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(54) Title: METHOD OF USING A MOISTURE METER DURING A LAUNDERING PROCESS

(57) Abstract: A method of processing at least one garment involves a local environment with ambient moisture, a garment having a moisture content, a plurality of work stations, and a threshold amount of moisture. The plurality of work stations operate according to a plurality of parameters. The threshold amount of moisture is the amount of ambient moisture naturally absorbed by the garment. The method includes a processing step, a measuring step, a determining step and an adjusting step. The garment is processed through at least one of the work stations during the processing step. During the measuring step, the moisture content of the garment is measured. The relationship between the measured moisture content and the threshold amount of moisture is determined during the determining step. And, at least one parameter is adjusted based on the relationship between the measured moisture content and the threshold amount of moisture during the adjusting step.



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**METHOD OF USING A MOISTURE METER DURING A
LAUNDERING PROCESS**

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Background of the Invention

[0001] Industrial and commercial laundering facilities have the capability of processing thousands of garments a day. As a result of this capacity, it may be beneficial to better define process controls to reduce cost and increase efficiency. Garments may naturally absorb ambient moisture present in the local environment. Consequently, it may be a waste of resources and inefficient to dry garments below a threshold moisture content (i.e. the ambient level of moisture). Therefore, it may be beneficial to monitor the moisture content of a garment at one or more points during the laundering process to allow process parameters to be adjusted to reduce cost and increase efficiency.

Brief Description of the Drawings

- [0002] FIG. 1 depicts a prior art moisture meter.
- [0003] FIG. 2 is a schematic representation of a generally-known example of a process for laundering, drying and sorting garments.
- [0004] FIG. 3 is a schematic representation of the process shown in FIG. 2 incorporating the step of measuring the moisture content of one or more garments.

Description of the Invention

[0005] Referring now to the figures, FIG. 2 shows a schematic of a generally-known process for laundering, drying, and sorting garments. While the steps and work stations involved in the processes shown in FIGS. 2 and 3 will be described in a particular order, it will be appreciated that the steps and work stations involved in these processes may be arranged in any suitable order. As will be described

herein, the inventive method of the present invention is an adaptation of this prior art method of garment processing. As used herein, “garments” includes clothing as well as any other washable items comprised of fabric including but not limited to towels, linens, mop heads, rugs or any other suitable item.

[0006] Garments 12, which may be soiled, may be delivered to the laundering facility by delivery vehicles, which may be delivery trucks. This incoming delivery step is indicated by box 10 in FIG. 2. Each delivery of soiled garments 12 corresponds to a specific route. The soiled garments 12 are unloaded from the vehicle and may undergo a pre-wash sorting 20 where the garments 12 may be separated by the type of garment 12 (e.g. garage wear, lab wear, etc.), by color (e.g. light, dark, etc.) or any other suitable characteristic.

[0007] After the pre-wash sort 20, the garments 12 may be transferred to a washing work station 30, which may comprise washing machines, where the garments 12 are washed. For the purposes of this description, “wash”, “washing” and “washed” may mean traditional laundering, dry cleaning, and any other suitable method or process and “washing machine” may refer to an apparatus for washing or any other suitable device. After being processed through the washing work station 30, the garments 12 are processed through a drying work station 40, during which the garments 12 may be dried using dryers, by passing through a steam tunnel or any other suitable method or device. Once dried, the garments 12 are transferred to an inspection work station 50. At the inspection work station 50, a worker may inspect the garments for damage such as rips, tears, missing buttons and such.

[0008] After inspection, each garment 12 is configured for processing and placed on a conveyor. Garments 12 may be configured for processing by being hung on hangers, folded or by undergoing any other suitable preparation. The garments 12 may be delivered as configured for processing or may be subsequently configured for delivery by being hung on hangers, folded or by undergoing any other suitable preparation. In one embodiment, a garment 12 is configured for processing by being hung from a clothes hanger where the hanger is attached to a carrier that interfaces with the conveyor. If the garment 12 is in satisfactory condition, the

garment 12 may be transferred to a sorting and storage work station 75.

