United States Patent

Tranier

[15] **3,688,546**

[45] **Sept. 5, 1972**

[54] **APPARATUS FOR PRESETTING THE ROTATIONAL SPEEDS OF PARTS USED TO CREATE THE DEFORMATION OF A METAL IN ORDER TO OBTAIN WIRES OR STRIPS, SUCH AS BY WIRE DRAWING MACHINE BLOCKS**

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[22] Filed: **July 10, 1970**

[21] Appl. No.: **53,734**

[30] **Foreign Application Priority Data**

Aug. 5, 1969 France....................6926791

[52] **U.S. Cl.** **72/289**, 72/8, 72/443

[51] **Int. Cl.**..........**B21c 1/02**, B21b 37/12, B21j 7/12

[58] **Field of Search**........72/274, 278, 279, 287, 288, 72/289, 22, 32, 443, 8

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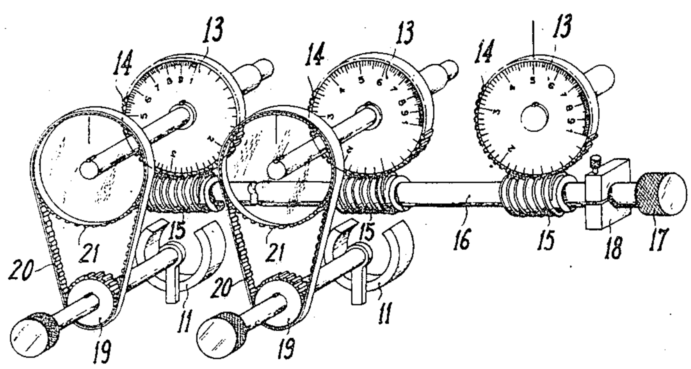
[57] **ABSTRACT**

Apparatus for the presetting of the rotational speeds of the various blocks of a multiple wire drawing machine by simple dialling on dials or rules corresponding respectively to each block, at first of the finished wire diameter, then of the wire diameter at each pass.

