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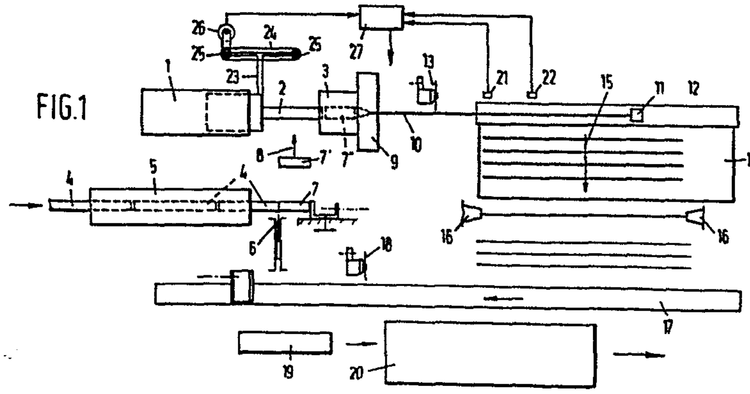
(54) A method of extruding material, and extruder for carrying out said method.

(57) A method of and apparatus for extruding material, such as aluminium. The material (4) to be extruded is supplied in commercial sizes, reduced to a pre-determined length to form a billet (7, 7', 7"), which is placed in a heating container (3), in which a ram (2) is operative to press the material present in the container (3) through a die (9) provided with at least one extrusion orifice to form extruded mouldings (10). The mouldings (10) are discharged by means of a discharge device (11). According to the invention the weight per unit length of the extruded moulding (10) is determined at least once during the extrusion of each billet (7, 7', 7").

FIG.1



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Croydon Printing Company Ltd

Title: A method of extruding material, and extruder for carrying out said method.

This invention relates to a method of extruding material, which comprises supplying material to be extruded in commercial sizes, reducing said material to a pre-determined length, and placing it in a heated container, in which a ram is operative to press material contained in the container through a die comprising at least one extrusion orifice to form extruded mouldings, said mouldings being discharged by means of a discharge device. The invention also relates to an extruder for carrying out said method.

Although the invention is in particular suitable for the extrusion of aluminium, and will be described hereinafter with reference to an aluminium extrusion process, the invention is also applicable to the extrusion of other materials.

Similar methods of extruding material, in particular aluminium, are known in the art. A disadvantage of these prior methods is that they do not permit accurate control of the extrusion process and the parameters determining its results, so that there is a relatively large amount of loss. This loss is caused, among other factors, by waste (scrap) and by a non-optimum rate of production.

Thus, in the extrusion of aluminium, scrap percentages of 25 to 27% are common practice. Furthermore, extrusion with one and the same die gives in practice variations in rate of production of 20 to 50% (and sometimes more).

It is an object of the present invention to remedy the above and other drawbacks, and, more generally, to provide an optimal extrusion method. To this effect, according to the invention, a method of the kind described is characterized in that during the extrusion of each billet, the weight per unit length of the extruded moulding is determined at least once.

An extruder according to the invention is characterized by weight determining means for determining the weight per unit length of the moulding extruded from each billet.

The invention will be described in more detail hereinafter with reference to the accompanying drawings, which by way of example relate to the extrusion of aluminium. In said drawings,

Fig. 1 is a diagrammatic showing of an extruder for aluminium;

Fig. 2 shows an example of an electronic circuit arrangement suitable for use in the apparatus of Fig. 1.

Fig. 1 diagrammatically shows an extruder for aluminium, suitable for realizing the method according to the invention.

The apparatus shown in Fig. 1 comprises a press 1 of known per se construction, comprising a ram 2 that can be pressed into a container 3 for material to be extruded.

The starting product in the extrusion of aluminium is Al poles having a diameter depending on the size of the extruder. These Al poles may, for example, in practice have a diameter of about 17.5 cm and a length of 3 to 4 m.

The Al poles are either cold-sawn to standard lengths adapted to the extruder by means of a cross-cutting machine and subsequently brought to the desired extrusion temperature, or bodily heated to be cut off to the desired length immediately before the extrusion process. As a cross-cutting machine, a guillotine shearing machine, sometimes referred to as a "hot-shear", may be used.

