(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 976 465 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.02.2000 Bulletin 2000/05

(51) Int. Cl.^{7}: B21C 1/12

(21) Application number: 98113975.1

(22) Date of filing: 27.07.1998

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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(54) A volume-control regulatinon procedure for plastic processing of material by cross-sectional reduction, and system

(57) In a system comprising an upstream die plate (12) and a downstream die plate (14) for carrying out plastic processing with reduction of cross section on a moving strip or wire (F) of material, one drawing capstan (16) downstream of an upstream die plate (12), and a further drawing capstan (18) downstream of a downstream die plate (14), possible errors of rotational speed of the upstream capstan (16) with respect to the downstream capstan (18) are detected by measuring the volume of material that passes per unit time at a location upstream of the upstream capstan (16), which is the capstan being controlled, and at a location upstream of the downstream capstan (18), which is the reference capstan.

The measurement must be made in the vicinity of the corresponding die plates (12,14)(it is not important whether before or behind).

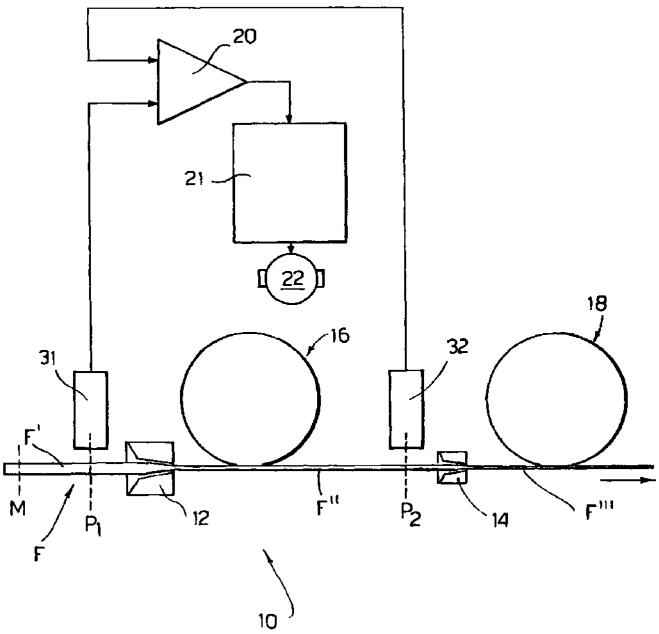

FIG .1

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Description

[0001] The invention refers to systems and procedures for processing of material without removal of the same and involving a cross-sectional reduction. In the following, reference will be made more in particular to a drawbench system.

[0002] In a drawbench, a metal wire is reduced in diameter by passing through one or more consecutive die plates. The metal wire is drawn through the die plates by tensile force applied by rollers or capstans set between the die plates, in particular after each die plate. To ensure proper operation of the system, it is necessary for the speeds of the capstans to be co-ordinated so that there is not too much slack between one capstan and another, and at the same time there should not be an excessive tensile force applied. The last capstan downstream dictates what should be the speed of the capstan or capstans upstream. The control of speed of the capstans is generally entrusted, in known systems, to a sensing device referred to as "dandy roll", which detects the slack in the wire at a location between one capstan and another. The "dandy roll" device comprises a feeler, generally a roller feeler, which is pushed against the wire or sheet material of the drawing line (or generally reduced-cross section plastic processing line). By detecting the variation in position of the feeler, which depends upon the slack of the material, a correction is made in the speed of the capstan or capstans upstream according to the variation detected. This type of regulation may present some drawbacks; for example, an instability of correction or hunting, which may even, in the case of wire, cause breaking of the wire. In addition, in the case once again of wire, since the "dandy" device has limited extension across the wire, it limits the possibility of filling the capstans, whereas it would be desirable to have a greater width of filling of the latter for the purpose of cooling the wire. Furthermore, the tension exerted by the action of the "dandy" on the wire itself may, in some cases, cause a problem inherent slipping of the wire on the capstan, thus leading to a limitation of the possibility of filling the capstan.

