United States Patent [19]

Leisenberg

[11] **3,777,407**

[45] **Dec. 11, 1973**

[54] **CONVEYING- AND DRYING-APPARATUS FOR CERAMIC MEMBERS**

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[21] Appl. No.: **229,292**

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Apr. 27, 1971 Germany ..... P 21 20 540.3

[52] **U.S. Cl.** **34/105,** 34/218, 34/230, 34/236

[51] **Int. Cl.** **F26b 25/00**

[58] **Field of Search** 34/21, 33, 104, 105, 34/215–218, 223, 225, 229, 230, 236

[56] **References Cited**

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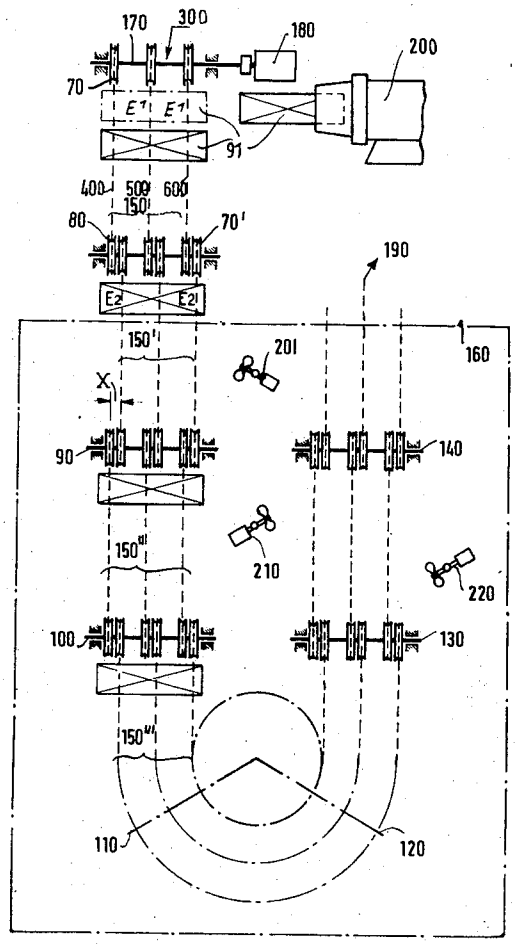
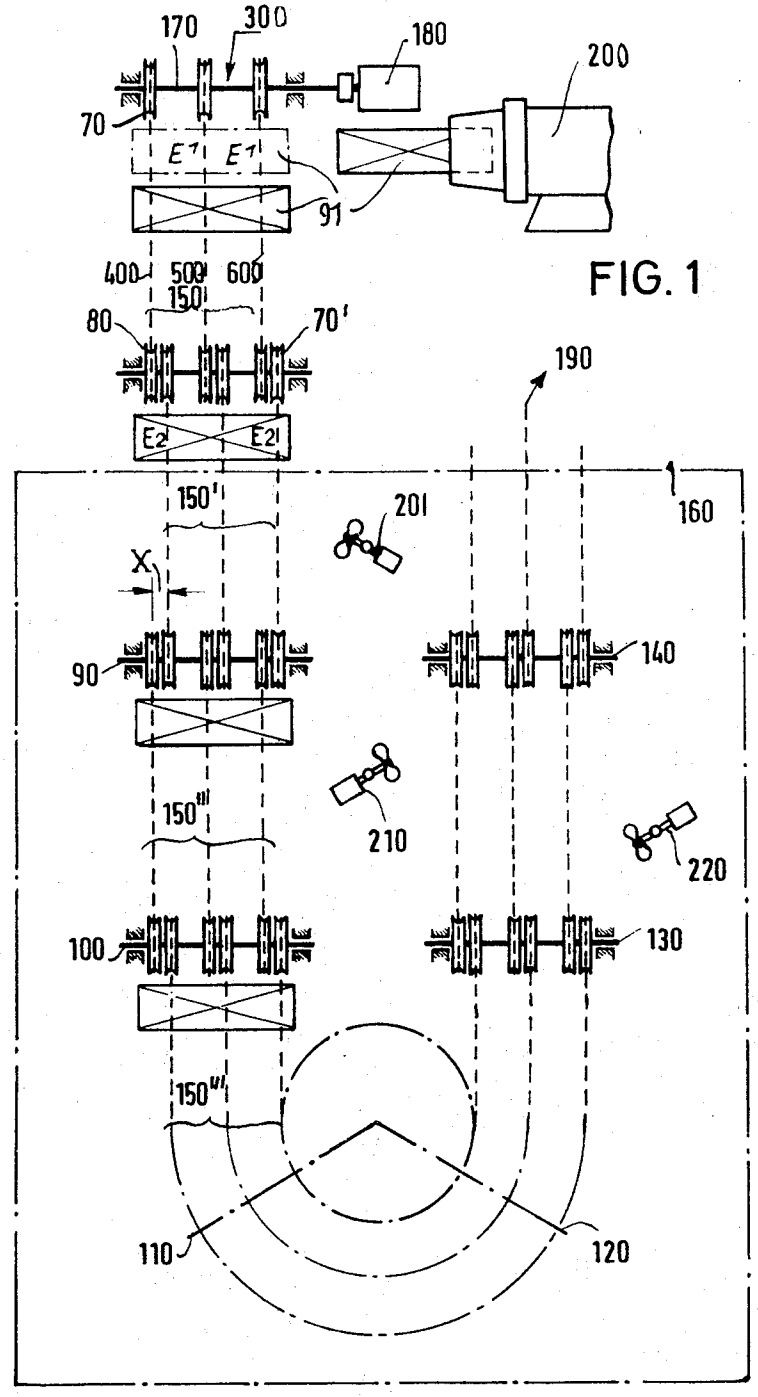
Primary Examiner—Kenneth W. Sprague
Assistant Examiner—James C. Yeung
Attorney—Ernest G. Montague