Alternatively, if the garment 12 has sustained some damage and is in need of repair, the garment 12 may be transferred to a repair work station 70. Once the garment 12 has been repaired, the garment 12 may be transferred to the sorting and storage work station 75. Additionally, the garments 12 may be steamed or pressed any time after washing, or not at all, and do not necessarily have to be steamed or pressed prior to sorting.

[0009] At the sorting and storage station 75, the garment 12 may be directed to a pre-sort buffer (not shown) determined by the delivery route for the garment 12. The pre-sort buffer may consist of several rails, where each route is temporarily assigned to one or more rails. Once all, or a substantial majority, of the garments 12 for a route are collected on a rail, the garments 12 may be directly conveyed to a sorter (not shown) where they are sorted by delivery sequence within the route. Once sorted, the garments 12 may be automatically and immediately conveyed to storage where they are stored until they are scheduled for loading and delivery 90.

[0010] Alternatively, the sorting and storage station 75 may incorporate a multi-destination storage capability (not shown) in lieu of a pre-sort buffer. In this version, the garments 12 may be grouped together in storage based on route, but may be out of sequence. Each garment 12 may be conveyed to a storage rail corresponding to its route. The garments 12 may remain in storage until it is determined that they should be sorted. From storage, the garments 12 may be conveyed to a sorter where they are sorted by delivery sequence within the route. Once sorted, the garments 12 may be conveyed to a staging area (not shown) prior to being transferred to loading and delivery 90, may be loaded for delivery, or may be conveyed back into storage and loaded for delivery at a later time.

[0011] Each garment 12 may include a permanent or temporary unique identifier (not shown), such as an alphanumeric code, which may be unique to each garment or a class of garments. The identifier may be manually readable by workers or may be encoded in a machine readable format, such as a bar code, radio frequency (RF) chip, and any other suitable method or device. The identifier may allow users to

track the progress of a particular garment or class of garments through the process or be used to collect various other types of data regarding a particular garment, a specific class of garments, certain steps of the process, the process as a whole or any other suitable category of information.

[0012] Embodiments of the improved method of garment processing of the present invention include a method of laundering, drying and sorting garments that comprises measurement of the moisture content of at least one garment 12 at one or more stages of the process. The moisture content may be observed and recorded. The moisture content may be measured using a moisture meter or any other suitable device. In one embodiment, the moisture content may be measured using a device similar to the BD-2100 Moisture Meter device manufactured by the Delmhorst Instrument Company, an example of which is shown in FIG. 1. Obviously, use of this particular device is not required. The moisture meter may be adapted to measure moisture content in various types of garments. The moisture content may then be measured and evaluated. Based on the results, the steps in the laundering, drying, and sorting process may be changed, equipment may be modified, equipment settings may be adjusted, or any other similar modifications may be made. In some embodiments of the inventive method, the garments may include a permanent or temporary unique identifier, as described above. The identifier may facilitate collection of data regarding a particular garment, a specific class of garments, certain steps of the process, the process as a whole or any other suitable category of information.

[0013] In one embodiment of the inventive method, shown in FIG. 3, the laundering, drying and sorting process is similar to the generally-known process described above and shown in FIG. 2, however it includes the additional step of moisture content measurement 145. As shown in FIG. 3, the process includes the following steps and work stations: incoming delivery 110, pre-wash sorting 120, washing work station 130, drying work station 140, moisture content measurement 145, inspection work station 150, repair work station 170, sorting and storage work station 175, and loading and delivery 190. In this embodiment,

the moisture content measurement 145 occurs directly after drying 140. However, it will be appreciated that the moisture content measurement 145 may be incorporated at one or more other stages during the process. For example, the moisture content measurement may occur prior to drying, after inspection, or any other suitable stage of the process. Additionally, the method may include multiple moisture content measurement work stations or steps. During the moisture content measurement 145, an operator may use a moisture meter or other similar device to measure the moisture content of one or more garments 112. To obtain accurate information, preferably 30 or more garments 112 are tested per load. However, any suitable number of garments may be tested per load.

