

Oct. 9, 1945.

H. T. COSS ET AL

2,386,294

JET CONTROL

Filed March 17, 1942

2 Sheets-Sheet 1

Fig. 1.

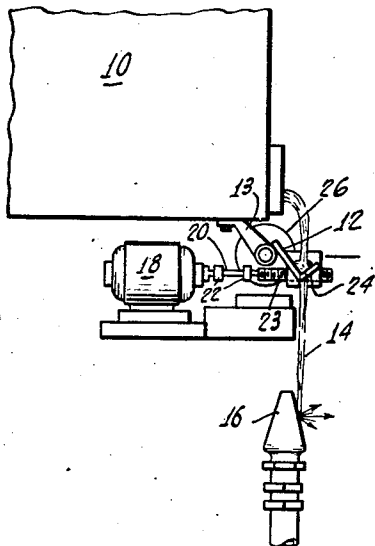


Fig. 2.

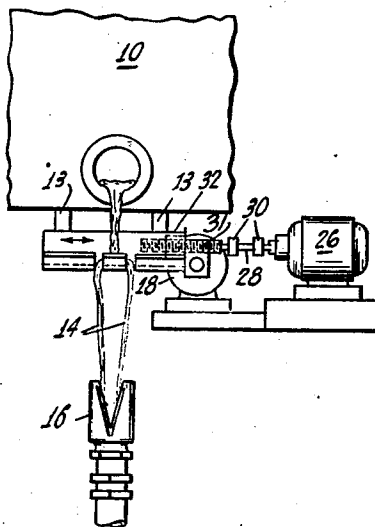
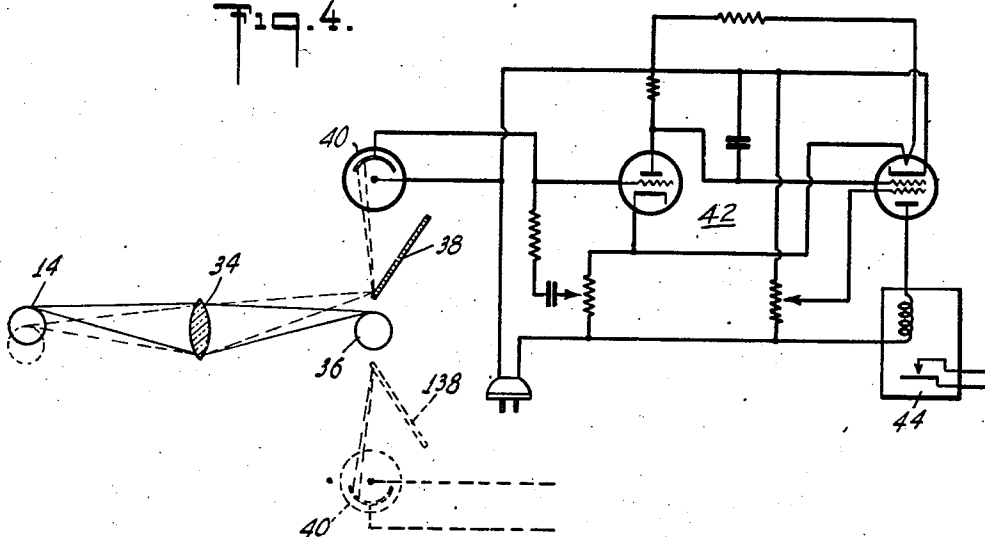


Fig. 4.



