April 21, 1942. P. N. GARDNER 2,280,483

DRYING TIME RECORDER

Filed Oct. 31, 1941

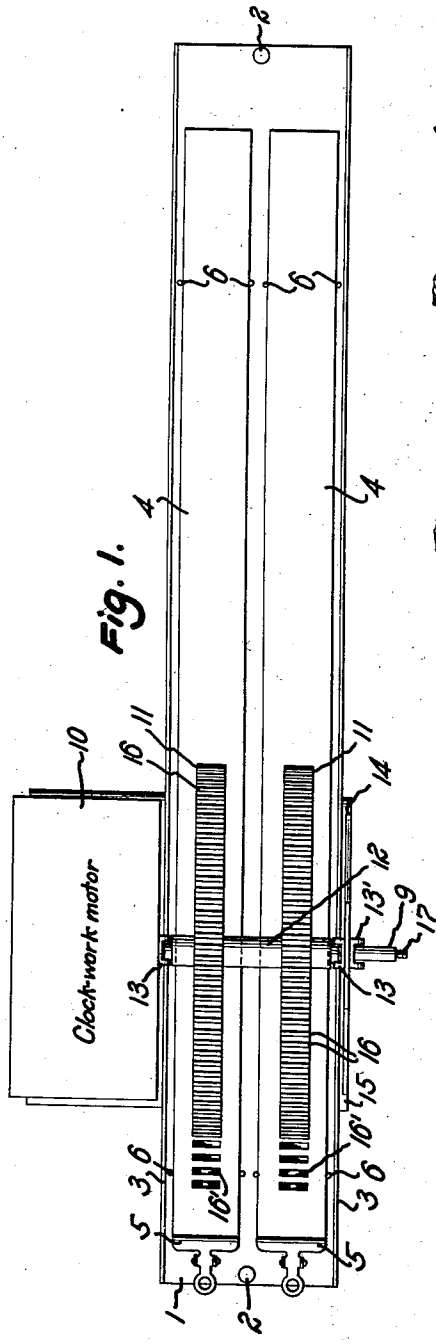


Fig. 1.

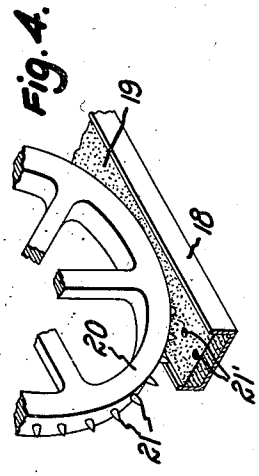


Fig. 4.

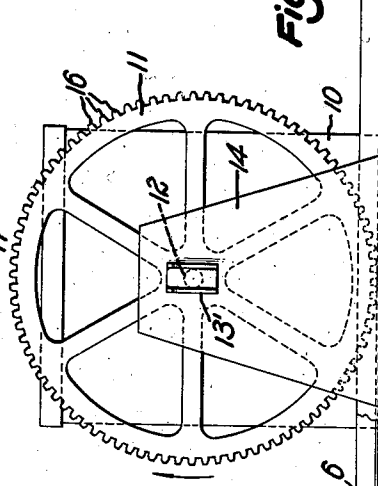


Fig. 2.

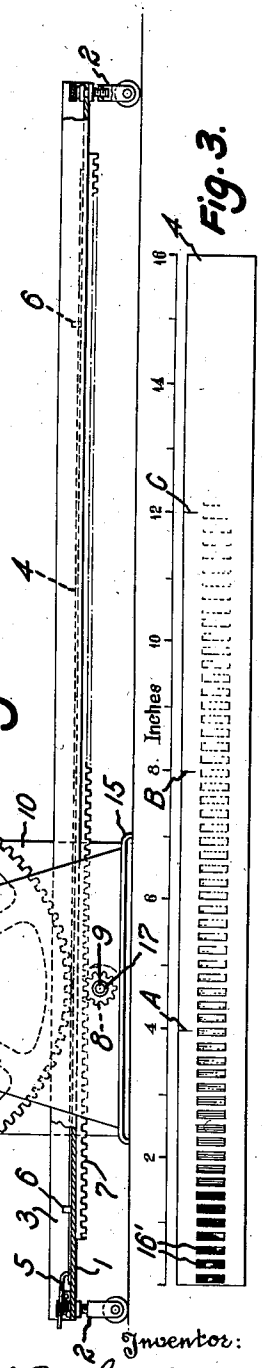


Fig. 3.