[0014] Garments may naturally absorb ambient moisture present in the local environment. Consequently, it may be inefficient and a waste of resources to dry garments below a threshold moisture content (i.e. the ambient humidity). For example, if a garment undergoes the drying process and has a moisture content of 1% after drying, once the garment is removed from the dryer and exposed to the environment (such as, for example while awaiting transfer to the next station, while undergoing repair, while being kept in storage, etc.) the garment may begin absorbing ambient moisture. As a result, after drying, the moisture content of the garment may have increased to equal the ambient humidity. Therefore, efficiency may be gained and resources may be saved if the parameters of the process are set such that the garment is only dried sufficiently to reduce the moisture content of the garment to a level that is approximately equal to the humidity.

[0015] In the embodiment of the present invention shown in FIG. 3, if the moisture content of the garment 112, or the average of the garments tested, is below a threshold amount, such as, for example 6% or any other suitable amount, then the parameters of the laundering, drying and/or sorting process may be adjusted to achieve a moisture content approximately equal to or above the threshold amount for garments 112 that undergo the process in the future. For instance, the moisture content of a garment 112 may be measured after the drying step 140 and prior to the inspection step 150. Based on that data, the speed of the washing

machines may be adjusted for a future load of garments 112 in order to achieve the desired moisture content in the future load.

[0016] Alternatively, in addition to, or instead of, adjusting parameters for garments 112 that undergo the process in the future, parameters for steps not yet completed by the garment 112 presently being measured may be adjusted to achieve the desired moisture content in the current load of garments. For instance, if the moisture content is measured after washing 130 and prior to drying 140, the temperature at which the garments 112 are dried in the drying step 140 may be adjusted to achieve a moisture content in the current load of garments 112 substantially equal to the threshold amount. One or more adjustments to the process may be made, including but not limited to adjusting the drying time for the garments 112, changing the temperature at which the garments 112 are dried, adjusting the speed of the washing machines, adjusting the speed of the conveyor transporting the garments 112, or any other suitable modifications to the process.

[0017] In one embodiment of the present invention, as a result of monitoring the moisture content of one or more garments after the drying process, the drying time for the garments may be decreased and the temperature at which the garments are dried may be increased. The following two Tables A and B provide sample data and calculations that demonstrate the potential time and financial savings resulting from these adjustments to the process parameters in a sample laundering facility.

FORMULA	Classification	Loads Ran	Old Time	New Time	Time Saved Per Load	Total Time Saved
1	Color Shirts	61	2	1	1	61
2	Color Pants	70	8	5	3	210
3	Food Service White	17	13	10	3	51
4	Blood Whites	15	13	10	3	45
5	Mats	0			0	0
6	Shop Towels	31	30	25	5	155
	Mops/Feners					
7	Covers	0			0	0
9	Cotton Shirts	11	14	10	4	44
11	Bar Mops	24	25	20	5	120
12	Color Aprons	0			0	0
15	Queens Mats	0			0	0
19	Nomex	0			0	0
20	Cotton Pants	30	32	27	5	150
	HVY Soil Colored					
28	Cottons	28	23	19	4	112
Average		31.9	17.8	14.1	2.4	67.71

Table A

Minutes Saved / Week	948
Hours Conversion / Week	15.8
MCF rate	1
MCF / week	15.8
Cost per hour of MCF	\$7.73
Estimated Savings / Week	\$122.13
Estimated Savings / Month	\$488.54
Estimated Savings / Year	\$6,350.97