6 Claims, 10 Drawing Figures



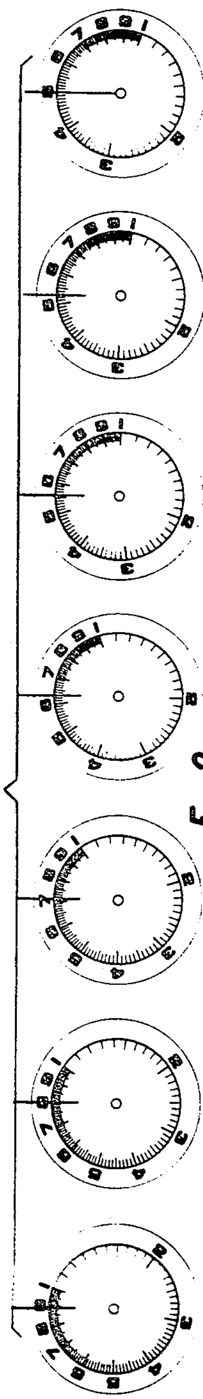


FIG. 1

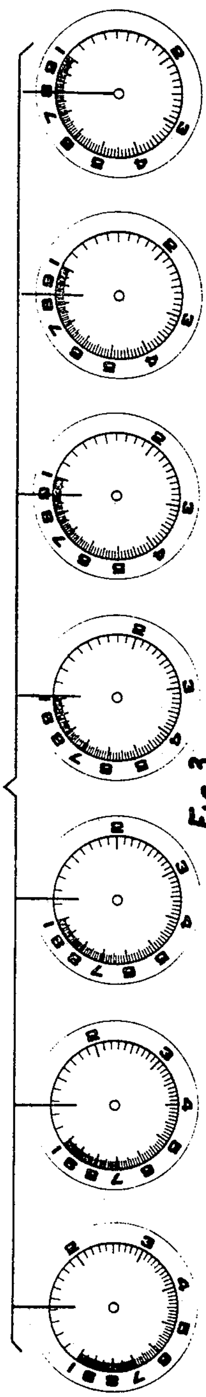


FIG. 2

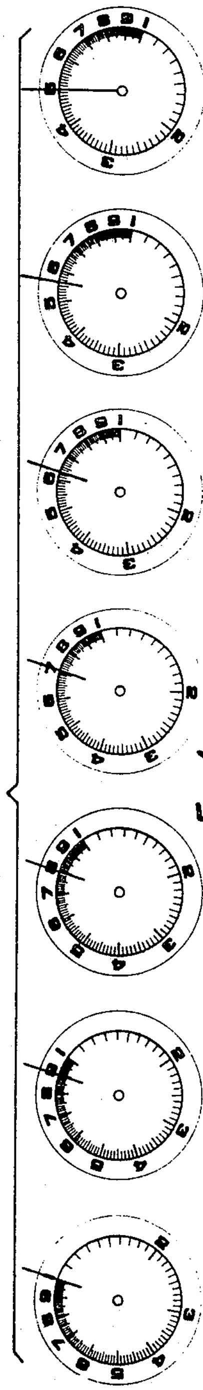


FIG. 3

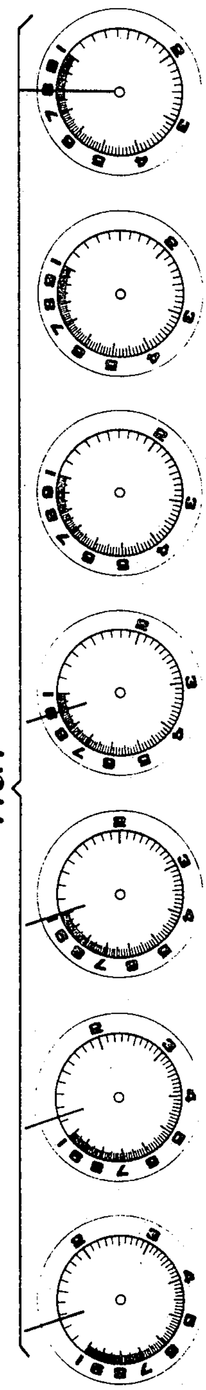


FIG. 4

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Fig. 6

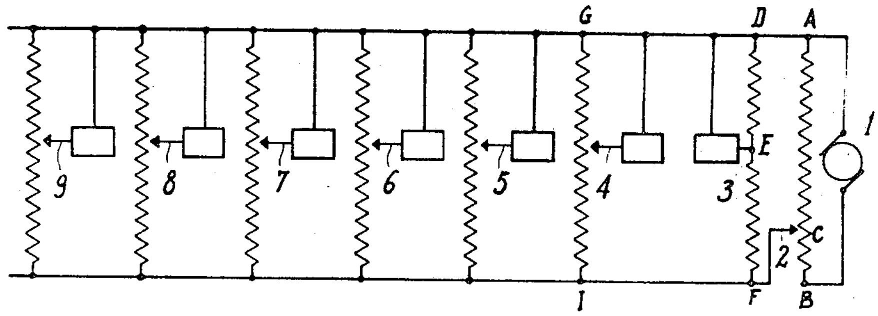

Fig. 5

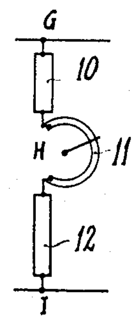

Fig. 7

Fig. 8

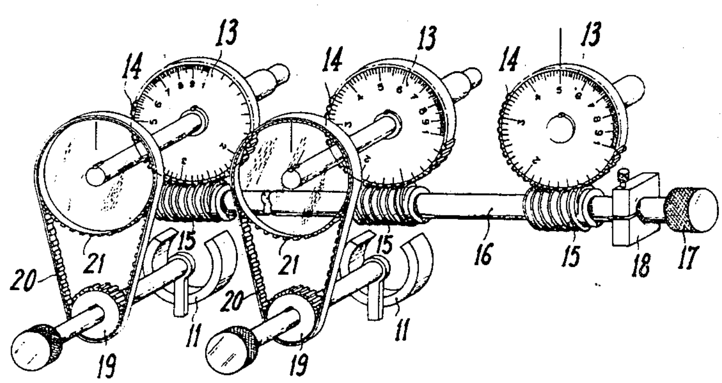

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FIG. 9

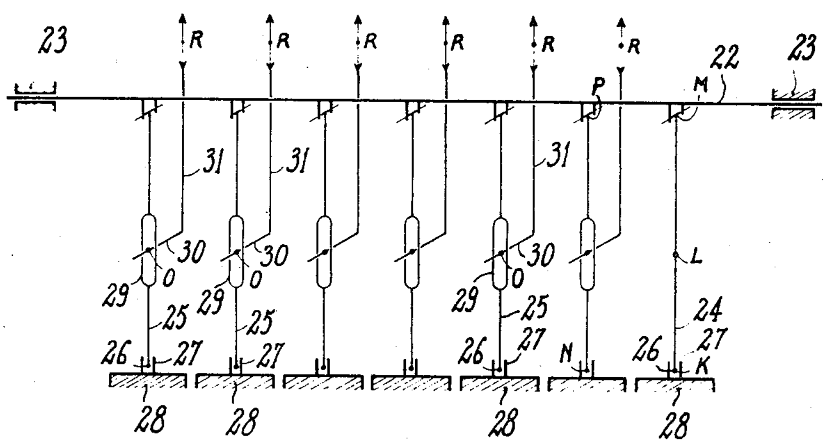
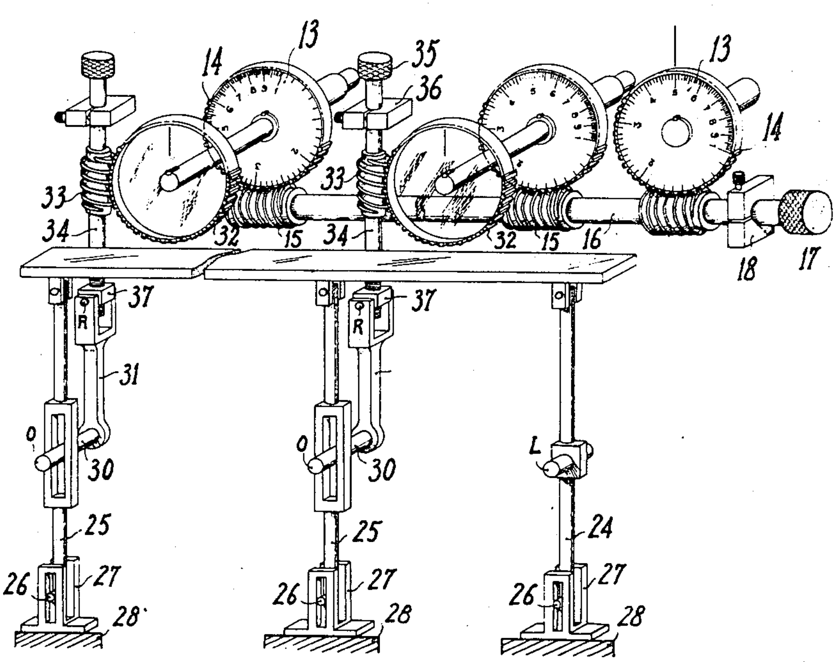


FIG. 10



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APPARATUS FOR PRESETTING THE ROTATIONAL SPEEDS OF PARTS USED TO CREATE THE DEFORMATION OF A METAL IN ORDER TO OBTAIN WIRES OR STRIPS, SUCH AS BY WIRE DRAWING MACHINE BLOCKS

The present invention has as principal subject a simple and mathematically precise method allowing the operator to set, without any previous calculation, the base speeds of each of the blocks forming a multiple wire drawing machine so that each block revolves with correct speed corresponding to non-slip wire drawing process without accumulation nor wire unwinding and this whatever the finisher speed and the dies used in the sequence may be. The process can also be applied to the wire collecting device (separate coiler or spooler) when the wire is not directly collected on the last multiple wire drawing machine block.

The process can also be applied to any process of continuous multiple pass deformation such as rod rolling mills or strip rolling mills. Although we limit ourselves to give the principle and one realization example applicable to a multiple wire drawing machine, the same principle and realizations of same kind can be applied to tandem rolling mills without leaving the spirit of the invention.