Inventor:
Paul N. Gardner,
By Pierce & Scheffler,
his Attorneys.

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DRYING TIME RECORDER

Paul Norris Gardner, Bethesda, Md.

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8 Claims. (Cl. 73—51)

This invention relates to the art of determining and recording the speed of setting, hardening or drying of plastic compositions, and is concerned with improvements in devices for use in said art. More particularly, the invention involves improvements in an apparatus for, and method of, determining the speed of drying of paints, enamels, varnishes and similar film-forming compositions: the improved apparatus also is adaptable for use in determining and recording the setting and hardening times of plastic masses, cementitious mixtures and other compositions which "set" from a soft plastic state to a hard or relatively stone-like state.

In essence, the improved apparatus of the present invention comprises a movable elongated table for supporting a test strip or layer, a rigid contacting member in the form of a freely rotatable rigid toothed wheel of predetermined weight, said rigid contacting toothed wheel being so journaled as to be free to move vertically and having a circumference substantially equal to the effective length of the movable table, and means for moving the table lengthwise, in one direction, beneath and in supporting relation to the rigid contacting toothed wheel at a predetermined and constant rate of speed so that each unit of lengthwise movement of the table represents a definite time interval. The device preferably is formed to be used on a substantially flat laboratory bench or table.

The movable table, which has a flat test strip- (or layer-) supporting surface, preferably is supported in a substantially horizontal plane by means of vertically adjustable castors or equivalent rolling supports positioned adjacent the ends of the table. The table may be adapted to support a single test strip or layer, or a plurality of the same disposed side by side. It may be, and if plastic layers are to be tested, preferably is, provided with upwardly flanged side portions. While it is possible to mount the material to be tested directly on the supporting surface of the table, I prefer to have the test material deposited on thin supporting strips which may be removably fastened to the table surface for the test and thereafter removed to constitute a permanent record of the test. Accordingly, I prefer to equip the movable table with suitable strip holding devices, e. g., spring clips, and with suitable centering and retaining devices, e. g., pins, for maintaining the test strips in predetermined positions on the movable table. The test strips may be formed of thin sheet metal (preferably tin-plated thin sheet steel) or of suitably prepared and sized paper or similar flat web material. The strips may, if desired, bear any wanted indicia, e. g., indicia of linear distance, or of time, or the like.

On the underside of the table there is provided a toothed rack preferably extending from end to end thereof; the rack meshes with a pinion mounted on a drive shaft journalled between upright supporting members which latter may mount the bearings for the axle of the contacting wheel. The pinion drive shaft is connected in conventional manner with a suitable constant speed motor such, for instance, as a clock mechanism, a small electric motor, or the like. The speed of the motor and the size of the pinion are so selected that the table and supported test strips may be caused to move at the rate of, say, one and one-sixth inches per hour, although slower or faster speeds may be introduced, in known manner, by suitable alteration of the diameter of the pinion and/or alteration of the motor speed. The motor may if desired be housed in any suitable manner.

The contacting toothed wheel is mounted on an axle which, when the device is in use, is substantially horizontal and transverse to the direction of travel of the table. The axle is journalled in vertical channel bearings which permit free rotation of the axle and free vertical movement of the latter while holding it against lateral movement. The teeth of the contacting toothed wheel may (as where the device is to be employed for determining and recording the setting and drying times of a paint or the like) may be formed as gear teeth having rectilinear faces, or they may (as where the device is to be employed for testing cementitious mixtures or equivalent plastic masses) be formed as relatively sharp spikes. The weight of the contacting toothed wheel is to be determined by the type of testing in which the device is to be used: it may be formed to a predetermined weight, or it may be formed as a spoked wheel adapted to be fitted with weights as desired.