INVENTOR
 HAROLD T. COSS.
 GALE T. PEARCE
 GEORGE A. DOWNSBROUGH.
 BY *Nirgil C. Kline*
 ATTORNEY

250-203

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H. T. COSS ET AL

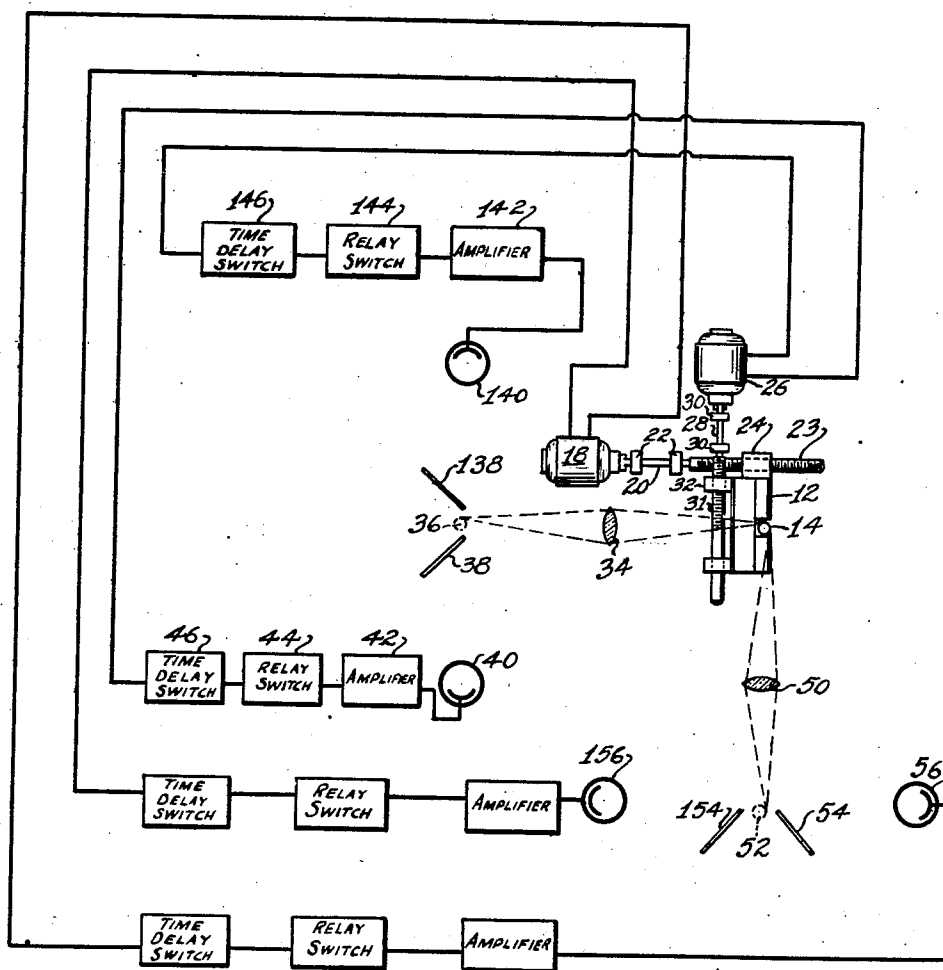
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2 Sheets-Sheet 2

Fig. 3.



INVENTOR
 HAROLD T. COSS
 GALE T. PEARCE
 GEORGE A. DOWNSBROUGH
 BY *Virgil O. Kline*
 ATTORNEY

UNITED STATES PATENT OFFICE

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JET CONTROL

Harold T. Coss and Gale T. Pearce, Somerville,
and George A. Downsborough, Princeton, N. J.,
assignors to Johns-Manville Corporation, New
York, N. Y., a corporation of New York

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14 Claims. (Cl. 83—91)

The present invention relates to an improved apparatus for fiberizing a stream of molten material and, more particularly, to an automatic apparatus for maintaining the relative positions of a fiberizing jet and the molten material stream so that the jet will be impelled directly against the stream notwithstanding changes in position of the latter. The invention finds a principal field of use in the manufacture of mineral wool and will be described in this connection.

Conventionally, mineral wool is produced by melting a suitable raw material, such as natural rock or blast furnace slag or mixtures thereof, in a furnace, such as a cupola, and discharging the molten material, either directly or from an intermediate stream splitter or the like, in the form of a stream. The stream is blasted by a jet of fluid, such as steam, issuing from a nozzle at a high velocity and is thereby converted into fibres. Heretofore, means have been proposed for adjustment of the nozzle to position the same to direct the fiberizing blast directly against the stream of molten material to obtain efficiency of fiberization. Such means have, however, been subject to the disadvantages attending a manual operation; for example, the time lag between the observance of a disturbance of the proper relationship between the stream and jet and the correction of the same by adjustment of the nozzle, and the necessity of constant attention on the fiberizing operation.

The principal object of the instant invention is the provision of an apparatus for automatically adjusting the relative positions of the molten stream discharging means and the jet nozzle to insure impingement of the jet or blast on the stream, irrespective of changes in position of the latter.