With the above and other objects in view which will become apparent from the detailed description below, a preferred form of the invention is shown in the drawings in which:

FIG. 1 is a diagrammatic set of seven dials wherein the finishing diameter is 5.0 mm.

FIG. 2 is a similar view in which the finishing diameter is 8.0 mm.

FIGS. 3 and 4 are similar diagrammatic views illustrating the positions of the various hairlines after dialing the sequences above.

FIG. 5 is a diagrammatic view of a divider.

FIG. 6 is a diagrammatic view illustrating the various resistances.

FIG. 7 is a diagrammatic view illustrating in more detail one of the resistances.

FIG. 8 is a perspective view showing the seven dials corresponding to the seven machine blocks.

FIG. 9 is a diagrammatic view illustrating the movement of the finisher lever and the intermediate block levels, and

FIG. 10 is a perspective view illustrating a practical realization adapted to the electrical system.

The result aimed for, i.e., the setting of the considered parts is obtained by the worker operating the machine by two simple operations, the effect of which will be explained later, i.e.,

Dialling by means of one dial A, corresponding to the finisher, in front of one fixed hairline, of the finisher die diameter,

Dialling on the dial B1 – B2 – B3 . . . Bn, corresponding each to one intermediate block by means of a movable hairline, of each of the die diameters used in sequence, i.e., D1 – D2 – D3 . . . Dn.

Eventually a complementary operation will consist in dialling on another dial or on a selecting device the drum diameter of the collecting spool or the nominal diameter of the block used for coiling.