Table B

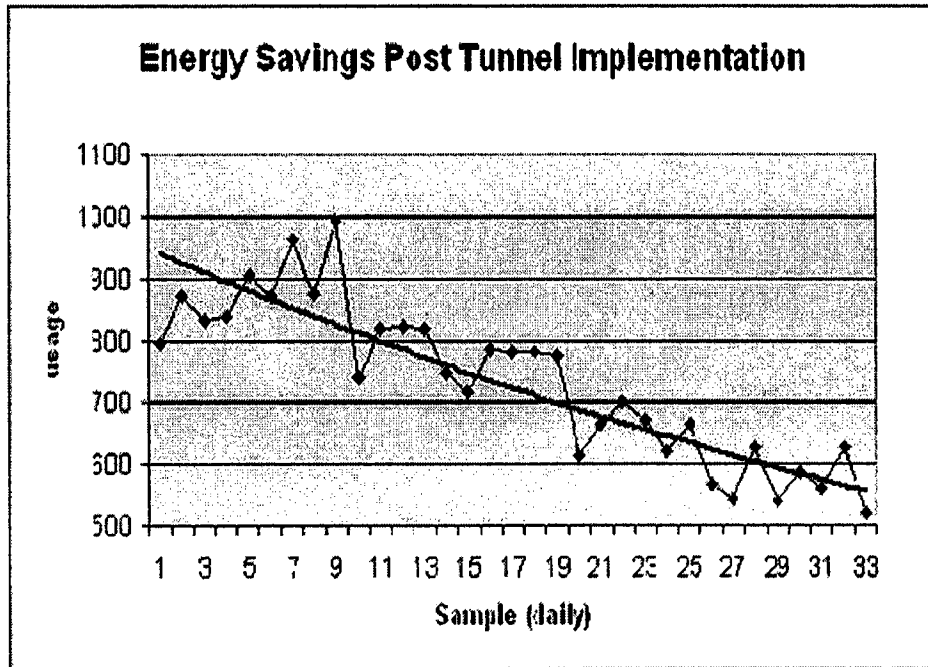
[0018] The data and calculations shown in Tables A and B represent a comparison between the amount of natural gas typically used during the drying process and the amount of natural gas used after making the adjustments. In the sample shown, the drying equipment generally requires one thousand cubic feet of natural gas (1 mcf) for every hour of operation (i.e. "MCF rate"). Consequently, if the hours of operation required are reduced, then less natural gas may be required, which may result in financial savings for the user. Obviously, the cost per hour of

MCF and estimated savings are estimates and may vary depending on actual costs.

[0019] Table C and Graph A further illustrate potential reductions in energy usage resulting from making adjustments to the process parameters in response to the monitoring of the moisture content of the garments at some point during the process. Table A includes the amount of energy used each work day over a seven week time period at a sample laundering plant where an embodiment of the inventive method was utilized.

	Avg. Energy Usage For the Week	Energy Usage Per Day
		936
		796
		872
		833
Week 1	855	839
		906
		873
		961
		874
Week 2	921	993
		742
		820
		821
		820
Week 3	790	749
		717
		785
		781
		782
Week 4	768	775
		613
		664
		700
		670
Week 5	654	621
		664
		568
		542
		627
Week 6	588	541
		586
		562
		629
		519
Week 7	574	

Table C



Graph A

[0020] Graph A depicts the energy usage data shown in Table C. In the sample depicted in Graph A, the energy usage clearly trends downward as a result of implementation of an embodiment of the inventive method. In fact, in this particular sample, implementing an embodiment of the inventive method resulted in a roughly 62% reduction in energy usage, based on the average usage in Week 7 and the highest average energy usage in Week 2. As discussed above, energy may be saved by adjusting the parameters of the laundering, drying and sorting process in order to produce garments that are not over-dried and have a moisture content approximately equal to or above the ambient humidity after drying. The energy savings may result in a more efficient process and significant financial savings.

[0021] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications may readily appear to those skilled in the art.