Another object of the invention is to provide an apparatus, as referred to, employing means such as photo-electric cells responsive to radiations from the molten stream to control the operation of an adjusting means.

The invention will be more fully understood and further objects and advantages thereof will become apparent when reference is made to the more detailed description thereof which is to follow and to the accompanying drawings in which:

Fig. 1 is a side elevational view of a mineral wool forming apparatus illustrating the instant invention in part;

Fig. 2 is a front elevational view of the apparatus of Fig. 1;

Fig. 3 is a diagrammatic plan view illustrating

the general hook-up of the control apparatus of the invention; and

Fig. 4 is a detail view on an enlarged scale illustrating diagrammatically a portion of the apparatus and including a partial wiring diagram therefor.

Referring now particularly to Figs. 1 and 2, an apparatus is illustrated comprising a furnace 10 for melting the raw mineral wool forming material, such as slag, rock or mixtures thereof. The furnace illustrated is of the cupola type, but it will be understood that any other suitable furnace, such as a tank furnace, is equally as applicable to the instant invention. The molten material is discharged from the cupola, preferably onto a stream splitter or like trough 12 as conventionally employed. The trough is supported by any suitable means as diagrammatically indicated at 13 which allows some substantial lateral and forward and backward movement of the trough by the adjustment device later described. The molten material falls in the form of a stream 14 in front of a nozzle 16, from which issues a fiberizing jet or blast of steam or other fluid under pressure. The steam jet impinging against the molten material splits or converts it into a great multiplicity of fibres and impels the fibres into a suitable blow chamber or other collecting means (not shown).

In accordance with the instant invention, an apparatus is provided for automatically adjusting either the position of the trough 12 or of the nozzle 16 relatively to the other to maintain direct impingement of the jet on the molten stream, irrespective of changes in position or meandering of the latter which may occur due, for example, to changes in viscosity and/or rate of flow of the molten material. In the drawings and following description, the adjusting means control the position of trough 12. It will be understood, however, that the apparatus operates equally well when employed to control the position of nozzle 16, this requiring only such a reversal of parts that the nozzle will be moved in the opposite direction to that in which the trough would be moved to effect the same adjustment.

The automatic adjustment apparatus comprises a reversing motor 18 supported in any suitable manner and operatively connected to the trough 12 to move the same forward or backward with respect to the nozzle depending upon the direction of drive of the motor. The connection between the motor and trough comprises shaft 20, extending from the motor shaft and including a pair of universal joints 22. Shaft 20

has a threaded end 23 engaged within an internally threaded sleeve 24 welded or otherwise secured to trough 12. A second reversing motor 26, supported in any suitable manner, is also operatively connected to trough 12 through shaft 28 extending from the motor shaft and including universal joints 30. Shaft 28 also includes threaded terminal portion 31 engaged within internally threaded sleeve 32 secured by welding or the like to the trough. Shafts 28 and 20 extend at substantially right angles to each other. As will be readily understood, the motor 18 will move trough 12 forward or backward depending upon the direction of rotation of the motor, and likewise, operation of motor 26 will move trough 12 laterally in one direction or the other depending upon its direction of rotation.

Referring now particularly to Figs. 3 and 4, the operation of motors 18 and 26 is controlled by means responsive to radiations from the molten stream. The control systems for the two motors are substantially identical and that for motor 26 will be described in detail for purposes of example. The control includes convex lens 34 positioned to concentrate the light radiations from the molten stream 14 to form an image 36 between a pair of mirrors 38 and 138, respectively, when the stream is in its desired lateral position with respect to the jet issuing from nozzle 16. The position of the image 36 when the fiberizing apparatus is properly adjusted is illustrated in full lines in Fig. 4. Each mirror is positioned to reflect light impinging thereon against an associated photo-electric cell 40 or 140, respectively. Each photo-electric cell forms a part of a circuit controlling one direction of rotation of motor 26. For example, cell 40 is part of a circuit (see Figs. 3 and 4) including amplifier 42, relay switch 44, and time delay switch 46, the circuit when energized causing rotation of the motor to move trough 12 toward the left in Fig. 2. Similarly, cell 140 is part of a circuit including amplifier 142, relay switch 144, and time delay switch 146, which when energized causes rotation of the motor to move the trough in the opposite direction. It will be understood that the particular circuits employed for the motor control may take different forms.