The latter method is illustrated in Fig. 1. The Al poles 4 are supplied to a furnace 5 and after leaving the furnace cut-off by a guillotine shearing machine 6. This machine comprises a stop, adjustable for example by means of a screw spindle, with the position of the stop determining the length of the cut-off part of the Al poles. These parts of the Al poles, sawn off or cut-off to length, are called billets, and are shown in the figure at 7, 7' and 7". The billets may for example be between about 350 and about 670 mm in length.

When a billet 7" present in container 3 has been used for extrusion, the ram 2 is withdrawn, and a next billet 7, meanwhile cut-off, is introduced in known manner, as indicated by an arrow 8 and billet 7', between the ram and the supply aperture of container 3. At the same time a steel dummy block is positioned between the ram and the billet. Subsequently the billet is placed in container 3, which is heated to maintain the correct extrusion temperature.

Provided at the end of container 3 remote from the ram, in operation, is a die, which is placed in a die carriage 9, and comprises one or more extrusion orifices having a shape corresponding to the moulding being extruded.

When the ram is energized, the billet present in the container is first upset to a diameter equal to the diameter of the container. When the ram is further displaced in the direction of the die, a moulding having the desired profile, shown diagrammatically at 10, is formed.

The mouldings are gripped by a mechanical hand of a so-called puller 11, and guided over a run-out table or conveyor 12. The puller is provided with a digital counter, which indicates the displacement of the mechanical hand, and hence the length extruded.

In case relatively short mouldings with a relatively large diameter are extruded, it is not necessary to use a puller. It is then often sufficient for the mouldings to be supported and if desired laterally guided. The displacement of the end of a moulding can then also be measured digitally, for example, by means of a series of photocells connected with a counter.

Provided in the vicinity of the die is a displaceable saw 13, serving to cut-off the extruded moulding. The cut moulding present on the run-out table or conveyor is subsequently transported to a cooling table 14, as shown diagrammatically at arrow 15.

After being sufficiently cooled on the cooling table, the extruded lengths are straightened by means of a horizontal stretcher leveller 16.

Finally the lengths thus produced are supplied by means of a conveyor 17, for example, a roller track, to a cutting machine 18, which saws the extruded lengths to the desired commercial length, which are then stacked on racks, and passed through an aging furnace 20.

In the production process of aluminium mouldings outlined hereinbefore, losses occur in various ways. Some important causes are:

a) Using standard billet lengths, which normally are oversized. This means that a portion of a billet is not extruded, but discharged as scrap. This portion is generally referred to as a butt end. It should be noted that normally there will always remain a butt end of a certain length, because during extrusion the outside of the billet, where aluminium oxide is present, is stripped off and, as it were, pushed to the trailing end of the billet. These aluminium oxides are generally considered less suitable for extrusion, the less so as other impurities accummulate therein. The aim should be, however, for as short butt ends as possible.

b) Damage to the ends of the mouldings, and sawing losses.

c) A varying weight per unit length of the extruded moulding, and the variations in billet lengths required therefor. The weight per unit length will hereinafter be referred to as: weight by metre.

d) The removal of welded joint scrap.

e) Damage to the ends of the extruded mouldings, caused by the horizontal stretch leveller can be determined or measured per moulding, and recorded (in a computer); this data is then used in determining the required billet length in a next production order.

The above and a few other causes lead in practice to waste percentages of 25 to 27%.

f) Furthermore, losses in man hours and machine hours result if the rate of extrusion, and hence the rate of production are not optimal.

One important role is played by the weight by metre. If, during the extrusion process, the actual weight by metre can be continuously determined, and adjustment can be accomplished upon deviations from the weight by metre, a considerable reduction in losses can be realized.

The weight by metre, together with the length of the moulding to be extruded, determine the required billet length and hence the adjustment of the guillotine shears, and also the required number of billets.

If a certain production order requires more than one billet to produce the desired number of metres of extruded moulding, a next billet is secured to the remainder of the previous billet in the die by means of a weld joint. These weld joints remain visible in the extruded moulding, and are later sawn off. If the weight by metre of the extruded moulding is accurately known, it is possible to determine the correct billet lengths, and it can be accomplished that the distance between the weld joints is always a whole number of times the desired commercial length of the mouldings. The loss caused by sawing off the welded joints is then as small as possible.

The actual weight by metre depends on a number of factors.