In case of a continuous rolling mill the same selection could be applied in order to take the real rolling mill roll diameter into account.

Finally the operator can dial, in a way already known in itself, the finisher wire drawing speed.

The present invention can naturally only be applied to multiple wire drawing machines or continuous tandem rolling mills; each of which of the intermediate blocks or intermediate stands being susceptible to be driven at variable speed. This result, in the present state of technical knowledge can be obtained in three ways :

Each block or stand is driven by a variable speed electric motor,

Each block or stand is driven by a variable speed hydraulic motor,

Each block or stand is driven, starting from a single motor or a single shaft line by a variable reduction ratio transmission, the speed of the single motor or the single shaft line itself being susceptible to be unchangeable or changeable without leaving the spirit of the invention of our method.

The invention not referring to the means of speed variation, it will be supposed, in a way already known in itself or in any other way likely to be invented later, that the motor appliance used for the drive of each of the blocks or stands is suceptible to give to this block or this stand a tangential speed proportional to the value of the signal which will be given to it by the device making use of the process subject of the invention.

It is admitted that an electric D.C. motor will take a rotational speed and therefore will give to the block or stand a tangential speed proportional to its armature voltage which itself will be proportional to the voltage at the entry of a thyristor piloting amplifier cell.

In hydraulics, it is admitted that a hydraulic motor with a fixed cylinder capacity will take a rotational speed and therefore will give to the block or stand a tangential speed proportional to the oil volume discharged by a variable delivery pump, a delivery which itself will be proportional to the linear or angular movement of its delivery variation mechanism.

Regarding speed variation, it is similarly admitted that the transmission ratio established by the speed variation device will give to the block or stand a tangential speed proportional to the linear or angular movement of its servomotor.

As stated previously, we shall give in the following part only the principles and the realization examples applicable to a multiple straight through wire drawing machine, it being well understood that the same principle and similar realization examples can be applied to any continuous rod or strip tandem rolling mill.

At the multiple non-slip wire drawing process, without accumulation, nor unwinding as defined above, the calculation of the wire speeds at the various blocks is reduced for each intermediate block to the resolution of one of the equations regarding this block with regard to the finisher:

$$\left.\begin{array}{l} D_1^2 \times V_1 = D_F^2 \times V_F \\ D_2^2 \times V_2 = D_F^2 \times V_F \\ D_3^2 \times V_3 = D_F^2 \times V_F \\ \hline D_n^2 \times V_n = D_F^2 \times V_F \end{array}\right\} \text{Equations } a$$

in which $D_1 - D_2 - D_3 - - - D_n - D_F$ represent respectively the wire diameter at the 1st – 2nd – 3rd – nth block and finisher and $V_1 - V_2 - V_3 - - - V_n - V_F$ respectively the wire speed at the same blocks.

Although these simple equations allow to make all the calculations necessary for the knowledge of the tangential speeds of each block as a function of the successive wire diameters and the finisher speed, they cannot be used as such for a physical actualization on a machine of a process of presetting of the tangential speeds of the various blocks by simple dialling of the diameter $D_1 - D_2 - D_3 - - - D_n - D_F$ on the appropriate dials as it is the principal aim of the invention.

On the contrary, if the equations *a* be written in logarithmic notation, they become:

$$\left.\begin{array}{l} 2\log D_1 + \log V_1 = 2\log D_F + \log V_F \\ 2\log D_2 + \log V_2 = 2\log D_F + \log V_F \\ 2\log D_3 + \log V_3 = 2\log D_F + \log V_F \\ \hline 2\log D_n + \log V_n = 2\log D_F + \log V_F \end{array}\right\} \quad \text{Equations } b$$

These equations can be written:

$$\left.\begin{array}{l} \log V_1 = \log V_F + 2(\log D_F - \log D_1) \\ \log V_2 = \log V_F + 2(\log D_F - \log D_2) \\ \log V_3 = \log V_F + 2(\log D_F - \log D_3) \\ \hline \log V_n = \log V_F + 2(\log D_F - \log D_n) \end{array}\right\} \quad \text{Equations } c$$

It can be seen then that each of these equations lends itself to a physical actualization in form of kinematic vectors obtained by simple parts such as lever arms, pinions, or chain or timing belt drive.

It is indeed sufficient, for anyone *n* of the wire drawing machine intermediate blocks, to add algebraically the vectors proportional to $\log V_F$, $2 \log D_F$ and $2 \log D_n$ in order to get a vector proportional to $\log V_n$ which will serve to pilot the tangential speed of block *n*.