A similar control is provided for motor 18, the control comprising convex lens 50 positioned to concentrate light radiations from the molten stream to form an image 52 between mirrors 54 and 154, respectively. Each mirror is placed to reflect light impinging thereon against photo-electric cells 56 or 156, respectively. The cells form parts of motor control circuits which, as stated above, are preferably similar in all respects to those described and which, when energized, cause forward or backward movement of trough 12, as illustrated in Fig. 1.

In operation, the several parts of the apparatus are initially adjusted so that the stream of molten material discharged from the member 12 falls directly in front of the fluid jet issuing from nozzle 16 and close to the face of the nozzle. The initial adjustment includes positioning of the control apparatus so that the image of the stream as formed by lens 34 lies between the pair of mirrors 38 and 138, included in the control of motor 26, and the image of the stream as formed by lens 50 lies between the pair of mirrors 54 and 154. The several circuits and the motor are connected to suitable sources of electrical current.

During the operation of the cupola, in the event that the stream 14 moves from its normal

path due to changes of viscosity, rate of flow, the presence of unmelted lumps or other obstructions or the like, the image projected by lens 34 or 52 as the case may be will likewise be shifted.

Assuming for the purposes of illustration that the stream shifts laterally, the image projected by lens 34 will be thrown either on the mirror 38 or 138, depending upon the direction of the shift, and from thence the light will be reflected to the corresponding photo-electric cell 40 or 140, thereby setting up a current in the cell which is amplified by amplifier 42 or 142. This current energizes the appropriate relay switch and, if its flow is of sufficient duration, energizes the time delay switch to complete a circuit controlling the operation of motor 26 in a direction to shift member 12 until the reflected image no longer impinges upon the photo-electric cell. When this occurs, the stream is again directly in front of the jet issuing from nozzle 16.

Likewise, if the molten stream moves toward or away from the nozzle to such an extent that the image thrown by lens 50 falls either on mirror 54 or 154, a current will be induced in the corresponding photo-electric cell 56 or 156 and the circuit including such cell energized to cause rotation of motor 18 in a direction to move trough 12 toward or away from nozzle 16 until the image thrown by lens 50 again falls between the mirrors.

The time delay switch employed in each circuit serves to prevent what would otherwise be a substantially continual stopping and starting of the motors due to the image of small splashes and globules of molten material striking the mirrors. As will be understood, the time delay switch requires the current induced by the reflected light thrown on the photo-electric cells to continue for a given length of time before the switch will be thrown to start operation of the motor.

The particular circuits and the particular drive mechanisms above discussed are for the purpose of illustration only, and these, as well as conventional portions of the apparatus, may be modified or other conventional means for similar purposes may be substituted therefor without departing from the instant invention. Also, as previously pointed out, although the invention has been specifically described in connection with the control of fiberization apparatus in the manufacture of mineral wool, it may be employed for other purposes where similar problems occur. For example, the control apparatus of the invention may be employed wherever an incandescent or molten stream must be maintained in proper alignment with respect to means cooperating therewith.

Having thus described our invention in rather complete detail, it will be understood that these details need not be strictly adhered to but that various changes and modifications will suggest themselves to one skilled in the art, all falling within the scope of the invention as defined by the subjoined claims.

What we claim is:

1. An apparatus comprising means for discharging a stream of molten material, a nozzle for projecting a fluid jet against said stream, means for adjusting the relative positions of said stream-discharging means and said nozzle, and means responsive to radiations from said stream for operating said adjusting means.

2. In a mineral wool forming apparatus, means for discharging a stream of molten mineral wool forming material, a nozzle for projecting a fluid jet against said stream to shred the stream into

a multiplicity of fibres, means for adjusting the relative positions of said stream-discharging means and nozzle, and means responsive to light radiations from said stream for automatically controlling said adjustment means to insure protection of the fluid jet against the stream, irrespective of changes in the position of the stream.

3. In a mineral wool forming apparatus, means for discharging a stream of molten mineral wool forming material, a nozzle for projecting a fluid jet against said stream to convert the same into a multiplicity of fibres, means for adjusting the relative positions of said stream-discharging means and nozzle, and means including photo-electric cells responsive to radiations from said stream for controlling said adjustment means to maintain the relative positions between said stream and jet, irrespective of changes in position of the stream.