[57] **ABSTRACT**

A conveying- and drying-apparatus for ceramic starting members, being transferred after pressing in a drying oven, comprises a drying oven, and a plurality of units disposed behind each other and about laterally set-off. Each of the units includes at least two parallel cable-paths endlessly guided over guide pulleys. The cable-paths serve as a conveying-device from a press to a drying oven and to a pile station. A plurality of blowers is disposed in the drying oven for blowing in different directions. The blowers comprise nozzle blowers and are disposed alternately at least at both sides of the paths at a distance in moving direction, and the distance corresponds with at least the double distance of the successive starting members.

8 Claims, 8 Drawing Figures




170
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180
200
70
E1
E1
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400
500
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80
70'
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E2
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160
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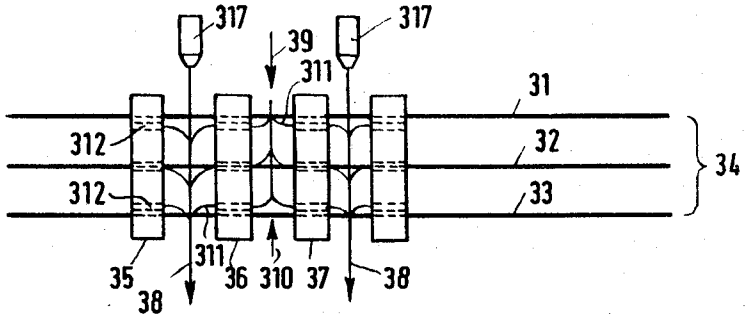
210
220
100
130
150''
110
120

FIG. 1

FIG. 2


317
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39
311
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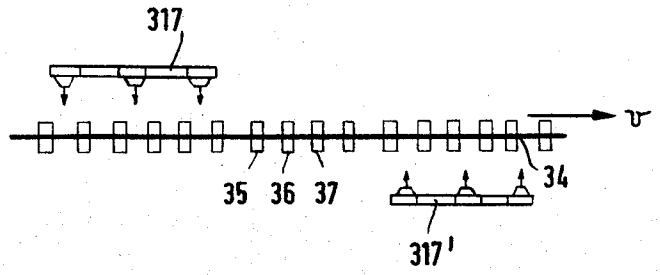
FIG. 3


317
v
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37
317'