It is advanced above that it was admitted in a very general way that the tangential speed of a block could, by known means, be supposed to be proportional to the piloting value (electric voltage, hydraulic delivery, rectilinear or rotating movement of a mechanical part). However, it is endeavoured to put this piloting value into a physical actual form by a vector which is actually proportional to the logarithm of the value aimed at.

The possibility naturally exists to reconcile these two considerations in a way as accurate as it is desired and in a range theoretically infinite, e.g., e.g., by interposition of cans cut according to an appropriate law or by use of amplifier cells answering this same law, but this is an useless complication in practice.

As in fact, if it is referred to equations *b* represented by anyone among them, e.g., $2 \log D_n + \log V_n = 2 \log D_F + \log V_F$, the possible variation of $\log V_n$ with regard to $\log V_F$ is limited to a range of values compatible with the possible variation of $\log D_n$ with regard to $\log D_F$, itself limited in practice by metallurgical considerations, it is not necessary to look for a proportionality on a very large scale of values.

However, there exists a point in the logarithmic scale for which the differential of an arithmetic value is equal to the differential of its logarithm. If the axiom is applied that the variation of a function is minimal in the vicinity of the point where this value passes itself by a minimum, it will be sufficient to choose for center point of the setting in plus or minus which it is desired to operate, the equality point of the differentials.

In practice, and in decimal logarithms, this point corresponds approximately to $\log 4.5 = 0.6532$. The practical application of this ascertainment will be seen later.

The appliance built according to the invention will comprise a certain number of dials, as many as the wire drawing machine comprises blocks; all the dials equal in diameter, being graduated according to a logarithmic scale of appropriate modulus, equal for all dials, each dial being alloted to one block.

All the dials are linked in rotation, one to each other, by any means, such as e.g., gear of ratio 1 : 1 with interposition of an intermediate in order to keep the same rotating direction for all the dials or by a set of chains of ratio 1 : 1, or yet by a common shaft carrying a certain number of worms gearing each one with a hollow tooth wheel integral with a dial. On building of the appliance, however, the dials are angularly offset with regard to that of the finisher in order to reproduce the various reduction ratios of the kinematic chain of the wire drawing machine so that, for a same speed of all the motors or a same position of the individual speed variation devices, the angle shown by the dial of each intermediate block with regard to that of the finisher is equal to half of the difference of $\log V_F - \log V_n$ in accordance with the chosen graduation modulus. These angular offsettings are therefore on the building of the appliance, the actualization of the kinematic chain of the wire drawing machine for which the appliance is built.

As an example, the FIGS. 1 and 2 reproduce the whole set of dials of a seven block wire drawing machine, the kinematic chain of which has been arbitrarily chosen so that the tangential speeds of the various blocks for a same speed of the various motors or a same position of the various speed variation devices answer the following equations.

$$\left.\begin{array}{l} \log V_1 = \log V_F - 0.50 \\ \log V_2 = \log V_F - 0.40 \\ \log V_3 = \log V_F - 0.30 \\ \log V_4 = \log V_F - 0.20 \\ \log V_5 = \log V_F - 0.10 \\ \log V_6 = \log V_F - 0.05 \end{array}\right\} \quad \text{Equations D}$$

If these equations are compared to the corresponding equations C, it is deduced after resolution:

$$\left.\begin{array}{l} \log D_1 = \log D_F + 0.25 \\ \log D_2 = \log D_F + 0.20 \\ \log D_3 = \log D_F + 0.15 \\ \log D_4 = \log D_F + 0.10 \\ \log D_5 = \log D_F + 0.05 \\ \log D_6 = \log D_F + 0.025 \end{array}\right\} \quad \text{Equations F}$$

It will be supposed that it was chosen, for simplification, a logarithmic graduation modulus for the dials equal to one dial revolution or 360° = antilog 10.0.

In these conditions, the angular displacements of the various dials with regard to that of the finisher would be:

dial 1 = 360° × 0.25 = 90°
dial 2 = 360° ×× = 72°
dial 3 = 360° × 0.15 = 54°
dial 4 = 360° × 0.10 = 36°
dial 5 = 360° 9° 0.05 = 18°
dial 6 = 360° × 0.025 = 0°

and the whole set of the seven dials takes for example the aspect of FIG. 1 when a finishing diameter of 5.0

mm is dialled and that of FIG. 2 when a finishing diameter of 8.0 mm is dialled.

The dial corresponding to the finisher is the only one accessible to a revolution operated by the operator for the purpose of dialling on this dial, in front of a fixed hairline, the finishing die diameter. However, any amount of revolution applied to this dial brings about a revolution equal and in the same direction as all the dials corresponding to the intermediate blocks and the whole set is locked after dialling of the finisher diameter which entails that the offsettings referred to in the previous paragraph are always maintained.