[0003] An aim of the present invention is to overcome these drawbacks of the prior art.

[0004] A further aim is to achieve a system for controlling speed of the capstans in a material-processing line with reduction of cross section and without removal of material, in which there is an improved stability and/or in which it is possible to exploit a greater filling width of the capstans. These aims have been achieved with a control or regulation process, as described in Claim 1, and with a system, as described in Claim 7.

[0005] Further characteristics and advantages of the invention are defined in the subsequent claims.

[0006] In other words, according to the new process, a volume per unit time of material undergoing processing is used as the control quantity to carry out regulation of capstan speed. In particular, there is measured a volume of material per unit time that passes in a given point or location upstream of a capstan, the speed of which it is intended to control, and the volume per unit time that passes in a given point or location upstream of a reference capstan (set downstream of the capstan being controlled), and a comparison value or error signal thus obtained is used to regulate the rotational speed of the controlled capstan. The regulation of the speed is obtained generally using a feedback control loop of the PID (proportional-integral-differential) type.

[0007] An examplary embodiment of the invention will be described in the following, with reference to the attached drawings, in which:

Figure 1 is a diagram of a drawing line or system with a regulation or control according to the invention;

Figure 2 is a diagram of a drawing line or system with a variant to the proposed regulation.

[0008] With reference to Figure 1, a drawing line or system is designated by the generic reference 10 and is illustrated as comprising a first die plate 12, upstream, a second die plate 14, downstream, a first capstan 16, downstream of the first die plate, and a second capstan 18, downstream of the second die plate. Capstan 16 is upstream of capstan 18. A wire being formed on the drawing line is indicated by the letter F. In particular, F' is a larger-section wire entering die plate 12, F'' is a wire with intermediate cross-section between die plate 12 and die plate 14, and F''' is a reduced cross-section wire downstream of die plate 14.

[0009] It is desired to regulate rotational speed of the upstream capstan 16, according to the rotational speed of the downstream capstan 18. The capstan 16, then, is the controlled member, and the capstan 18 the reference member.

[0010] According to the invention, at a location P_1 upstream of the capstan 16, and at a location P_2 upstream of the capstan 18 and downstream of the capstan 16, the volume per unit time of wire F that passes through each of the said sections is monitored. Reference 31 is a measuring apparatus in P_1 , and reference 32 is a measuring apparatus in P_2. Unit volumes V_{u1} measured in P_1 and V_{u2} measured in P_2 are compared. Since the drawing operation takes place without removal of material, for proper running of the system it should be $V_{u1} = V_{u2}$. In practice, however, V_{u1} is frequently different from V_{u2}. The comparison is used to regulate the speed of motor 22 driving the capstan 16, preferably through a feedback loop control (not illustrated herein) of the PID type. In the figure, reference 20 is a differential error amplifier, and reference 21 is a driving circuit for motor 22.

[0011] The volume V_u passing per unit time in a given section may be measured in various ways. To provide an unrestrictive example, a marking is provided at intervals along the wire, obtained by visual means (for example, paint marks sprayed on), or electrical means, such as magnetization. The system illustrated in Fig. 1 is particularly suited for marking by paint-spraying, the paint being applied at a location M upstream of the die plate 12. In practice, by marking the wire F' at regular intervals upstream of the die plate 12, a marking is also obtained, at different regular intervals, of the wire F'' upstream of the die plate 14. Counting the number of stretches of wire passing per unit time at location P_1 and the number of stretches of wire passing per unit time at location P_2 gives the values of volume per unit time V_{u1} and V_{u2}. Counting can be done using known means; for example, 31 and 32 may be counters of electric pulses coming from optical (or magnetic) sensors which detect the passage of the marks (stored in memory) on the wire.

[0012] As has been said, the system illustrated in Fig. 1 is particularly suitable when there is a paint-type marking.