In a first approximation, the diameter of the die orifice(s) is decisive. Deviations occur, however, inter alia, as a result of wear and tear of the die - as a result deviations of up to 20% may occur; as a result of the pressure used; as a result of billet temperature during extrusion; as a result of misalignment of ram, container and die; and as a result of variations in effective interior diameter of the container.

According to the invention, the actual weight by metre is continuously determined during extrusion. This data can be supplied to the press operator, who can then, upon deviations from the desired value, vary one or more process parameters to optimize extrusion.

Preferably, however, although this information is supplied to the press operator, for example by means of a visual display unit (V.D.U.), the steps to be taken pursuant to the actual weight by metre found are as much as possible taken automatically, that is to say, without direct action by the operator. Such a step may be, for example, adjusting the position of the shearing machine. If such automatic operations are performed, information about them is preferably also supplied to the press operator, so that the latter may at all times be in complete control of the extrusion process.

The weight by metre follows from the following formula:

$$A.x.sg = 1.mg.z$$

in which

A = interior cross-sectional area of the container

x = displacement of the ram

sg = specific gravity extruded material

l = length extruded moulding

z = number of die orifices

mg = actual weight by metre.

In order to determine the actual weight by metre in practice, two detectors 21, 22, for example, proximity switches, are provided along the path of movement of the leading end of the moulding, or of puller 11, which detectors are spaced a known distance apart, which in the case of long mouldings may for example be 4 metres, and are capable of detecting the passage of the leading end of the moulding or the puller.

At the same time the displacement of the ram is measured. For this purpose, in one embodiment of the invention, the ram is coupled to an arm 23, which drives an endless string 24 lapped about two pulleys 25. One of these pulleys in turn drives a rotary pulse generator 26, which generates a large number of pulses, e.g. 10,000, per revolution.

These pulses, and also the signals from detectors 21, 22, are supplied to a processor 27, e.g. a mini-computer, which as soon as a signal from the first detector 21 is received begins to count the pulses from pulse generator 26, and stops counting as soon as the second detector 22 generates a signal. Furthermore there is stored in the mini-computer a factor f, which represents the effect of the interior cross-sectional area of the container, the number of die orifices, the specific gravity of the extruded material, the distance between detectors 21 and 22, and the ratio between the number of pulses of pulse generator 26 and the displacement of the ram.

Instead of a commercially available mini-computer, it is naturally also possible to use a binary logic circuit, built up in a conventional manner. One example of such a logic circuit is shown diagrammatically in Fig. 2.

An AND gate 30 having two inputs has one input 31 connected to pulse generator 26, and the other input 32 to the output of a flip-flop 33 having two inputs respectively connected to the first detector 21 and the second detector 22. A signal from the first detector brings the flip-flop into such a state that a signal appears at the input 32 of gate 30, which causes the gate to pass pulses from pulse generator 26, whereas a subsequent signal from the second detector switches the flip-flop, whereby gate 30 is switched into the closed state.

The output of gate 30 is connected to a binary counter T. A signal from the second detector also causes the contents of the counter to be transferred, for example by means of a gating device 34, shown diagrammatically, to a multiplier and/or divider F, which multiplies the contents of the counter by the factor f, so that the output signal of unit F represents the weight by metre. This output signal can be displayed in a known manner, if necessary after being converted into a decimal number, by means of a VDU, by printing or by punching, and could also be used to vary process parameters directly.

Thus, for example, the output signal could be used to vary the temperature of the billet furnace and/or to vary the temperature of the container and/or to vary the extrusion pressure. In the first instance, according to the invention the output signal of the mini-computer or the logic circuit is used to determine the required length of the next billet, and to adapt the position of the guillotine machine. The position of the shearing machine can be varied in a simple manner by using a controlled incremental motor driving a screw spindle. It should be noted that when two detectors are used the weight by metre is determined only with regard to a moulding length corresponding to the distance between these detectors, which distance may, for example, be 4 metres. By placing detectors at uniform distances throughout the entire length of the run-out table, it is possible, in a manner similar to that described above, to determine the weight by metre throughout the entire extruded moulding length, and, if necessary, to vary the extrusion pressure during the extrusion of one and the same billet.

The apparatus is further provided with a position detector which continuously monitors the position of the puller, or the leading end of the moulding, relative to the die or relative to another fixed point along the discharge path of the moulding. Such a position detector can be built up in a simple manner by means of a digital counter which during the movement of the puller or the leading end of the moulding receives a pulse for example every 10 cm.