The actualization of the dialling of the intermediate die diameters is obtained on each corresponding dial by moving a hairline in front of the logarithmic graduation which has become fixed by the locking operation stated in the previous paragraph.

As an example and by using, as basis, the two finishing diameter diallings shown on FIGS. 1 and 2, in each of the cases, a wire drawing sequence is supposed, voluntarily simplified, and only made up of preferential numbers according to French standard NF X01/.001, these preferential numbers being supposed to be taken as representing antilogs of an accurate arithmetic series in the ratio of 0.050 (series R 20) in the spirit of the preferential number principle. Therefore, afterwards

D_3 = 8.0 represents actually D_3 = 7.943 = antilog 0.90 and

D_6 = 5.6 represents actually D_6 = 5.6 represents actually D_6 = 5.623 = antilog 0.75.

It is equally voluntarily supposed that the sequence finishing at 5.0 mm comprises seven passes as follows:

D_1= 10.0
D_2= 9.0
D_3= 8.0
D_4= 7.1
D_5= 6.3
D_6= 5.6
D_7= 5.0

whereas the sequence finishing at 7.1 mm only comprises five passes by bypassing the fifth and sixth blocks as this can be done in practice.

D_1= 11.2
D_2= 10.0
D_3= 9.0
D_4= 8.0
D_5= not used
D_6= not used
D_7= 7.1

The FIGS. 3 and 4 show respectively the positions of the various hairlines after dialling both the sequences above.

It is then seen, on analyzing the positions of these various hairlines, that their respective angular offsetting with regard to the vertical representing the finisher diameter dialling represents very precisely the physical actualization of each of the equations *c*.

If the dial 3 in FIG. 3 is taken as an example, it can be seen that the angular offsetting of its hairline is equal to $[360° \times (\log 8.0 - \log 5.0)] - 54° = (360° \times 0.20) - 54° = 72° - 54° = 18°$ whereas the hairline of dial 3 in FIG. 4 shows an offsetting equal to

$[360° \times (\log 9.0 - \log 7.1)] - 54° = (360° \times 0.10) - 54° = 36° - 54° = -18°$.

This positive or negative angular offsetting represents therefore very precisely the actualization of vector log V_n of the equations *c*, paragraph 4.2.

As it was suggested previously, the proportionality between a logarithmic vector and the value which it represents is the most approaching one (and largely sufficient in practice) around a point defined by log 4.5 = 0.6532.

Therefore it will be sufficient to choose on the kinematic part serving as material support to vector log V_n and which will be called afterwards by the term "-Divider", the median point from which the correction in plus or minus is made at 45 percent from one of the ends and at 55 percent from the other end and in such an orientation that any vector modification in the way of a speed reduction is made towards the shortest portion of the divider and any modification in the way of a speed increase is made towards the longest position of this part as shown on FIG. 5.

It can be seen that in these conditions a variation of the vector log V_n of + or − 0.10 corresponding theoretically to a variation of the true value V_n of 80 − 100 − 125, entails an error in the region of 1 percent only which can be perfectly admitted in practice and is completely within the spirit of this invention.

Now some examples to build the appliance will be given allowing to carry out the above invention with reference to FIGS. 1 to 10 of the attached drawings.

a. For D.C. motors, it is naturally supposed that the various motors have separate feed and that the speed of each motor is proportional to the electric voltage of a signal. The whole set, commercially available under various names, which receives this signal and feeds the motor with direct current at the necessary voltage so that the motor rotational speed is proportional to this signal, will be referred to under the generic name "amplifier".

Remaining within the above example of a seven block wire drawing machine, the diagram is given in FIG. 6 in which

1 is a D.C. generator, preferably at stabilized voltage,
2 is a variable potentiometric resistance serving for the general speed regulation of the wire drawing machine,
3 is a fixed potentiometric resistance feeding by its branch DE the amplifier of the finisher (divider for the finisher)
4–5–6–7–8 and 9 are variable potentiometric resistances, all equal to each other and equal to the fixed resistance 3, each of them feeding the amplifier of an intermediate block by its branch GH (dividers for the intermediate blocks).

The potentiometric taking point E on the fixed resistance DF is situated in such a point that branch DE represents 45 percent of the total resistance DF.

Equally the median points H of the resistances GI are situated in such a point that the branches GH represents 45 percent of the total resistance GI which is equal to DF.

FIG. 7 reproduces with more detail the practical realization of anyone of the resistances GI.