FIG. 4

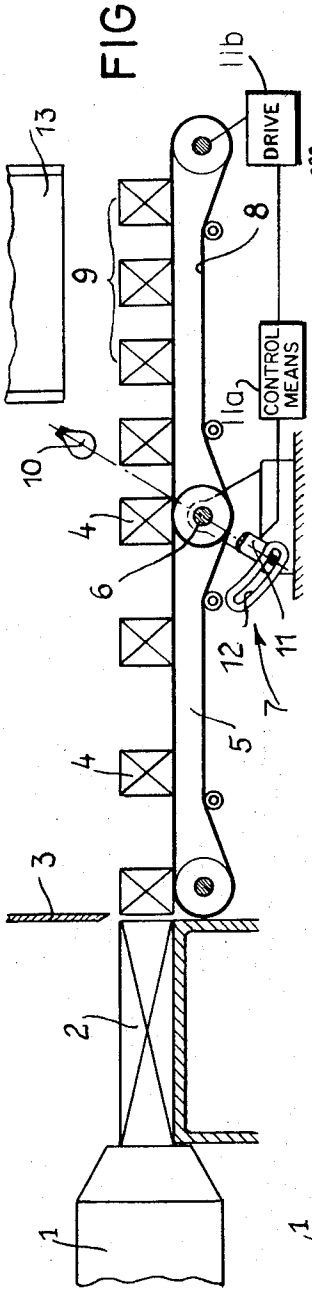


FIG. 5

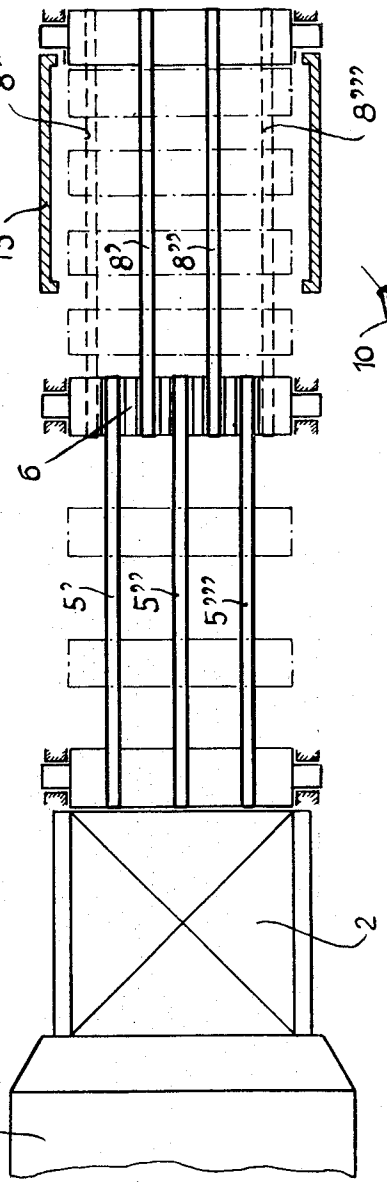


FIG. 6

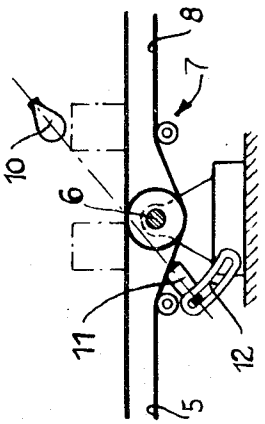
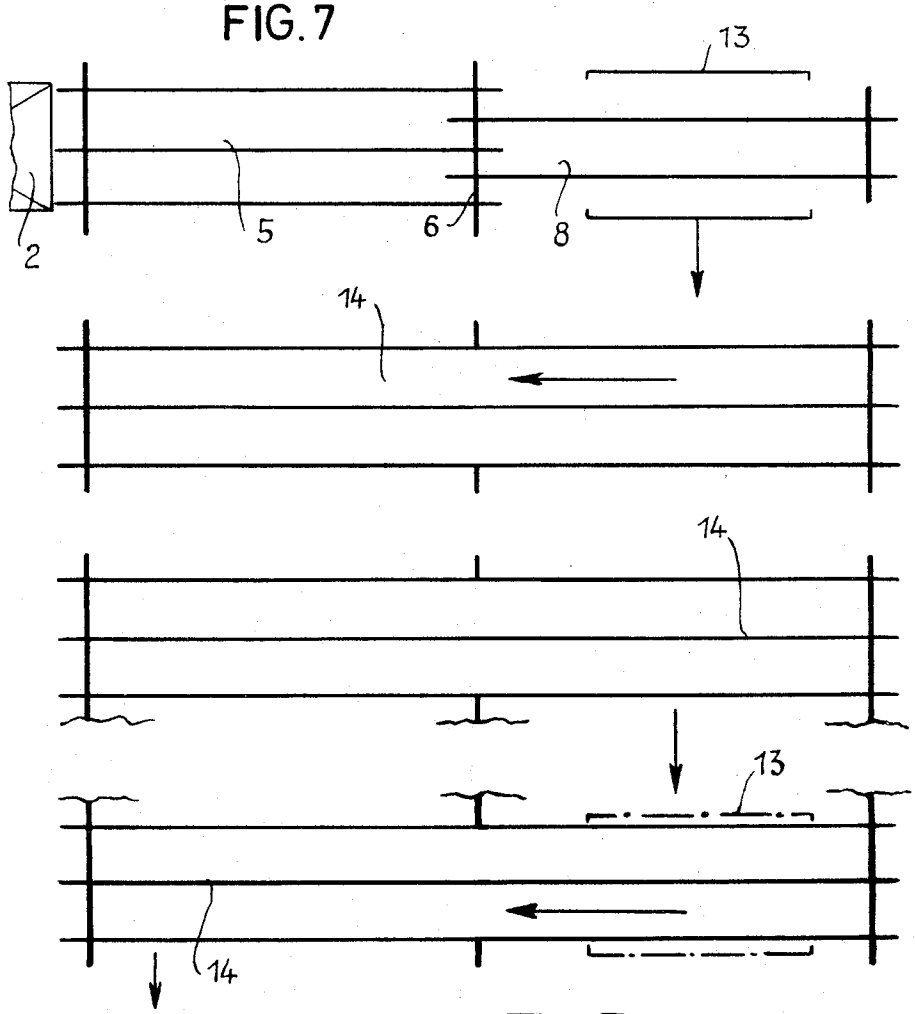


FIG. 7



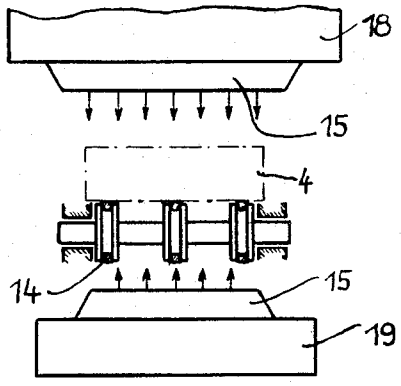


FIG. 8

CONVEYING- AND DRYING-APPARATUS FOR CERAMIC MEMBERS

The present invention relates to a conveying- and drying- device for ceramic members or forms which are transferred after extrusion into a drying oven, in which are provided as conveying-device from the press to the drying oven and to the pile location, a plurality of units slightly laterally set off and disposed one behind the other, each of the units consisting of two or more parallel cable paths guided over endlessly guided rollers, on which cable paths the members arriving at the press are conveyed continuously up to the pile location and are blown on in the drying oven from a plurality of blowers from different directions.

Until now the members arriving from the press are most automatically brought at different levels onto adjacently disposed drying-lattices, which then combined to groups, are brought by means of a sliding platform to the drying device in form of a chamber- or tunnel-oven. Even in case of use of large groups for economization of the transportation labor, a comparatively large and corresponding expensive machine and personal expenditure remains, since the members or forms had to be lifted again after drying from the drying lattices, to be returned to the press and transferred to particular storage frames. Also in forms continuously moved on conveyors lattices are used also for the reason, that in order to bring over the dry air at least to a small extent, also from below towards the members.