This position detector can be adjusted to a desired value so that when this desired value is reached, which for example may correspond to a desired length of the extruded moulding, generates an output signal which stops the press and actuates saw 13.

Saw 13 is normally also actuated each time a billet has been extruded. If, however, more than one billet is required for a desired length of moulding, the saw should not be actuated after the first billet. This can be realized on the basis of the output signals of the position detector, or by using the billet counter which not until a position is reached corresponding to the desired number of extruded billets generates an output signal actuating the saw.

Furthermore, on the basis of the position detector output signals, the known length of the billet introduced into the press, the sg of aluminium, the number of orifices in the die, the cross-sectional area of the container, and the weight by metre of the extruded moulding, determined as described above, and the desired length of the butt end (this depends on the nature of the die, among other factors) it can be determined in a simple manner at what moment the press should be stopped for the supply of a fresh billet.

For that matter, the press is normally provided with an end switch to prevent the ram from pushing the dummy block against the die, by causing the press to be switched off at a given maximum position. This end switch, which for example may be a microswitch, can also be used to adjust the desired butt end length. Furthermore, this end switch can be used to control the billet counter.

It is further noted that, instead of the output signals of detectors 21, 22 and possible further detectors, the output signals of the position detector can be used to continuously determine the weight by metre of the extruded moulding.

Furthermore, during an extrusion process the time is recorded. In this way the production rate in kg/h can be determined on the basis of the length of moulding produced between two points of time and on the basis of the weight by metre and, if desired, measures can be taken to increase the rate of production.

In a further elaboration of the invention, the following data is determined and collected for each die:

1) the weight by metre obtained with the die during a previous extrusion or, if the die is used for the first time, the weight by metre to be theoretically expected;

2) the number of extrusion orifices of the die;

3) the end-face loss occurring at the stretcher leveller;

4) the required butt end; this depends on the kind of die;

5) the theoretically possible rate of production;

6) the optimum, actually realized rate of production, achieved until then, in relation to a simultaneously collected number of parameters, such as: pressure variation during pressure, in relation to the billet length employed; the adjustment of temperature in the heating furnace for the aluminium poles (and the exit temperature of the extruded moulding).

These data are processed together with data on the desired commercial length of the mouldings and the magnitude of the order, and also with data on the dimensions and the carrying capacity of the cooling table, the possibilities of adjustment of saw 13, the sg of aluminium, and the difference between the contraction of the profiles occurring upon cooling, and the extension occurring during stretching in unit 16, by a data processing device which is productive of a production-order card specifying, among other data:

a) the billet length to which the guillotine shearing machine must be adjusted;

b) the theoretical value of the output signal of the position detector of the puller;

c) the number of billets to be extruded before saw 13 is actuated;

d) the number of billets to be processed per hour to attain the theoretical rate of production;

e) the number of millimeters which a next billet should be selected longer or shorter, if the position detector generates a real output signal deviating from the value specified on the production card; the output signal corresponds to unit lengths and the number of millimeters which the billet length should be varied can therefore be related to, for example, the number of metres corresponding to the difference between the theoretical value of the output signal of the position detector and the value which actually occurs;

f) the theoretically estimated percentage of waste;

g) the total number of billets needed for the order;

h) the end-face waste;

i) the adjustment of saw 13.

This data may be optimized to achieve as low a waste percentage as possible and as high a rate of production as possible and as few stoppages of the production apparatus as possible, resulting from the cooling table being unduly loaded.

In this way the parameters associated with a given die may be entered, whether or not automatically, before an extrusion process is started.

Of all the data to be introduced, only one is variable in a production order being carried out, i.e. the actual weight by metre, which has an effect on the above points a), b), c), d), e), g) and, accordingly, on the waste percentage to be realized and the rate of production to be realized in practice.

It is noted that the data processing unit may be a commercially available mini-computer, in which, if desired, the position detector may be partially integrated, in the sense that the pulses generated are further processed. The same applies to the billet counter mentioned hereinbefore.

Furthermore, the mini-computer is preferably coupled to a VDU, disposed in the vicinity of the extrusion press, and on which a number of relevant data are displayed, such as the instantaneous and cumulative real rate of production in kg/h, so that the press operator can always monitor the extrusion process and, where necessary, take corrective action.

In a further elaboration of the inventive concept, the extrusion process may be optimized still further by adjusting an optimum rate of production.