10 is a fixed resistance, the value of which is 35 percent of the total resistance GI,
11 is a potentiometer, the value of which is 20 percent of the total resistance GI,

12 is a fixed resistance, the value of which is 45 percent of the total resistance GI.

It can be seen that in these conditions, for a central position of the slider of potentiometer 11, the resistance GH is 45 percent of GI, and equal to finisher resistance DE and that, for the two extreme slider positions, resistance GH varies between 35 percent and 55 percent of GI.

The practical realization is shown on FIG. 8 in which the references 13 represent the seven dials corresponding to the seven machine blocks.

Each of these dials is fixed on a gear 14 with the above stated angular offsetting and each gear engages a worm 15, all the worms being carried on the same shaft 16 which can be operated by knurled button 17 and locked into position by any system 18.

On the other hand, the six potentiometers 11 are disposed on a line parallel to that of the seven dials.

On the shaft of each of those is keyed a gear 19 meshing with a timing belt 20, itself driving a gear 21 coaxial with dial 13 and gear 14.

On gear 21 a hairline is fixed moving in front of the graduation of dial 13.

The ratio of the tooth numbers of the gears 19 and 21 is chosen in accordance with the logarithmic graduation modulus of the dials in such a way that for the total length of stroke of one of the potentiometers 11 the angular movement of this hairline corresponds to the desired degree of individual speed variation.

It is to be said that only the intermediate blocks are so equipped with a potentiometer and a movable hairline, the rotation of which is linked to that of the potentiometer. In other words, the finisher has a fixed potentiometric resistance and a movable dial in front of a fixed hairline whereas the intermediate blocks have a variable potentiometer and a movable hairline in front of a fixed dial.

b. For hydraulic motors.

In this case it will be supposed that each hydraulic motor is separately fed by a variable delivery pump, said pump being driven at a fixed speed by an asynchronous motor or by a shaft line.

The delivery variation of the pump, obtained by the rectilinear movement in case of a radial piston pump or by angular movement in case of an axial piston pump, will always be driven by a hydraulic servo-motor in such a way that the rotational speed of said motor is always proportional to the movement of the part piloting the servo-motor.

In perfect analogy with the electrical speed control, the signal given to the pump servo-motor is proportional to a general speed signal and to the ratio of the lever arms corresponding to the correction of the desired relative speed with regard to the finisher speed.

FIG. 9 explains this diagram in which a rectilinear lever 22 sliding in two bearings 23 is linked to seven elementary parallel levers of which 24 is the finisher lever and 25 are the different intermediate block levers. The other end of the levers 24 and 25 is connected with a fixed point 26. Some device as e.g., a sliding movement in a slide 27 integral with a casing 28 allows the angular movement of the levers 24 and 25.

On lever 24 and in a point *L* such as $KL = 45$ percent of *KM*, the servo-motor drive of the finisher pump is taken.

On each of the levers 25 and in a point *O*, the median position of which is such as $NO = 45$ percent of *NP* are taken the servo-motor drives of each of the intermediate blocks. In order to be able to have this median position varied within the desired individual regulation limits, each of the levers 25 comprises a slide 29, and the spigot 30 materializing point *O* hangs on a swivelling arm, whose swivelling point R can be moved; as desired, by a limited value.

The movement of point *L* and of each of the points *O* is transmitted to the various pump servo-motors by any suitable rod system.

The practical realization, shown on FIG. 10, equally follows very closely the realization of the electrical system.

The system includes the seven dials 13 with their gears 14, worms 15, shaft 16, operating button 17 and locking system 18.

The dialling hairline appropriate to the intermediate blocks is carried by a gear 32 coaxial with dial 13. This gear engages a worm 33 keyed to a shaft 34 carrying a knurled operating button 35 and some locking device 36. On the other end of shaft 34 is situated another screw engaging a nut 37 linked to a point R of lever 31. The rotation of nut 37 is prevented by any suitable system so that the rotation of shaft 34 creates a linear movement of point R and consequently of point *O* of lever 31.

The reduction ratio of the worm-wheel-set 32/33, the pitch of nut 37 and the total length of lever 31 are, of course, calculated in accordance with the logarithmic dial modulus and the features of the pump servo-meter in such a way that the movement of the hairline in front of the dials 13 be in relation to the required speed variation.

c. For mechanical speed variation devices.

The diagram and realization can be similar to the example given for the hydraulic motor being understood that the transformation process of a linear or angular movement into a reduction ratio change of a speed variation device is supposed to be known in itself and is outside the scope of this invention.