The mounting of dry lattices can cause, in particular in some slightly too humid press members, easily waste, since the drying lattices press across the forms, whereby during shrinking so-called lattice tears can be created in the form along the lattice edges by the hindrance of the movement. A great number of working materials exist, which have a dry shrinking of 5 percent and more. The higher, however, the dry shrinking, the larger is also the proportion of waste by tear formation, since the form pressed into the dry plates cannot move freely any more during shrinking and can contrast correspondingly with the measure for shrinking. If it is pressed too hard, not only a larger driving force with greater wear of the machines is required, rather the characteristics are visibly worsened.

In order to avoid the lattice tears and in addition to dry each of the starting forms under the same conditions and uniformly from all sides, it has been proposed as a conveying device from the press through the drying oven to the bearing location a plurality of units disposed one behind the other and set off relative to each other slightly laterally of two or a plurality of parallel cable paths endlessly guided about guiding pulleys. The starting member remains then on the same supporting position only for a short time. Since it displaces itself during each transfer to the next following unit laterally. For this reason it has no time to press itself remarkably on the supporting station. A prevention of the shrinkage exists likewise only for a short time period which does not suffice to create shrinkage tears. In addition, the starting member can be applied due to the small engaging faces well from all sides with dry air. By the continuous conveying of the starting papers from the press to the bearing location the arrangement is extremely economical. The units disposed one behind the other are suitably set off laterally relative to each other for the width of the guide pulleys laterally.

It has been shown now, that the acceleration of the drying process finds its limit by application of the dryness with flowing air, thus the blowing on by means of the circulation ventilators from different directions, finds a limit, which is given by the maximum quantity of the possible water removal per time unit.

The drying of ceramic starting members requires first of all in the coarse ceramic, where large numbers of pieces of equal format must be dried quickly and rationally, a high proportion of the cost in the drying process depends, on the one hand, on the working material, on the other hand, on the form of the starting members, for instance, fullstones, grid stones, roof slates, plates and the like. Working material and form determine at first the dry speed. This can be improved by free storing of the starting members on continuously moved cable paths and all around application of flowing air during the run through of the drying oven. It has been shown, that the limit given by the possible water removal time limit can be reduced by a rhythmical blowing on of dry air, since then in the path given by the rhythm the water present inside of the starting members has sufficient time to move to the previously dried surface where it evaporates during the next air push. Since in this manner a too sharp drying of the surface of the starting members is avoided, deformations do not occur.

In accordance with the present invention, the problem on which the present invention is based is solved such, that as drying devices nozzle blowers are provided which are arranged alternately on both sides and/or above and below the path of the members at a distance in moving direction, the distance corresponding at least to the double distance of successive members.

The nozzle blowers operate the drying air suitably rhythmically and for a short time period with high speed through the spaces between adjacent members. Since the nozzles are provided in a double spacing of the successive members, by example in case grit stones a strong force is produced which sucks up the adjacent nozzle free space air in the openings between the members and thus drives very much thereby the inner drying of the members, which is not possible by direct blowing on to the end faces of the members, since here the obtainable penetration depth of the dry air remains very low.

It has been shown, that with a device in accordance with the present invention, the dry period, by example, takes place to about 10 percent of the time required until now can be reduced. Even fullstones can be completely oven-dried in a maximum of 6 to 7 hours.

In connection with the continuously operating transporting system, a completely new concept of a ceramic arrangement results, since now the members arrive from the press directly in the drying process, which can be set optionally by corresponding arrangement of the nozzles and their blowing periods, as well as their pauses tube inserted—after flow time.

An advantage results, since all machines can operate appreciably slower and more economically and that in addition all manual labors, as lattice insertion, moving of sliding stages, lattice return transportation, and the thereby additional works connected therewith are removed. In the end effect, thus in technical and economical relation the particularly difficult and cumbersome drying process can be formed particularly rational.

In the known devices several cable paths can be provided on top of each other in order to create some space, furthermore by deviation means oppositely running movement paths can be created. In case of small dimensions of the drying chamber then too many guide pulleys are required which have an unfavorable effect on the apparatus and the operation.