What is claimed is:

1. A method of processing at least one garment comprising the following steps:
 - a. providing:
 - i. a local environment, wherein the local environment comprises an amount of ambient moisture,
 - ii. a garment, wherein the garment comprises a moisture content,
 - iii. a plurality of work stations, wherein the plurality of work stations are configured to operate according to a plurality of parameters, wherein at least one of the plurality of work stations is located within the local environment, and
 - iv. a threshold amount of moisture, wherein the threshold amount of moisture comprises the amount of the ambient moisture in the local environment naturally absorbed by the garment;
 - b. processing the garment through at least one of the plurality of work stations;
 - c. measuring the moisture content of the garment after the garment has been processed through at least one of the plurality of work stations;
 - d. determining a relationship between the measured moisture content of the garment and the threshold amount of moisture; and
 - e. adjusting at least one of the plurality of parameters based on the relationship between the measured moisture content of the garment and the threshold amount of moisture.
2. The method of claim 1, wherein the garment comprises an item selected from the group consisting of clothing, towels, linens, mop heads, and rugs.
3. The method of claim 1, wherein the garment comprises a unique identifier, wherein the unique identifier comprises a format selected from the group consisting of a manually readable format and a machine readable format.

4. The method of claim 3, wherein the unique identifier indicates a particular garment.
5. The method of claim 3, wherein the method further comprises a step of collecting data using the unique identifier to facilitate collection of the data.
6. The method of claim 1, wherein the plurality of work stations are configured to launder, dry and sort the garment.
7. The method of claim 1, wherein the plurality of work stations comprise at least one work station selected from the group consisting of an incoming delivery work station, a pre-wash sorting work station, a washing work station, a drying work station, a steaming work station, a pressing work station, an inspection work station, a repair work station, a sorting work station, a storage work station, a loading work station and an outgoing delivery work station.
8. The method of claim 1, wherein the determining step further comprises determining whether the measured moisture content of the garment is above, substantially equal to, or below the threshold amount of moisture.
9. The method of claim 1, wherein the adjusting step further comprises adjusting at least one of the plurality of parameters to achieve a measured moisture content at least substantially equal to the threshold amount of moisture.
10. The method of claim 1, wherein the processing step comprises drying the garment, wherein the measuring step occurs sequentially immediately after the processing step.
11. The method of claim 1, further comprising the step of providing a moisture meter, wherein the moisture meter is operably configured to measure the moisture content of the garment, wherein the step of measuring the moisture content of the first garment is accomplished using the moisture meter.
12. The method of claim 1, wherein the at least one of the plurality of parameters adjusted during the adjusting step is selected from the group consisting of an amount of time spent drying the garment, a temperature at which the garment is dried, a speed at which a washing machine is operated, and a speed at which a conveyor configured to transport the garment is operated.

13. The method of claim 1, providing a plurality of garments, wherein the measuring step comprises measuring the moisture content of the plurality of garments after the plurality of garments have been processed through at least one of the plurality of work stations; wherein the determining step comprises calculating an average moisture content of the plurality of garments and determining a relationship between the average measured moisture content of the plurality of garments and the threshold amount of moisture; wherein the adjusting step comprises adjusting at least one of the plurality of parameters based on the relationship between the average measured moisture content of the plurality of garments and the threshold amount of moisture.

14. A method of processing at least one garment comprising the following steps:

- a. providing:
 - i. a local environment, the local environment comprising an amount of ambient moisture,
 - ii. a first garment, the first garment having a moisture content,
 - iii. a second garment, the second garment having a moisture content,
 - iv. a first work station and a second work station, wherein the first work station and the second work station are configured to operate according to a plurality of parameters, and
 - v. a threshold amount of moisture, the threshold amount of moisture comprising the amount of ambient moisture in the local environment naturally absorbed by the second garment;
- b. processing the first garment through at least one of the plurality of work stations;
- c. measuring the moisture content of the first garment after the first garment has been processed through the first work station and prior to being processed through the second work station;
- d. determining whether the measured moisture content of the first garment is above or below the threshold amount of moisture; and