According to a preferred embodiment of the invention, the movable table is adapted to support a pair of test strips (e. g., an "unknown" and a "control"), and a pair of contacting toothed wheels are mounted on the wheel axle in such manner that each wheel contacts a single test strip. In this embodiment, the device is adapted to determine and record the setting and drying times of a paint (or equivalent) sample and simultaneously to check that test against a control sample of known setting and

drying times,—in order to overcome inaccuracies occasioned by extraordinary atmospheric conditions obtaining at the time of the particular test.

The operation of the device will now be described with particular reference to the testing of a paint film of unknown setting and drying times against a control of known characteristics, and using removable test strips for supporting the paint films:

A uniform film, say of about .003" thickness, of the paint to be tested is applied, as by means of known final-coating devices or gauges, to the tinned test strip, and a layer, of the same thickness, of the control paint is applied to a like test strip. These freshly coated test strips are those clipped onto the strip-supporting surface of the movable table, the forward end of the table is mounted on the pinion, the pinion-driving mechanism is set in operation (so that the table and supported test strips start slowly to move), and the axle carrying the contacting toothed wheels is slipped into its channel bearings so that the wheels press into the fresh coatings on the test strips. As the table and supported test strips move, the contacting toothed wheels are caused to rotate, the teeth of the contacting toothed wheels successively bearing the weight of their respective wheels upon the "wet" paint films. That weight (e. g., approximately 750 grams in a particular example) is such that at first the teeth press through the wet films and pick up portions of the films upon their surfaces, exposing the bright metal surfaces of the tinned strips where the teeth have impinged thereupon. The paint films usually continue to remain "wet" for from two to eight hours (depending of course on the speed of drying of the composition) after their application; and the impressions of the teeth through the films and down to the bare metal will be visible for a like period. I call the end of this period the "set to touch time."

As soon as the paint films have taken up sufficient oxygen (or, have otherwise altered their properties) to have become thickened or gelled, the successively contacted teeth no longer remove portions of the paint films from the test strips, but merely travel over the surfaces of the films leaving surface indentations in the latter. I call the end of this period the "tack-free time." At such further time intervals as the paint films become finally hardened, the successively contacted teeth no longer make impressions in the films: this latter paint I call the "hard dry time." The filmed test strips bear permanent direct records of the courses of these several periods, and, desirably, these records are interpreted by time or distance indicia along an edge of each test strip.

In adapting the above specifically described device for use in determining and recording the setting time of a cementitious mixture (e. g., a Portland cement mix), I substitute for the cogged wheel one, of suitable weight, bearing sharp spikes along its periphery, and I substitute a tray for the test-supporting strips. In operating the so-adapted device, the tray is filled with a from one-fourth inch to one inch layer of the freshly prepared cementitious mixture and is fixed to the moving table, the driving mechanism is started, and the spiked wheel is placed in position. As the table and supported tray slowly move forward, the spikes at first penetrate into the mixture under test, leaving deep indentations therein; thereafter as the mixture "sets," it progressively resists indentation by the spikes of the wheel so that the depressions (made by the spikes) progressively become shallower and shallower until they fade out altogether and the wheel rides upon the surface of the test layer.

It is to be understood that a single test (be it of paint, or cementitious mixture, or other plastic composition) may be made, with a single contacting toothed wheel. It is to be understood, also, that it is within the scope of the invention to modify the device in such manner that the pinion drive shaft is sufficiently extended (from the motor) to mount a plurality of spaced driving pinions, that a plurality of movable tables (each bearing one or a plurality of test strips) are actuated by said pinions, and that a plurality of axled contacting toothed wheels are employed, in a plurality of pairs of vertically "floating" channel bearings, above said movable tables.

The invention will now be described in greater detail and with reference to the accompanying drawing, in which

Fig. 1 is a plan view of a complete apparatus according to the invention, with a test strip and a control strip in place therein;

Fig. 2 is a side elevation, with parts in section, of the apparatus shown in Fig. 1;

Fig. 3 is a plan view of a test strip illustrating the recordation of a drying time test made on a layer of film-forming coating composition (e. g., paint); and

Fig. 4 is a fragmentary perspective view illustrating a modification of parts of the complete apparatus of Fig. 1.