An appreciable space saving and improvement of the economy of the apparatus can be made possible in accordance with the present invention such, that the starting members arriving from the press in uniform rhythm in a straight path reach a grouping device, to which are provided a plurality of parallel drying bands running with controllable speed with nozzles, which are disposed at least above and below their path for the drying air and that by a rhythmically operating gripping device, which are transformed to the drying band from the grouping device taken from groups of starting members. The nozzle for the drying air can be arranged about the drying band also in a different arrangement, in particular in a spiral shape.

The grouping device comprises suitably likewise cord- or belt-paths the stop drive of which is controlled by a photo cell, whereby the variation of the group division is brought about by rotation of the light gate consisting of a photo cell and a light beam.

From the groups of starting members formed on the grouping device, by example a band of a few meters length the gripping device takes off then one group after another and sets the latter onto the drying bands running in the same direction parallel to the grouping band, in particular such, that a drying band is alternately running closer or more remote to the grouping band. By this arrangement the running periods of the gripping device are equalized for always two paths for practical purposes.

As a further advantage, the appreciable simplification of the arrangement of the nozzle for the drying air is obtained, since now merely above and below of drying air channels must be provided above and below the drying bands, which drying air channels are equipped at the distance desired corresponding with the optimum blowing and pause time period and in the required number of the shifting nozzles. The nozzles must then be upon variation of the operational conditions merely set off or increased.

Finally the gripping device can be used additionally for the setting work for the tunnel oven carriage, so that a further simplification, acceleration and automatization of the operation is made possible.

With these and other objects in view, which will become apparent in the following detailed description, the present invention, which is shown by example only, will be clearly understood in connection with the accompanying drawings, in which:

FIG. 1 is a schematic showing of an apparatus with a plurality of cable paths;

FIG. 2 is a schematic showing of the flowing arrangement of nozzle air and foreign air sucked on between adjacent nozzle-free starting members;

FIG. 3 is a principal showing of nozzles and starting members of the drying path;

FIG. 4 is a schematic side elevation of a device in accordance with the present invention with an extrusion press, transportation band and following grouping device;

FIG. 5 is top plan view of the arrangement shown in FIG. 4;

FIG. 6 is a schematic view of the light gate of the grouping device;

FIG. 7 is a schematic view showing of the drying band following the grouping device. and

FIG. 8 is a schematic showing of drying air nozzles as shown by example.

Referring now to the drawings, the individual starting members, or forms **91**, come in conventional manner from the press **200** and pile put on a plurality, for example, three parallel cable paths **400, 500** and **600** at **300,** the number and distance E^1 and E^2 of which depend upon the characteristic in length of the members. In any case, each member must be supported sufficiently often and must be mounted on the cables such, that it cannot fall down. The parallel cable parts or paths **400, 500** and **600** are endless and are formed in such length that the cable hanging between the guide pulleys **70** and **80** does not become too large.

In the drawing, supporting positions are indicated at **90** to **140.** Between adjacent supporting positions, for example **70** and **80,** a unit consisting of three parallel cable paths **40, 50** and **60** is arranged. The supporting places **90 – 140** are disposed in the drying oven **160.** The drive of the cable path takes place over the first unit **150,** the guide pulleys **70** of which sit on a shaft **170,** which are driven by a driving motor **180,** dis which driving motor permits a setting of different cable speeds. The following units **150′, 150″,** etc. are driven such that the guide roller **80** of the first unit **150** is formed with the adjacently disposed guide pulley **70′,** the second unit **150′** is formed as a double pulley. The following units **150″** etc. are coupled together correspondingly.

The members **91** travel continuously on the cable parts from the press **200** through the drying oven **160** up to the pilot location **190.** The speed of the cable paths **40, 50** and **60** is adjusted to the press speed, so that a sufficiently large but also possibly low distance between the successive members is obtained, which reach without waiting time, transfer, etc., now directly through the drying oven **160** up to a pile station. For the exploitation of the drying oven, a plurality of cable paths of the shown type can be provided adjacent each other or on top of each other, each of which preferably is fed from a particular press. During the selection of the number and the place of the supporting positions **80** to **140,** not only a sufficient maintenance of smallness of the hanging of the cable is of importance, which under circumstances can be caught by conventional counter weights or springs, rather it depends also on the creation of new supporing places for the members, by example, transferring laterally a member from the first cable path unit **150** and to the second cable path unit **15′** in supporting position about the distance X, which corresponds about with the width of a guide roller **70** and **80,** respectively, whereby suitable selection of the length of the successive cable paths **150, 150′** etc. corresponding with the measure of the increasing shrinkages in the formation and deformation is avoided on the changing supporting places of the members changing with each cable path unit.