- e. adjusting at least one of the plurality of parameters to achieve a measured moisture content of the second garment at least substantially equal to the threshold amount of moisture.
15. The method of claim 14, wherein the adjustment made to at least one of the plurality of parameters during the adjusting step results in improved efficiency as the second garment is processed through at least one of the plurality of work stations.
16. The method of claim 14, wherein the adjustment made to at least one of the plurality of parameters during the adjusting step reduces the amount of energy used during the processing step for the second garment.
17. The method of claim 14, wherein the first work station comprises a washing work station.
18. The method of claim 14 further comprising an additional measuring step, wherein the additional measuring step comprises measuring the moisture content of the first garment after the first garment has been processed through the second work station.
19. A method of processing at least one garment comprising the following steps:
- a. providing:
 - i. at least one garment, the at least one garment comprising a moisture content,
 - ii. a threshold amount of moisture, the threshold amount of moisture comprising the amount of ambient moisture naturally absorbed by the garment from a surrounding environment;
 - b. laundering the at least one garment in accordance with a first plurality of parameters;
 - c. drying the at least one garment in accordance with a second plurality of parameters;
 - d. sorting the at least one garment in accordance with a third plurality of parameters;
 - e. measuring the moisture content of the at least one garment;

- f. determining whether the measured moisture content of the garment is above or below the threshold amount of moisture; and
 - g. adjusting at least one parameter based on the relationship between the measured moisture content of the garment and the threshold amount of moisture, wherein the at least one parameter is selected from the group consisting of the first plurality of parameters, the second plurality of parameters and the third plurality of parameters.
20. The method of claim 19, wherein the laundering step comprises dry cleaning the at least one garment.