It is stated above that the subject of this invention is to preset the relative speeds of the intermediate blocks with an approximation of industrial exactitude. If it is desired to proceed to non-slip straight-through wire drawing process, this approximation is, however, not sufficient in itself. Application has to be made of a "dancer roll" placed between the wire exit of an intermediate block and the entry of the wire into the following die according to an already known technique. The signal issued by this dancer roll by any means, already knows, such as rheostat, induction regulators, etc. as regards the electric circuits or by simple linear movement of a swivelling arm as regards control by levers can, without any difficulty, be added algebraically to the signal issued from the predialling in order to give it the small necessary correction.

In case of the electric circuits, this signal, in form of a small difference of positive or negative potential will be sent to the amplifier of the intermediate block concerned.

IN case of regulation by kinematic elements the linear movement corresponding to the position of each dancer roll will be linked with point *N* of each lever 29 and will so replace the fixed point 26 (FIG. 9).

The invention process can finally be extended to the speed control of a wire take-up device.

If the take-up device in question which can be, either a coiler collecting wire in coils or a spooler collecting wire on spools, comprises one only coiling diameter or one only reel size, the speed presetting system which is applied to it, is strictly identical to that which regulates the finisher speed, i.e., the taking point (E in the electrical case or *L* in the mechanical case) is fixed on the divider. It is only in case the take-up device can take 2 or several diameters that the invention process shows its value. It is sufficient in this case that the divider comprises as many fixed taking points as there are block diameters so that by simple circuit commutation the motor speed of the take-up device adjusts itself according to the diameter of this take-up device and the general speed reference in order to give the desired tangential speed to the take-up device.

What is claimed is:

1. An apparatus for equipping a multiple wire drawing machine comprising a plurality of intermediary blocks, a die for each block, a motor for driving each block, a finishing block receiving the wire once drawn, means regulating without preliminary calculation the speed of rotation of each of said intermediary blocks as a function of the speed of said finishing block to obtain a wire drawing without slipping, accumulation and curving, said means comprising a plurality of dials corresponding in number to said blocks graduated according to the logarithmic scale, means for placing said various dials jointly in rotation, the dials of said intermediary blocks being angularly set each one to a different quantity with relation to the dial of said finishing block, means controlling the rotation of said dial of said finishing block and means for posting opposite each of the logarithmic graduations of said dials of said intermediary blocks a deflection acting upon the motor of each of said intermediary blocks to vary the speed of rotation of said intermediate blocks relative to the speed of rotation of said finishing block.

2. An apparatus as set forth in claim 1 wherein said blocks are each driven by a direct current motor having means for rendering the speed of each motor proportional to the electric voltage of a signal comprising a variable potentiometric resistance for the regulation of the overall speed of said wire drawing machine, a fixed potentiometric resistance for said finishing block, a plurality of equal variable potentiometric resistances corresponding in number to said intermediary blocks equal to said potentiometric resistance of said finishing block and means for varying said variable potentiometric resistances as a function of the angular displacements of said deflections with relation to the logarithmic graduations of the various dials of said intermediary blocks.

3. An apparatus according to claim 2 wherein means are provided defining a divider element for said finishing block comprising a fixed potentiometric resistance for said finishing block, divider elements for each of said intermediary blocks consisting of equal variable potentiometric resistances equal to said divider element of said finishing block, means for determining a point of potentiometric deduction upon said divider element of said finishing block located at a point so that the branch of said divider element feeding said finishing block represents 45 percent of the total resistance and means for determining the reduction points for said divider elements of said intermediary blocks whereby said points of reduction are located so that the branches of the resistances constituting said divider elements represent 45 percent of the total value of each of said resistances.

4. An apparatus according to claim 3 in which the number of teeth of the gear driving said coaxial wheel is chosen as a function of the graduation carried by the dials so that for the total course of one of said potentiometers the angular displacement of said reference line corresponds to the degree of variation of the individual speed desired.

5. An apparatus according to claim 3 in which said finishing block comprises a plurality of diameters, said divider element of said finishing block having a number of deduction points equal to the number of diameters of said block whereby the commutation is carried out according to the diameter of the finishing block used, the various points of deduction being harmoniously deducted around a point located at 45 percent of the total value of the divider element.

6. An apparatus according to claim 3 comprising dials in a number corresponding to the passes of the machine each fixed upon a gear with an angular deduction corresponding to the cinematic chain adopted, a plurality of endless screws, each one meshing with one of said gears, a shaft for said endless screws, means for rotating said shaft and locking said shaft in a predetermined position, said regulating potentiometers of the voltage of said intermediary blocks being located parallel to said dials, a shaft for each potentiometer, a driving gear on said shaft, a wheel coaxial to the corresponding dial having a reference line which is displaced according to the graduation of the corresponding dial.

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