, 22 and 7 as having internally projecting pins thereon. This provides a positive engagement, but these annular surfaces may be arranged to have a yielding or frictional engagement if desired. In Fig. 10 I have shown a construction designed to secure this result. The shells 4 and 5 and the various wheels 9, 19, etc., are constructed exactly as in the preceding described modification with the exception that in place of the pins 23 and 24, a frictional engagement is used. The outer surfaces 37 of the various wheels are rounded in this case, and the shell 4 has rollers 38 journaled in radial planes thereon so as to firmly bear against the surfaces 37. By having the rollers 38 in radial planes no considerable resistance is imposed to the axial movements of the shell, but these rollers have no anti-friction effect in a circumferential or tangential direction. Accordingly the shell 4 engages any selected wheel with as great a force as its elasticity will produce, and this is made sufficient to afford adequate transmission torque. In order to avoid shock when shifting from one wheel to another it is best to have the outer peripheries, which have the surfaces 37, as separate rings. These rings, indicated at 39, surround the various wheels and have sufficient frictional engagement there with when pressed by the rollers 38 to transmit the driving torque, but which are capable of slipping in overcoming the inertia of the elements 9', 19, etc., when making shifts at speed. The same frictional yielding effect is secured to a certain extent by the preferred construction shown in Figs. 5, 6 and 7. The internally projecting pins 24 are made long enough to bear against the peripheries of the wheels and rings so as to first frictionally engage the same. The elasticity of the shells is sufficient to insure a firm pressure. With this arrangement the internal pins 24 first engage portions of the various wheels and rings, while the speed changes are being made, and the wheels and rings thereby tend to come to the actual speed of the member with which they are about to be engaged before the pins actually fall into engagement. This prevents shock and jar on the pins in changing.

Of course the frictional planetary system herein described is not absolutely essential since all the advantages with respect to wide speed variations are obtained if ordinary gears are substituted for the friction rings. In Fig. 11 I have illustrated a manner of supporting the rings 13 and 14 in this case. The wheels

10, 19', have tie rods 20, as in the previous case, and serve to revolvably support the planetary rollers, which in this case are made in the form of gears. These gears are fixed together and have their axes journaled in the wheels 10, 19', as before, and which need not, therefore, be again shown. The wheels 10, 19', and the rings 13 and 14 each have raceways 40 in their side faces and balls 41 in these raceways serve to support the rings 13 and 14, so that they are freely revolvable. 42 indicate teeth on the inside of the rings, and the central rolls 11 and 12 are also cut with gear teeth 11', 12'. It is obvious that the manner of operation of this form of the invention is exactly like that of the preferred construction so far as the speed ratios, power factors and their changes are concerned. The essential characteristic is to have some sort of circular motion, preferably epicyclic or differential, the different parts of which can be engaged in different combinations to a driving member, to a driven member and to a fixed position member.

What I claim, is:—

1. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, and means for engaging selected elements, as the driving, as the driven and as the fixed element respectively.
2. In a transmission system, a plurality of elements correlated to have a predetermined movement, and means co-axial therewith for connecting different elements for the application of power and the work respectively.
3. In a transmission system, a plurality of elements mechanically organized together to have predetermined relative movements, and three members co-axial therewith arranged to selectively engage said elements.
4. In a transmission system, a plurality of elements mechanically organized to have predetermined relative movements, and three members corresponding to power, work and a fixed position, adapted to selectively engage said elements.
5. A transmission system comprising a part having a frictional surface of revolution, a second part having a surface of revolution concentric therewith, and rollers mounted to have a planetary movement and contained between the parts by their resiliency and adapted to transmit power from one to the other at a different speed.
6. In a transmission system, an epicyclic train, and means for selectively applying power and work to different elements of said train.
7. In a transmission system, an epicyclic train having three relatively movable elements of substantially equal diameter, means for applying the power and work to different elements, and means for engaging the third element against rotation.
8. In a transmission system, a plurality of elements having equal peripheral diameters, said elements being correlated to have a predetermined relative movement, a power member, a work member, and a fixed position member concentric with said elements and movable axially with relation thereto, each of said members being capable of being engaged with a selected element.
9. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, plus on said elements, and three members having pins and axially movable to engage the pins of three selected elements simultaneously.
10. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, a power member, a work member, a fixed position member, and means for moving said members into engagement with selected elements respectively in different combinations successively.
11. In a transmission system, a driving shaft, a driven shaft, a plurality of elements co-axial with said shafts and supported thereby, said elements being correlated to have a predetermined relative movement, a shell splined to the driving shaft, another shell splined to the driven

shaft, a ring having an axial movement but fixed against rotation, and means for moving said shells and said ring axially to selectively engage different elements in different combinations successively.