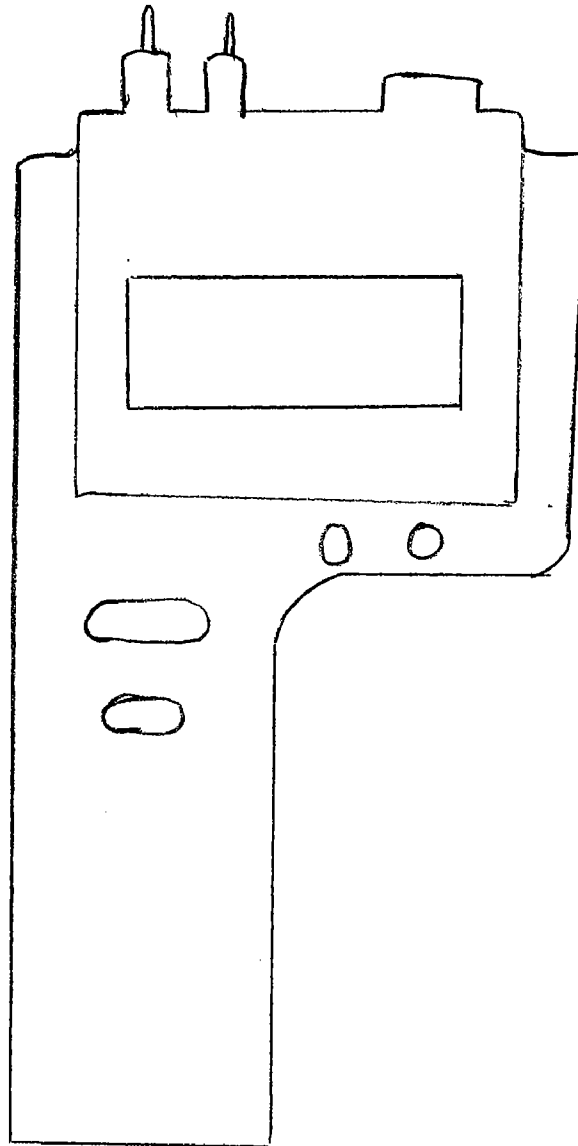
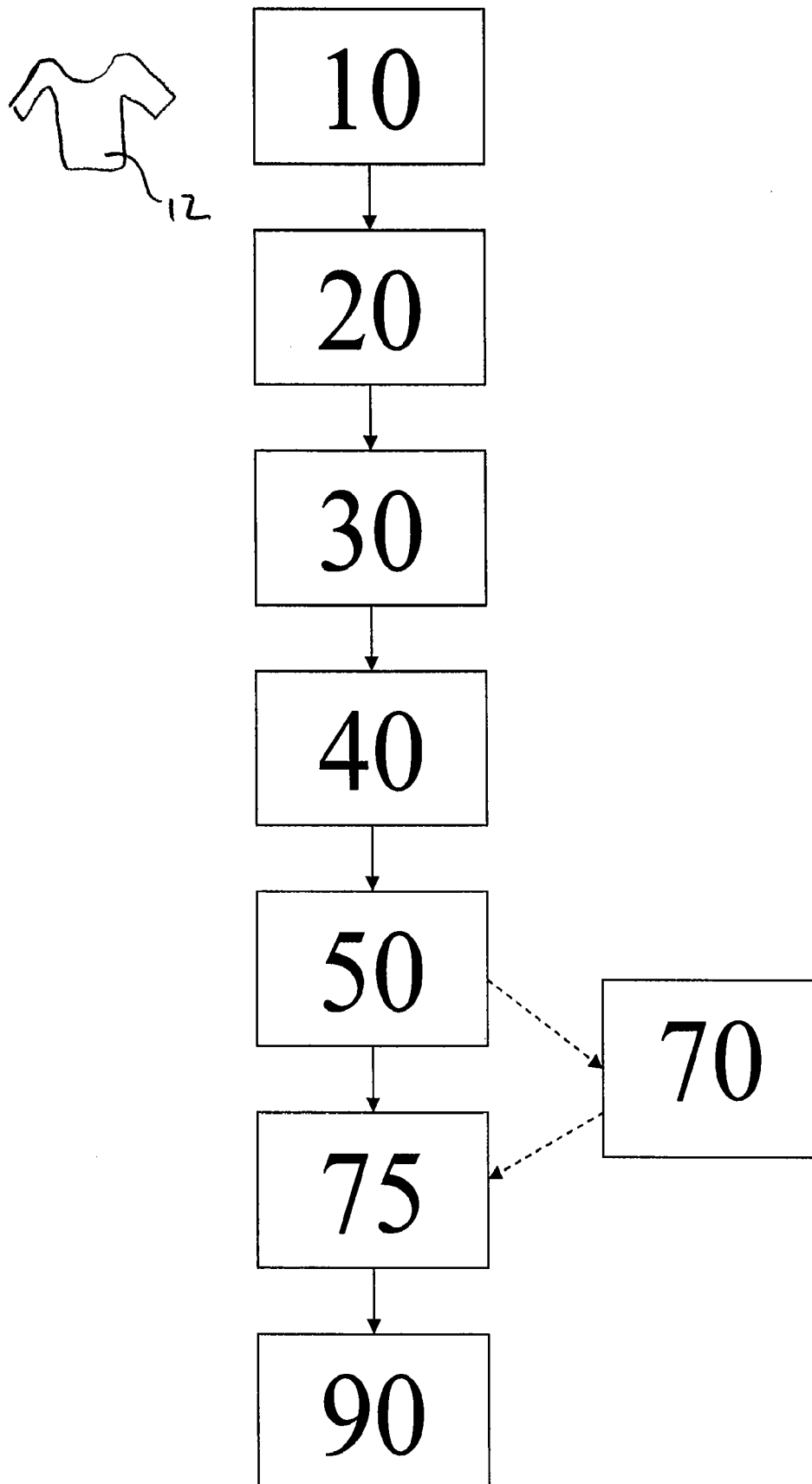