The drying oven indicated at **160** in the example is designed as a counter running tunnel oven for improvement of economy such, that each of the passing members **91** is dried under the same conditions as the previ-

ous members. The drying itself is brought about by ventilators known per se, **201, 210** and **220,** which vary continuously in the direction of the drying air and thereby cause a particularly intensive turbulence and homogenization of the dry air in the entire oven range. This is favored by suitable setting of the ventilators such, that the main blowing device of the ventilators is basically different. By this arrangement, a drying of a best uniform degree and least possible drying time are obtained.

The height of the temperature of the drying air as well as its quantity is dependent upon the type and characteristic of the members. Thus, the total energy expenditure of the apparatus will be shifted more towards the press from the drying oven in case of hot press members.

While it is possible in the laboratory to dry members completely air free in a few hours, this was only possible until now with a great time requirement of several days, without preventing thereby any waste.

The described apparatus makes it now possible to obtain in the shortest possible time qualitatively nonobjectionably members and in particular, without additional labor and with simple means. In this case, the tunnel oven is particularly suitable since here the drive could be transported directly from the press up to the pile plate. The advantages remain, however, also in chamber ovens, ring ovens and ZZ-ovens, since here also the members can be brought in without turning and with avoidance of lattice frames, as well as their disadvantages from the press location directly into the drying oven.

In FIG. **2** a transportation unit **34** is arranged, which consists of three cable paths **31, 32** and **33,** on which the members to be dried, in the example gridstones **35, 36** and **37,** are located, which preferably are moved at a speed of 10 mm per second. The members are mounted at a relative distance corresponding with the injection time of the press which is uniform on the cable path. In the drying oven on both sides of the cable path under circumstances also above and below nozzle dryers **317** are provided, which rhythmically and for a short time period blow a sharp air flow **38** crosswise to the end face of the adjacent members **35** and **36.** Blowing time and pass time depend upon the required drying conditions. By the air flow **38** now a strong suction **39** is created, which sucks air from the following nozzle free station **310** between the members **36** and **37** and causes a strong air flow **311** through the inner opening **312** of the gridstone. The air flow **311** is removed then together with the nozzle air stream **38.**

Referring now again to the drawings, and in particular to FIG. **3,** an arrangement is indicated in which, on the one hand, a plurality of nozzle dryers **317** disposed at the mentioned distance from each other, and, on the other hand, at a distance the same number **317'** on the other hand, of the transportation unit **34,** are provided. The distance of successive nozzle dryers must not correspond thereby at least in double distance of successive members. For a better view and for clarification, the members to be dried are only indicated as **35–37.**

Referring now again to the drawing, and in particular to FIG. **4,** on the left side, an extruder press **1** with extending extruder **2** is shown, from which a means of a cutter **3** the individual forms are separated and are brought to a transportation band **5.** This transportation band **5** comprises, by example, three parallel belt drives **5', 5''** and **5'''**, which are moved by a driving shaft **6.** When, thus the, forms **4** arriving in uniform rhythm from the press and thus also at uniform distance from the transportation band **5** come to a grouping device **7,** which has the purpose to combine a greater number of members or forms with slight relative distance to a group, which is easily lifted by means of a gripper **13** and can be transported. The grouping device **7** consists of a further transportation band likewise moved over the roller **6** over a stop drive with belt paths **8',** and **8'',** if necessary also **8'''**, **8''''**, relative to the available band **5,** thus, the reduction of the relative spacing of form members forming one group **9** can be set continuously by means of a light gate consisting of a light source **10** and a photocell **11.** This can be brought about such that the photocell and the light source are provided at opposite ends of a rotatable new frame (not shown) and the desired inclination angle, that means, the oblique position of the light gate **10** consisting of photocell and light source relative to the moving direction of the transportation band **8** is adjustable along a guide **12.** Depending upon the oblique position of the light gate *a*, drive **11***b* for the grouping band **8,** controlled by an electric control means **11***a* connected to the photocell **11,** is stopped for a shorter or longer time period and thereby, the relative distance of the members or forms is reduced on this band to the measure desired for the group formation **9.**