12. In a transmission system, a plurality of elements correlated to have a predetermined relative movement and having peripheries of substantially equal diameter, a power member, a work member and a fixed position member capable of being selectively engaged with said peripheries, and means for so engaging said members in different combinations successively.

13. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, a power member, a work member, a fixed position member, a cam cylinder having grooves, and means controlled by the grooves of said cam cylinder for moving said members to engage the elements in different combinations successively.

14. In a transmission system, a differential train of gearing having three relatively movable elements, a plurality of members and means for connecting all the different members to different elements in different combinations whereby the power factor between a pair of said elements is varied.

15. In a transmission system, a differential train of gearing having three elements each relatively movable to the other, and means for applying the work and the power to different selected elements, and independent means for securing said third element against rotation.

16. In a transmission system, a differential train of gearing having a plurality of relatively movable elements co-axially arranged with respect to one another, and means movable parallel to the axis of said elements for selectively engaging different elements with the power and with the work.

17. In a transmission system, a differential train of gearing having a plurality of elements co-axially arranged with respect to one another, a power member and a work member also co-axial with said elements, and means for shifting the power member and the work member selectively into engagement with different elements.

18. In a transmission system, a driving and a driven member a plurality of elements correlated to have a predetermined relative movement and co-axially arranged with respect to the driving and the driven member, and means for selectively engaging said driving and said driven member to different elements.

19. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, a driving member, a driven member co-axial with said elements, a cam cylinder having grooves, and means controlled by said grooves for moving said members into selective engagement with said elements in different combinations successively.

20. In a transmission system, a plurality of elements correlated to have a predetermined relative movement, a cam cylinder having grooves, and means controlled by said grooves for applying the power and work to different elements.

21. In a transmission system, a roll, a ring in the plane of said roll, a plurality of planetary rollers between said ring and roll and held tightly in such relation by the resiliency of said ring, a plurality of elements co-axially arranged and connected respectively with said roll, said rollers and said ring, and means for applying the power and the work respectively to said elements in different combinations successively.

22. In a transmission system, a roll, a ring, a plurality of rollers mounted to have a planetary movement between said roll and ring and held in such relation by the resiliency of said ring, and means for transmitting power through the differential train thus produced.

23. In a transmission system, a planetary train of gearing having a plurality of elements, a plurality of members corresponding respectively to power, work and fixed position, and means for selectively engaging said members with selected elements in different combinations successively.

24. In a transmission system, a plurality of parts rolling in contact with one another, said parts being powerfully pressed into such contact by their resiliency whereby they are co-related to have a predetermined relative move-

- ment and are capable of transmitting power, the parts being arranged to balance the various forces of reaction whereby all forces and their reactions which serve to keep the parts pressed together are self contained within the system, and a plurality of members cooperating therewith to transmit power at a different speed.
25. In a transmission system, a plurality of parts rolling against one another and firmly pressed together at their points of contact by their own resiliency, whereby they are co-related to have a predetermined relative movement and are capable of transmitting power, the various forces of action and reaction all extending in the same plane and through a common point and being equal in value whereby all of said forces of action and reaction which serve to keep the members pressed together are self contained within the system, and no unbalanced force is produced in any direction by the engagement of the members.
26. In a transmission system, a driving and a driven member, a plurality of elements co-related to have a predetermined relative movement, means for engaging the driving and the driven members with different elements co-axial therewith whereby the power factor is varied, and means for connecting the driving member directly to the driven member to produce a unit power factor or direct drive.
27. In a transmission system, a driving and a driven member, a plurality of elements co-related to have a predetermined relative movement, means for selectively engaging said driving and driven members to different elements, and means for directly connecting the driving to the driven member whereby the power transmission is direct.
28. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, said elements being extended to a substantially common diameter, a power member, a work member and a fixed position member movable co-axially with respect to said elements, and means on said members for engaging said elements on their portions of substantially equal diameter.
29. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member and a fixed position member, and devices on said members for engaging said elements when the members are moved into proper relation thereto.
30. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member and a fixed position member capable of being moved co-axially with respect to said elements, and devices intermediate said members and elements for engaging them together.
31. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member, a fixed position member, and means for frictionally engaging said members to said elements in different combinations.
32. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member, a fixed position member, pins on said elements and on said members adapted to interlock with one another, the pins on said members being adapted to initially frictionally engage said elements whereby the engagement of said members and elements is initially frictional and subsequently positive.
33. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member, a fixed position member, and means for positively engaging said members and said elements in interlocking engagement in different combinations successively.
34. In a transmission system, a plurality of elements co-related to have a predetermined relative movement, a power member, a work member, a fixed position member, means on said members for initially engaging said elements in frictional engagement, and means whereby the engagement becomes positive or interlocking when the members are fully engaged with said elements.
- In witness whereof, I subscribe my signature, in the presence of two witnesses.
- JAMES C. ANDERSON.
- Witnesses:
WALDO M. CHAPIN,
MAX BIRD.