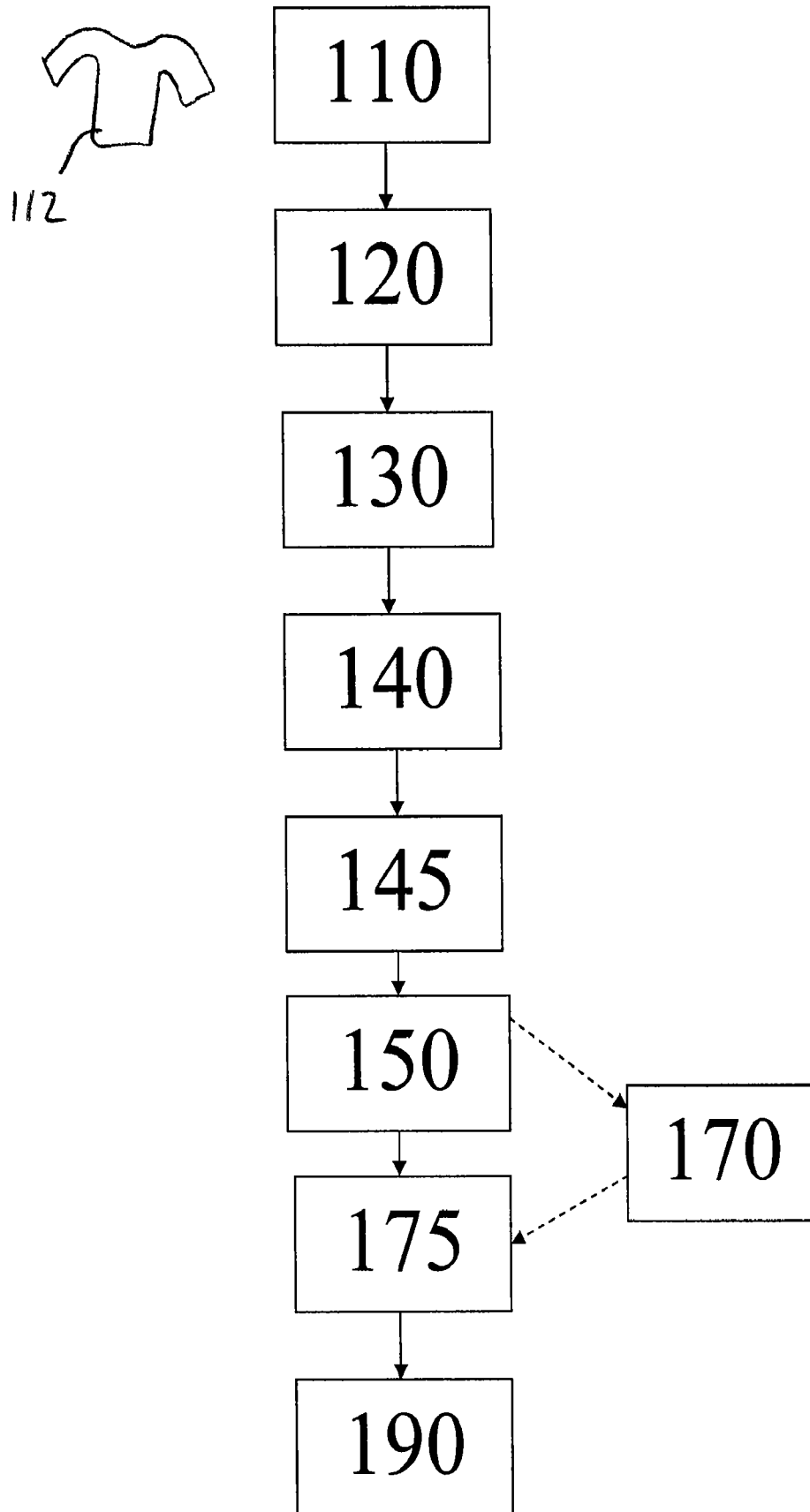


FIG. 1

**FIG. 2**

**FIG. 3**