4. An apparatus comprising means for discharging a stream of molten material, a nozzle for projecting a fluid jet against said stream, means for adjusting the relative position of said nozzle and stream-discharging means, said adjustment means including a drive for effecting a relative movement between the nozzle and stream-discharging means, and means responsive to radiation from said stream to control the operation of said drive.

5. An apparatus comprising means for discharging a stream of molten material, a nozzle for projecting a fluid jet against said stream, means for adjusting the relative position of said nozzle and stream-discharging means, said adjustment means including a drive for effecting a relative movement between the nozzle and stream-discharging means, and means including photo-electric cells responsive to radiation from said stream to control the operation of said drive.

6. In a mineral wool forming apparatus, means for discharging a stream of molten material, a nozzle for discharging a steam jet against said stream to shred the same into a multiplicity of fibres, means for adjusting the relative position of said stream-discharging means and nozzle, said last-named means including drives operatively connected to reversing motors, photo-electric cells positioned and arranged to become energized upon changes in position of said stream, and operative connections between said cells and said motors to operate the same upon change in position of the stream.

7. In a mineral wool forming apparatus means for delivering a stream of molten material, a nozzle for discharging a steam jet against said stream to shred the same into a multiplicity of fibres, means for automatically adjusting the relative positions of said stream-discharging means and nozzle to cause changes in position of the stream, said last-named means including a threaded sleeve carried by said first-mentioned means, a shaft threaded in said sleeve and connected to a reversing motor for rotation thereby to move said first-mentioned means, and means responsive to light radiations from said stream for controlling the operation of said motor.

8. In a mineral wool forming apparatus, means for delivering a stream of molten material, a nozzle for discharging a steam jet against said stream to shred the same into a multiplicity of fibres, threaded sleeves carried by said stream-

discharging means, said sleeves extending at substantially right angles to each other, shafts threaded in said sleeves and connected to reversing motors for rotation thereby, and means responsive to radiations from said stream to control the operation of said motors.

9. In a mineral wool forming apparatus, means for delivering a stream of molten material, means to convert said stream into a multiplicity of fibres, means for automatically adjusting the relative positions of said stream-discharging means and said second mentioned means to cause changes in position of the stream, said last-named means including a threaded sleeve carried by said first-mentioned means, a shaft threaded in said sleeve and connected to a reversing motor for rotation thereby to move said first-mentioned means, and means including photo-electric cells responsive to radiations from said stream for controlling the operation of said motor.

10. In a mineral wool forming apparatus, means for delivering a stream of molten material, a nozzle for discharging a steam jet against said stream to shred the same into a multiplicity of fibres, threaded sleeves carried by said stream-discharging means, said sleeves extending at substantially right angles to each other, shafts threaded in said sleeves and connected to reversing motors for rotation thereby, and means including photo-electric cells responsive to radiations from said stream to control the operation of said motors.

11. An apparatus comprising means for discharging a stream of molten material, means spaced from said first-mentioned means for cooperation with said stream, and means for automatically adjusting the relative positions of said first and second-mentioned means to align said stream for cooperation with said second-mentioned means, irrespective of changes in position of the stream, said adjusting means including a photo-electric cell responsive to radiations from said stream.

12. An apparatus comprising means for discharging a stream of molten material, means for fiberizing said stream, means for adjusting the relative positions of said stream and second mentioned means, and means responsive to radiations from said stream for controlling said adjusting means.

13. In a mineral wool forming apparatus, means for discharging a stream of molten material, means for converting said stream into a multiplicity of fibers, means for adjusting the relative positions of said first and second mentioned means, and means responsive to radiations from said stream for controlling said adjusting means, to maintain said second mentioned means in operative relationship to said stream irrespective of meandering of the stream.

14. An apparatus comprising means for discharging a stream of incandescent material, means for cooperation with said stream to convert said stream into fibrous form, means for adjusting the relative positions of said first and second mentioned means, and means controlled by light radiations from said stream for controlling the operation of said adjusting means.

HAROLD T. COSS.

GALE T. PEARCE.

GEORGE A. DOWNSBROUGH.