For this purpose, at the beginning of the extrusion process the initial extrusion pressure is measured. If this is less than a given value, for example, less than 200 ats., the speed knob, provided on each extrusion press, is incrementally set at a higher value (with each next billet) so long as the rate of production, determined and displayed as described hereinbefore, is increased. This procedure is continued until the initial pressure exceeds, for example, 200 ats. Thereafter, the speed knob is adjusted at smaller increments until the maximum permissible pressure, e.g. 210 ats., is reached. The momentary position of the speed knob and the rate of production are then determined.

Furthermore, after the extrusion of a few billets, the extrusion pressure at the end of the extrusion stroke is measured. Depending on this end pressure, during a next extrusion stroke, the speed knob is turned to a higher position by a certain increment, and, for reaching the previous end position of the position detector, returned by the same increment, to prevent the initial extrusion pressure from becoming too high with the next billet. The value of the increment referred to is selected depending on the end pressure measured.

Instead of batch-wise, the process may be conducted continuously.

When, in this way, as high a rate of production as possible has been reached, the adjusted temperature of the billet furnace is checked and, if found to be lower than a given value, first adjusted to this value and subsequently increased by increments of, e.g. 5°C. During this process, the rate of production is being checked. If this is found to decrease, the temperature is incrementally decreased until the optimum adjusted temperature has been reached.

The optimum values of the adjusted temperature and the position of the speed knob and the associated rate of production are stored and, for later extrusion using the same die, made available to the operator as target values, for example by means of a VDU, and/or automatically processed for adjusting the extruder.

Should it turn out during the extrusion of a next batch using the same die that the optimum production rate cannot be attained, or cannot without quality problems with regard to the extruded moulding, this may be a reason for re-conditoning or replacing the die.

Experiments have shown that there is a substantially linear relationship between the instantaneous moulding pressure and the billet length already extruded. Accordingly, after the puller or the leading end of the moulding has passed two fixed points, for example, the second detector and another point, it is possible, on the basis of the moulding pressure prevailing at the instants in question, the weight by metre and the location of the fixed point relative to the die, to calculate the final moulding pressure and also the initial moulding pressure, so that the above-described procedure for attaining the optimum moulding pressure with a next billet can be started immediately. Instead of measuring the pressure at a second fixed point, it is also possible to measure the final moulding pressure directly.

It is noted that various modifications of the method and apparatus described herein will readily occur to one skilled in the art without departing from the scope of the invention.

* CLAIMS *

1. A method of extruding material, which comprises supplying the material to be extruded in commercial sizes, reducing it to a pre-determined length to form a billet, which is placed in a heating container, in which a ram is operative to press the material present in the container through a die provided with at least one extrusion orifice to form extruded mouldings, and discharging said mouldings by means of a discharge device, characterized in that during the extrusion of each billet the weight per unit length of the extruded moulding is determined at least once.

2. A method according to claim 1, characterized in that the weight per unit length is determined by detecting the passage of the leading end of the moulding, or a puller used to discharge the moulding along at least two points spaced a fixed distance along the path of the moulding, and by measuring the displacement of the ram between the moment at which the leading end or the puller passes the first point and the moment at which the leading end or the puller passes the second point, whereafter, on the basis of the fixed distance, the displacement of the ram, the inner dimensions of the container, the number of orifices of the die, and the specific gravity of the extruded material, the actual weight per unit length of the extruded moulding is determined.

3. A method according to claim 2, characterized in that the distance covered by the leading end or the puller is continuously measured by means of a position detector cooperating with the leading end or the puller, with the fixed distance being related to two pre-determined positions of the position detector.

4. A method according to any one of the preceding claims, characterized in that the length of the next billet to be extruded is determined on the basis of the actual weight per unit length of the extruded moulding and of the desired length of the moulding.

5. A method according to any one of claims 2-4, characterized in that during the displacement of the leading end or the puller the time interval is measured and that, on the basis of the weight per unit length of the extruded moulding, the displacement of the leading end or the puller and the time elapsed, the production rate in weight units per time unit is determined.

6. A method according to any one of claims 2-5, characterized in that electrical signals corresponding to the displacement of the ram and to the displacement of the leading end or the puller are supplied to a logic data processing device which automatically determines the weight per unit length of the extruded moulding and displays the same on a visual display unit.