In Figs. 1 and 2, the movable elongated table 1 is shown as being adapted to support a pair of test strips 4, 4'. The table is supported on vertically adjustable castors 2, 2. It is provided with upstanding flange portions 3, 3, along its sides. Metal test strips 4, 4' (one strip 4 being, in this case, the "unknown" and the other the control strip) are secured to the upper surface of table 1 by a pair of spring clips 5, 5, attached to the table at one end thereof: spaced pins 6, 6, are disposed in the table top for aligning the test strips on the table.

Attached to the undersurface of table 1 is a rack 7 which extends substantially from end to end of the table. 8 is a pinion, mounted on drive shaft 9, adapted to engage rack 7 and thereby to move table 1 from right to left. Drive shaft 9 is connected to a clock-work motor, diagrammatically represented by housing 10, as driving mechanism for the apparatus.

The rigid contacting member is represented in Figs. 1 and 2 by two spoked gear wheels 11, 11, mounted on a common axle 12. Axle 12 is free to rotate and to move vertically, but is held against longitudinal movement by two vertical channel bearings 13, 13. As shown, one channel bearing 13 is secured to motor housing 10, and the other is secured to a face of vertical supporting member 14. Supporting member 14 is mounted on flanged base 15 which latter may be, and preferably is, secured to motor housing 10.

Each gear wheel 11 is constructed to have a periphery substantially corresponding to the length of test strip 4. The gear teeth are provided with rectilinear peripheral faces 16, 16.

In using the apparatus, table 1 is mounted over pinion 8 so that the latter engages the left hand end of rack 7. One test strip 4 is coated with a layer, of controlled thickness, of a paint of known drying time characteristics (i. e., the control),

and the other test strip 4 is likewise coated with a layer of the paint to be tested. The freshly coated strips 4, 4, are immediately mounted on the upper surface of table 1, by means of clips 5, 5, and aligning pins 6, 6, and the table is caused slowly to move from right to left, by actuation of the clock-work motor. As soon as the mechanism is started in operation, the axle 12 of the pair of wheels 11, 11, is slipped into place in channel bearings 13, 13, and wheels 11, 11 are permitted to rest upon the freshly coated test strips 4, 4.

The teeth of wheels 11, 11, sink through the layers of paint and directly contact the bright surfaces of strips 4, 4. Movement of table 1 serves to rotate wheels 11, 11, and, at the outset of the test, the teeth of the latter successively pick up paint from the strips, making a series of rectilinear markings 16', 16' in the respective coating layers. As the test progresses, exposure of the bare metal in markings 16', 16' becomes less and less, and eventually ceases. This point (the "set to touch" time) is represented at A in Fig. 3, opposite the indicia representing 4 inches of travel of the strip (say, 4 and ⅔ hours of test). Point B represents the end of the "tack-free" period, and became manifest after the strip had traveled 8 inches. Point C represents the "hard dry time" of the test, and appeared after the strip had traveled 12 inches.

After the test has been run, and the driving mechanism stopped, wheels 11, 11, are lifted from their bearings, and the strips 4, 4, are removed from clips 5, 5, and either stored as permanent records of the test or cleaned for subsequent testing use.

It is to be understood that table 1 may be adapted to support but a single test strip, in which event but a single wheel 11 is mounted on axle 12; or, it may be adapted to support more than two test strips, in which event as many wheels 11 are mounted on axle 12 as there are test strips.

It is to be understood, also, that the apparatus may be expanded by adding a further support 14 and base 15, extending drive shaft 9, as by addition of a pinion-bearing stub drive shaft (not shown) at the threaded end 17 of shaft 9, and by providing a second table unit. In this way, a series of unknown-control tests simultaneously may be run off, using a single driving mechanism.