[0013] Figure 2 illustrates a system tat is particularly suited for operating with a magnetic-type marking. In the system of Fig. 2, the same notation used in Fig. 1 for corresponding parts has been maintained. For this reason, said parts will not be described any further. In this case, marking is made at a location M downstream of the first die plate 12, and the first reading of volume per unit time is made at a location P_1 downstream of the first die plate and of the marking, and upstream of the first capstan 16. The location P_2 of the second reading of unit volume is set downstream of the controlled capstan 16, i.e., upstream of the die plate 14, as in the previous drawing line.

[0014] Variants to what has been described are possible.

[0015] As far as the application of the marking and/or marking-detection devices is concerned, it may be pointed out that it makes no difference whether they are set at the entry point or at the exit point of the die plates, provided that they are set in the immediate vicinity of the die plates. This possibility exists in so far as the volume of the material coming into the die plate is exactly the same as the outgoing material.

Claims

1. A procedure for regulating the speed of rotation of a controlled capstan on the basis of the speed of rotation of a reference capstan, in a system for the continuous plastic processing of material by reduction of cross section, characterized in that the values measured in the system for the regulation of the said speed consist of volumes of material that pass per unit time at spaced locations in the system.

2. A procedure according to Claim 1, characterized in that the value of volume per unit time is measured at a first location upstream of the controlled capstan, and the value of volume per unit time is measured at a second location downstream of the controlled capstan.

3. A procedure according to Claim 2, characterized in that said first location (P_1) is downstream of a first piece of equipment (12) for reduction of section, and the said second location (P_2) is upstream of a second piece of equipment (14) for reduction of section.

4. A procedure according to Claim 2, characterized in that the said first location is upstream of a first piece of equipment for reduction of section, and the said second location is upstream of a second piece of equipment for reduction of section.

5. A procedure according to Claim 1, characterized in that the regulation of the speed of the motor of the controlled capstan is made by means of a feedback control loop of the PID type.

6. A procedure according to Claim 1, characterized in that the measurement of the volume of material per unit time that passes in a given location is made by means of marking at intervals the moving material upstream of the said section and counting of the marks passing per unit time at said location.

7. A system for plastic processing of material by reduction of cross section comprising a piece of equipment (12) for reduction of section upstream, a piece of equipment (14) for reduction of section downstream, a first drawing capstan (16) set downstream of the first piece of equipment for reduction of section, and a second drawing capstan (18) set downstream of the second piece of equipment for reduction of section and of the first capstan, characterized in that it comprises two measuring apparatuses (31, 32) for measuring volumes per unit time upstream (at location P_1) and downstream (at location P_2) of a said capstan (16), the speed of rotation of which is to be controlled.

8. A system according to Claim 7, characterized in that it comprises a paint-marking device (M), and that the measuring apparatus consists of counters, the marking device and the first measuring apparatus (31) being set upstream of the first piece of equipment for reduction of section, the second measuring apparatus being set upstream of the second piece of equipment for reduction of section.

9. A system according to Claim 7, characterized in that it comprises a magnetic-marking device (M), and wherein the measuring apparatus consists of counters, the marking device and the first counter being set downstream of the first piece of equipment for reduction of section, the second counter

being set upstream of the second piece of equipment for reduction of section.

10. A system according to Claim 7 for a drawing line, in which the said first piece of equipment and the said second piece of equipment are die plates.