7. A method according to claim 6, characterized by using as the data processing device a mini-computer to which data concerning the production order are supplied,

and which on the basis of said data determines and displays the length of the next billet to be extruded and the number of billets to be extruded.

8. A method according to claim 7, characterized in that said mini-computer further determines the production rate and is used for automatically adjusting the length of the next billet to be extruded.

9. A method according to claim 8, characterized in that, on the basis of data concerning the production order, the weight per unit length of the extruded moulding, the length of the billets extruded and still to be extruded at that moment, the mini-computer determines the position of the position detector at which the extrusion should be terminated or interrupted, and switches off the extruder when this position is reached.

10. A method according to claim 9, characterized in that said mini-computer is used to control a sawing device for sawing the moulding just extruded.

11. A method according to claim 6 or 8-10, characterized in that during the extrusion the production rate is continuously determined, and that said rate is optimized by varying the initial moulding pressure of the ram with each next billet by means of a speed knob provided on the extruder until the position at which the highest production rate occurs, has been found.

12. A method according to claim 11, characterized in that the rate of production is further optimized by varying the temperature of successive extruded billets

until the temperature at which the highest production rate occurs, has been found.

13. A method according to claim 11 or 12, characterized in that, after the extrusion of a few billets, the final moulding pressure prevailing at the end of an extrusion stroke is determined, and also the position of the position detector is recorded, and that during the next extrusion stroke, when a pre-determined percentage of the recorded final position of the position detector has been reached, the speed knob is set higher by an increment depending on the final moulding pressure determined, and is re-set before reaching the recorded final position of the position detector.

14. A method according to claim 11, 12 or 13, characterized in that the initial moulding pressure and the final moulding pressure of an extrusion stroke are determined on the basis of the instantaneous moulding pressures prevailing at two instants during the extrusion stroke and the billet length already extruded at said instants.

15. A method according to any of the preceding claims, characterized in that the production results achieved during the extrusion with a given die, and also the pertinent process parameters are stored and that during the extrusion of a next batch using the same die the process parameters are set on the basis of this stored data, and the production results are compared with the data stored.

16. A method according to claim 15, characterized in that the stored data are supplied to a data processing unit which automatically sets the process parameters during the extrusion of a next batch using the same die.

17. An extruder comprising a press including rate adjusting means and including a ram arranged to press a billet placed in a container through a die to form an extruded moulding; a furnace for pre-heating said billets; reducing means for cutting the billets to the desired length; discharge means for conducting the extruded moulding, and sawing means for sawing off the extruded moulding, characterized by weight determining means for determining the weight per unit length of the moulding extruded from each billet.

18. An extruder according to claim 17, characterized in that the weight determining means comprises a position detection means for detecting the position of the puller or the leading end of the moulding being extruded, and displacement measuring means cooperating with said ram, and logic means operatively associated with said position detection means and with said displacement measuring means.

19. An extruder according to claim 18, characterized in that said position detection means comprises at least two detectors spaced a fixed distance along the path of the puller or the leading end of the moulding being extruded, each said detectors supplying an electrical pulse to said logic means in response to the passage of said puller or said leading end; that said displacement

measuring means during the displacement of the ram generates electrical pulses in a fixed ratio to the degree of displacement of said ram, which pulses are supplied to said logic means; and that said logic means is arranged to count the pulses of the displacement measuring means during the interval between the pulses of the position detection means.

20. An extruder according to claim 19, characterized in that said logic means comprises gating means to which the pulses of the displacement measuring means are supplied, and which is enabled by a first pulse from said position detection means, and disabled by a second pulse of the displacement measuring means; and that the gating means is connected to a counter which in turn is connected to a divider/multiplier whose output signal represents the weight per unit length of the extruded moulding.

21. An extruder according to any one of claims 18 to 20, characterized in that the position detection means comprises a digital counter whose output signal, in operation, continuously represents the position of the puller or the leading end of the moulding being extruded.

22. An extruder according to claim 18 or 21, characterized in that the digital counter produces an output pulse at at least two different positions, which output pulses are supplied to a gating means, to which the pulses from the displacement measuring means are also supplied, a first output pulse from the digital counter enabling the

gating means, and a second output pulse from the digital counter disabling the gating means; and that the gating means is connected to a counter which in turn is connected to a divider/multiplier whose output signal represents the weight per unit length of the extruded moulding.