The provided group **9** of members or forms is measured such, that it can be gripped without difficulty and damage through a gripper **13** and can be lifted and transformed to one of the drying bands **14.**

These drying bands **14** are parallel to the grouping band **8** in their required number and parallel towards each other, as well as to its length and speed are, arranged such that the drying process of the members or forms is terminated upon reaching end of the band. The drying is brought about by drying air, which is blown over a greater number of nozzles **15** onto the forms. These nozzles **15** can be provided according to requirements about the drying band by example screw-like. Suitably, for the simplification above and below this drying band **14,** a drying air channel **18** and **19** each can be provided, which is equipped at a distance and a number of desired optimum blowing and pause time periods.

The operating rhythm of the gripper **13** is preferably provided such that during arrangement of the drying bands **14** a longer path stroke follows a shorter path stroke, so that the travelling times for two paths can be practically equalized.

Finally, the gripping device **13** can additionally be used for the setting work for the tunnel oven carriage **20,** as indicated in FIG. **7,** at the height of the left end of the drying bands **14,** so that the finished dried forms are lifted in a straight path from the gripping device and set on the tunnel oven carriage.

While I have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense.

I claim:

1. A conveying-and drying-apparatus for ceramic starting members having openings, being transferred after pressing in a drying oven, comprising

a drying oven,

a plurality of units disposed behind each other and slightly laterally set-off,

each of said units including at least two parallel cable paths endlessly guided over guide pulleys, said cable paths serving as a conveying-device for said starting members from a press to said drying oven and to a pile station, said starting members being disposed on said cable paths in successive uniform spacing and with said openings aligned in the direction of movement of said cable paths,

a plurality of blowers disposed in said drying oven for blowing at least in a direction cross-wise to the direction of movement of said cable paths,

said blowers comprising nozzle blowers and disposed alternately at least at both sides of said paths at a distance in moving direction, and

said distance corresponding with at least the double distance of said successive starting members.

2. The apparatus, as set forth in claim **1,** wherein

said nozzle blowers eject cyclically and for short time periods dry air with high speed through each pair of adjacent starting members.

3. The apparatus, as set forth in claim **1,** wherein

said cable paths include means for controlling their speed,

said cable paths are disposed behind said press and are equipped with a grouping device, and following of said cable paths having nozzles for dry air at least above and below said cable paths, and

a cyclically operating gripping device for transferring groups of said starting members taken from said grouping device to additional cable paths.

4. The apparatus, as set forth in claim **3,** which includes

drying bands, and wherein

said nozzles for the dry air are disposed screw-like about said drying bands.

5. The apparatus, as set forth in claim **3,** wherein

said grouping device comprises belt paths receiving said starting members and having a stop drive, and

a photo cell means for controlling said stop drive.

6. The apparatus, as set forth in claim **5,** which includes

a light gate including said photo cell means and a light ray source disposed in the path of said starting members and capable of being rotated relative to the path of said starting members, so that upon rotation of said light gate a variation of the group division is obtained.

7. The apparatus, as set forth in claim **3,** which includes

dry air channels disposed above and below along said drying bands, and

said drying air channels have a plurality of ejection nozzles at a distance and at a number corresponding with the optimum blowing- and pause-time-period.

8. The apparatus, as set forth in claim **3,** wherein

said gripping device for transferring said groups from one of said cable paths uniformly to three of said additional cable paths.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,777,407 Dated December 11, 1973

Inventor(s) Manfred Leisenberg

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet item [76] should read as follows:

-- Inventor: Manfred Leisenberg, Alter Wall 3, 775 Konstanz/ Bodensee, Germany --.

Signed and sealed this 30th day of April 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.