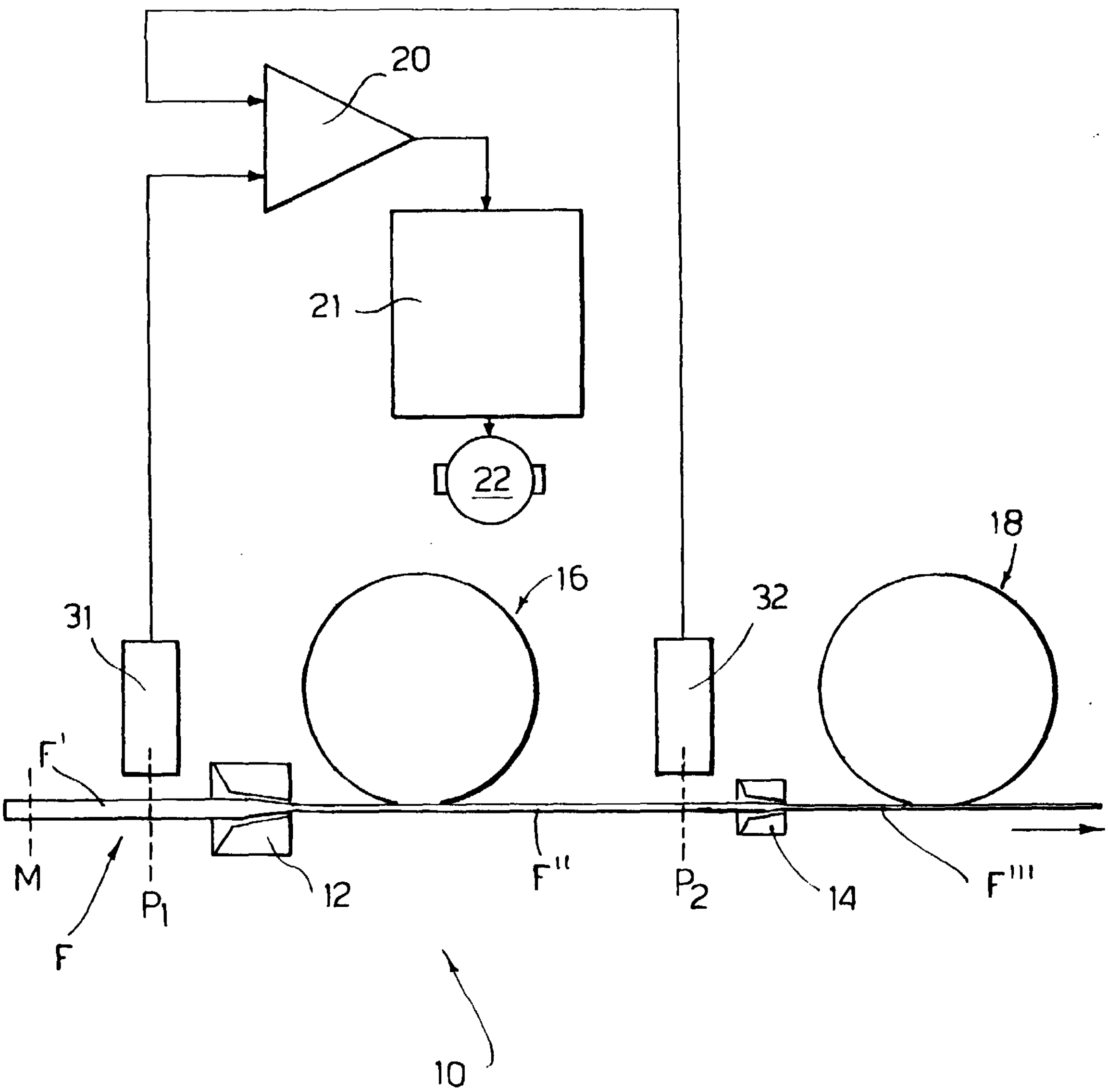

FIG.1

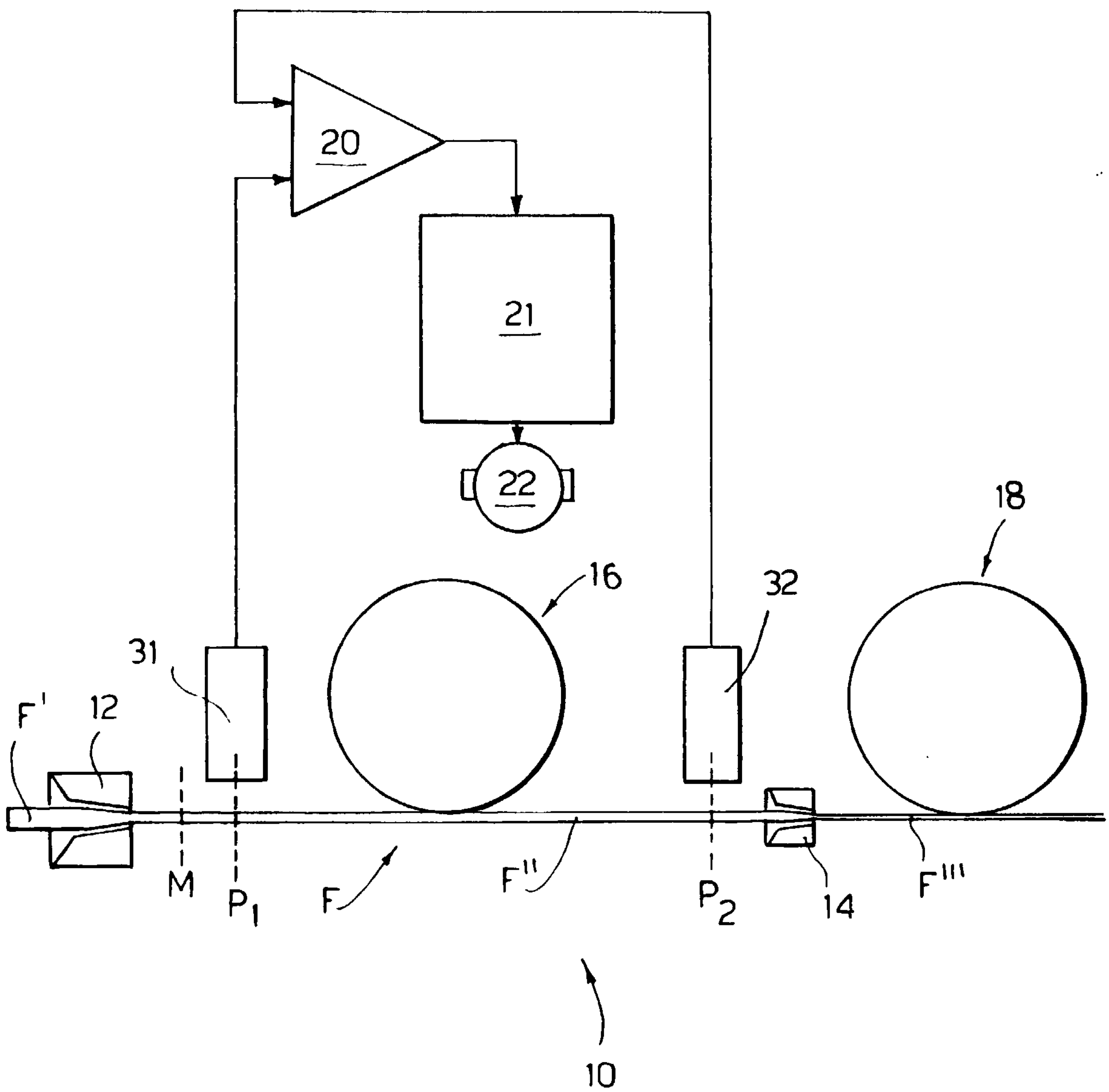

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 98 11 3975

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 005, no. 112 (M-079), 21 July 1981 & JP 56 053817 A (TOSHIBA CORP), 13 May 1981 * abstract *	1-3,7,10	B21C1/12
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A	PATENT ABSTRACTS OF JAPAN vol. 002, no. 049 (E-025), 6 April 1978 & JP 53 011057 A (NIPPON STEEL CORP), 1 February 1978 * abstract *	1,2,7,10	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B21C B21B
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 December 1998	Barrow, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 11 3975

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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