23. An extruder according to claim 19, characterized in that the detectors disposed along the path of the puller or the leading end of the moulding being extruded are proximity switches.

24. An extruder according to any one of claims 18 to 23, characterized in that said logic means is a mini-computer.

25. An extruder according to any one of claims 18 to 24, characterized in that the displacement measuring means comprises an endless belt lapped about two pulleys and coupled, and driven by, said ram, one of said pulleys driving a rotary pulse generator.

26. An extruder according to any one of claims 21-25, characterized in that said logic means comprises means for calculating the position of the digital counter at which the extruder should be stopped on the basis of the determined weight per unit length of the extruded moulding and of the length of the length of the extruded billet, said means being operatively associated with said digital counter, and passing a control signal to the extruder when the calculated position of the digital counter is reached.

27. An extruder according to any one of claims 21 to 26, characterized in that said logic means comprises means capable of determining the length of the next billet(s) to be extruded on the basis of the determined weight per unit length of the extruded moulding and of the desired total length of the moulding to be extruded, and also the associated position(s) of the digital counter.

28. An extruder according to any one of claims 21 to 27, characterized in that said logic means comprises means which, on the basis of the desired commercial length of the moulding to be extruded, determines the associated position(s) of the digital counter, and actuates the sawing means when such position is reached.

29. An extruder according to claim 28, characterized by a separate billet counter coupled with said logic means, and by means which on the basis of the determined weight per unit length of the extruded moulding and of the desired total length of the moulding to be extruded, calculates the total number of billets to be extruded, said means being coupled with said billet counter, and in response to the calculated position of the billet counter and the also calculated final position of the digital counter being reached passing a switching-off signal to the extruder and also an actuating signal to the sawing means.

30. An extruder according to any one of claims 18 to 29, characterized by time measuring means coupled with said logic means, and by means which on the basis of

the determined weight per unit length of the extruded moulding and of the output signals from the time measuring means calculate and display the rate of production in weight units per time unit.

31. Apparatus according to any one of claims 27 to 30, characterized in that the means for determining the length of the next billet(s) to be extruded is coupled to adjusting means for adjusting the reducing means.

32. Apparatus according to claim 30 or 31, characterized by means for storing and displaying, for a given die, among other data, the rate of production realized, the weight per unit length of the moulding extruded, the number of billets used, and the length thereof, and for determining and displaying, on the basis of this data, with a next production order for this die, the required number of billets and the length thereof, setting the reducing means, calculating the end position of the digital counter, and displaying the rate of production realized before.

33. Apparatus according to any one of claims 30 to 31, characterized by means for determining the initial and final moulding pressure during an extrusion stroke and varying for each next billet, by the speed adjusting means, the initial moulding pressure, and each time comparing the rate of production associated with the new initial moulding pressure with the rate of production realized before to determine the position of the speed adjusting means corresponding to the maximum production rate.

34. Apparatus according to claim 33, characterized by means for temporarily increasing the said speed to a certain extent during the extrusion of a billet, depending on the final moulding pressure determined.

35. Apparatus according to any one of claims 30 to 34, characterized by means for detecting the temperature of the billet furnace and for varying said temperature, with comparison with the production rate realized before, to determine the temperature associated with the highest production rate.

36. Apparatus according to any one of claims 33-35, characterized by means for storing and displaying the speed setting and billet furnace temperature associated with the maximum production rate, and for setting said speed setting andtemperature value for the extrusion of a next batch using the same die.

37. Apparatus according to any one of claims 33-36, characterized by means for measuring, storing and displaying the container temperature associated with the maximum production rate, and for setting this container temperature value for the extrusion of a next batch using the same die.

38. Apparatus according to any one of claims 33-37, characterized by means energized at the moment when the puller or the leading end of the moulding being extruded passes two spaced fixed points to measure the moulding pressure prevailing at these moments, and to calculate the

initial moulding pressure and the end moulding pressure on the basis of the values measured.