For determining, or determining and record, the setting time of a freshly prepared Portland cement mix (or plaster, or putty or similar composition which is freely plastic as prepared but sets to a relatively stone-like state), the apparatus of Figs. 1 and 2 is modified, as shown in Fig. 4, by substituting a trough 18 for flat test strip 4, for containing the plastic mass 19, and by substituting for gear wheel 11 a wheel 20 provided over its periphery with regularly spaced sharp-ended spikes 21, 21. In using this modified apparatus, spikes 21 at first pierce the mass 19 and engage trough 18; movement of the table, and hence of trough 18, causes the successive piercing of mass 19 by spikes 21, 21, leaving in the mass their indentations 21'. As the mass 19 sets, indentations 21' fade out and eventually disappear, marking the setting time of the mass being tested.

I claim:

1. Apparatus for determining and recording the setting, hardening or drying time of a plastic composition such as a paint, a cementitious mix or the like, which comprises a movable elongated table for supporting a test layer, a rigid contacting member in the form of a freely rotatable wheel on the periphery of which are spaced protuberances, said wheel being journaled to be free to rotate and to move vertically and being adapted to rest peripherally on said table, and means for advancing the table beneath said wheel, and with the weight of said wheel resting thereon, at constant speed.

2. Apparatus for determining and recording the setting, hardening or drying time of a plastic composition such as a paint, a cementitious mix or the like, which comprises a movable elongated table for supporting a test layer, a rack attached to the table, a co-operating pinion in mesh with said rack, means for rotating the pinion at constant speed, and a rigid contacting member in the form of a freely rotatable wheel on the periphery of which are spaced protuberances, said wheel having a circumference substantially corresponding to the effective length of said table, and being journaled to be free to rotate and to move vertically and being adapted to rest peripherally on said table.

3. Apparatus for determining and recording the setting, hardening or drying time of a plastic composition such as a paint, a cementitious mix or the like, which comprises a movable elongated table for supporting a test layer, a rack attached to the under surface of the table, a pinion mounted on a drive shaft, said pinion being adapted to mesh with said rack, means for rotating the drive shaft at constant speed, and a rigid contacting member in the form of a freely rotatable wheel on the periphery of which are spaced protuberances, said wheel having a circumference substantially corresponding to the effective length of said table, and being journaled to be free to rotate and to move vertically and being adapted to rest peripherally on said table.

4. The apparatus defined in claim 1, in which the protuberances are gear teeth presenting substantially plane peripheral surfaces.

5. The apparatus defined in claim 1, in which the protuberances are gear teeth presenting rectilinear peripheral surfaces.

6. The apparatus defined in claim 1, in which the protuberances are relatively sharp-ended spikes.

7. Apparatus for determining and recording the setting, hardening or drying time of a plastic composition such as a paint, a cementitious mix or the like, which comprises a movable elongated table for supporting a test layer, a removable test strip for carrying a test layer of the material to be tested, said strip being adapted to be supported on the upper surface of said table, means for removably securing said test strip lengthwise on said table, a rigid contacting member in the form of a freely rotatable wheel on the periphery of which are spaced protuberances, said wheel being journaled to be free to rotate and to move vertically and being adapted to rest peripherally on said test strip on said table, and means for advancing the table and test strip beneath said wheel, and with the weight of said wheel resting thereon, at constant speed.

8. Apparatus for determining and recording the setting, hardening or drying time of a plastic composition such as a paint, a cementitious mix or the like, and for comparing such time with that of a control sample, of known setting, hardening or drying time, under identical conditions of test, which comprises a movable elongated table adapted to support a pair of test strips thereon, a pair of elongated removable test

strips supported on said table, means for removably securing said test strips lengthwise to and for aligning the same in spaced parallel relation on said table, a rack attached to the under surface of said table, a cooperating pinion in mesh with said rack and mounted on a drive shaft, means for rotating the drive shaft at constant speed, a pair of substantially vertical open-ended channel bearings on either side of and above said table, an axle adapted freely to rotate and to move vertically in said bearings above and transverse to said table, and a pair of rigid contacting members mounted on said axle, said contacting members being equal diametered wheels on the peripheries of which are spaced protuberances, each wheel being so spaced on said axle as to align peripherally with one of said removable test strips, the pair of wheels having circumferences substantially corresponding to the effective lengths of said test strips.

PAUL NORRIS GARDNER.