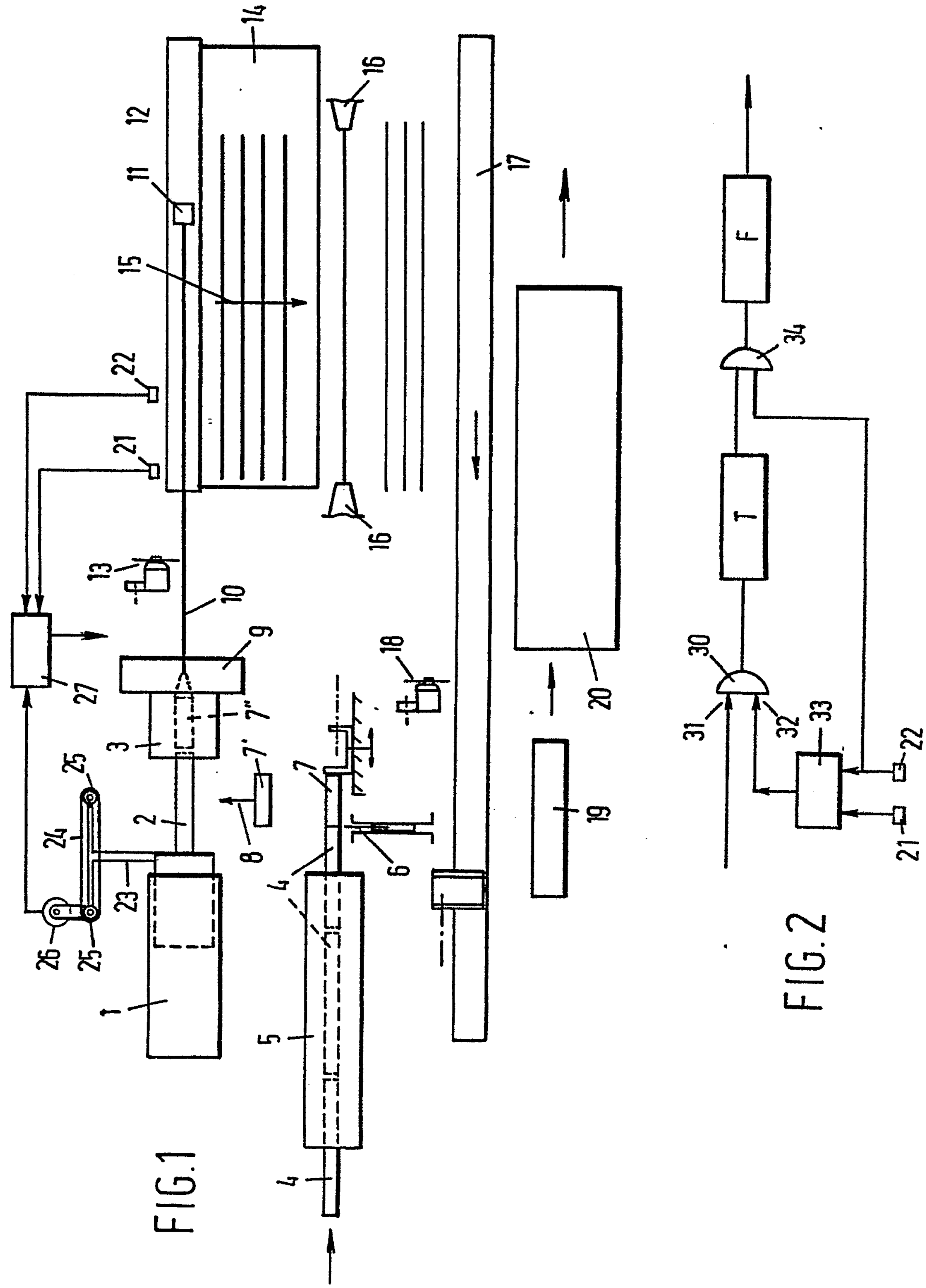

FIG.1

FIG.2

European Patent Office

EUROPEAN SEARCH REPORT

0091176
Application number

EP 83 20 0488

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. 3)
X,Y	GB-A-2 041 273 (ELHAUS) * Whole document *	1-38	B 21 C 31/00 B 21 C 23/04

X	US-A-2 113 208 (ANDREWS) * Whole document *	1-3,17	

Y	US-A-3 344 632 (PHILLIPSON) * Whole document *	1-3,10,17	

A	US-A-3 157 281 (SCHNETTKER)		

A	US-A-2 018 217 (McNAMEE)		

			TECHNICAL FIELDS SEARCHED (Int. Cl. 3)
			B 21 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27-05-1983	THE K.H.

CATEGORY OF CITED DOCUMENTS

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