The invention relates to garments and undergarments. More particularly, to a garment that may induce caloric burn while the wearer goes about his or her day. An objective for the garment is to increase exercise of body muscles used in daily living. In one embodiment, a garment and/or shaper is described with carefully positioned resistance bands that are relatively more resistant (i.e., less stretchy or elastic) than the fabric used to construct the remainder of the garment. At least two of these bands are positioned to extend from the thighs upwards towards the waist and cross at the ischium. These bands have a direct effect on muscles that would normally be activated during regular activity and cause them to be further exercised, but in a gentle manner. The effect, which may be slightly perceptible, is felt while the wearer goes about his or her day.
FIG. 10

Without a slimmer novel undergarment, the oxygen consumption at different speeds of walk is as follows:

- **1.5 mph**:
  - Without: 200 (vol/ml/Kg)
  - Slimmer: 250
  - Novel Undergarment: 300

- **2.5 mph**:
  - Without: 250
  - Slimmer: 300
  - Novel Undergarment: 350

- **3.5 mph**:
  - Without: 300
  - Slimmer: 350
  - Novel Undergarment: 400

FIG. 11

The oxygen consumption in liters per minute (l/min) over time is shown for each condition:

- **Without**:
  - 1 min: 10 l/min
  - 2 min: 20 l/min
  - 3 min: 30 l/min
  - 4 min: 40 l/min
  - 5 min: 50 l/min
  - 6 min: 60 l/min
  - 7 min: 70 l/min
  - 8 min: 80 l/min

- **Slimmer**:
  - 1 min: 5 l/min
  - 2 min: 10 l/min
  - 3 min: 15 l/min
  - 4 min: 20 l/min
  - 5 min: 25 l/min
  - 6 min: 30 l/min
  - 7 min: 35 l/min
  - 8 min: 40 l/min

- **Novel Undergarment**:
  - 1 min: 20 l/min
  - 2 min: 40 l/min
  - 3 min: 60 l/min
  - 4 min: 80 l/min
  - 5 min: 100 l/min
  - 6 min: 120 l/min
  - 7 min: 140 l/min
  - 8 min: 160 l/min
Figure 16

**Resistance test**

*Figure 16* shows the resistance test of Shatobu-2 and Without. The graph plots the number of Pounds against the Degrees. The graph indicates that Shatobu-2 and Without have different resistance levels at varying degrees.

Figure 17

**Resistance test**

*Figure 17* displays the resistance test for various samples (S#1 to S#8) and Without. The graph plots the number of Pounds against the Degrees. The graph shows the resistance levels at different degrees for each sample and theWithout condition.
The present application is a continuation-in-part of International Application No. PCT/CA2009/001898 filed Dec. 30, 2009, entitled Caloric Burn Undergarment, which claims priority to and the benefit of U.S. Provisional Patent Application No. 61/159,575, filed Mar. 12, 2009, both of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present application relates generally to the field of garments, including outerwear and undergarments that cause movement resistance and induce muscle toning and caloric burn while the wearer is engaged in his or her daily activities. More specifically, the present application relates to a novel undergarment or shaper that induces caloric burn when the subject wearing it engages in his or her daily activities.

BACKGROUND OF THE INVENTION

Undergarments of all kinds abound in the marketplace. In addition to their primary function of covering the wearer’s body, a number of undergarments have the added features of being able to shape and/or provide support. More recent garments, such as those manufactured by Wacoal, are enhanced to perform sports software. Wacoal also has a CW-X Series® of garments that is based on “variable compression technology.” These garments are stated to facilitate circulation and venous return, thereby minimizing lactoacid buildup and muscle soreness during and after activity.

Undergarments and bottom wear that include design elements that shape the body include girdles or undergarments that are designed to be worn as a dress or to be worn over the lower abdomen, to flatten or enhance the profile of the body, or underneath the buttocks to lift and shape this section of the body. Inconveniently, women’s underwear of this type can be uncomfortable for the wearer, as the binding or compressing elements can irritate the skin and make individuals feel squeezed in. Consequently, individuals wearing such garments will often minimize the duration of contact against their bodies. Moreover, fabrics used to manufacture garments of this type are often synthetic or synthetic blends that do not allow the skin to breathe, and this adds to the discomfort.

At the other end of the spectrum are higher end garments made of state of the art woven fabrics that are very comfortable for the individual wearing them. Such garments are favored by athletes, and include features designed to minimize the stress of exercise in areas of the body such as the lower extremities.

It would be advantageous if an undergarment could be designed to include the shaping features of the more traditional shaping garments while including the novel fabrics, comfort, and support of high-end training clothing. It would be even more advantageous if such a garment were designed for everyday use and would solicit the muscles of the pelvic girdle to exercise, resulting in caloric burn. It would be more advantageous if such a garment also induced muscle toning. The present application seeks to meet these and other related needs.

SUMMARY OF THE INVENTION

It is an object of the present application to obviate or mitigate the disadvantages of traditional shapers while including some of the more desirable elements of high-end training clothing.

In one aspect, the present invention provides a novel garment, including outerwear and undergarments with carefully positioned resistance bands that are relatively more resistant (i.e., less stretchy or elastic) than the fabric that is used to construct the remainder of the garment. These resistance bands have a direct effect on muscles that would normally be activated during regular activity and cause them to be exercised to a further degree, but in a gentle manner. The effect, which is in many cases is slightly perceptible, is felt while the wearer goes about his or her daily routine. This results in increasing the external load and inducing muscle toning and caloric burn.

In a further aspect, the present application provides a novel undergarment and/or shaper with carefully positioned non-stretch (or isometric) bands, or the equivalent thereof, that are relatively more resistant (i.e., less stretchy or elastic) than the fabric that is used to construct the remainder of the undergarment. These bands have a direct effect on muscles that would normally be activated during regular activity and cause them to be exercised to a further degree, but in a gentle manner. The effect, which in many cases is slightly perceptible, is felt while the wearer goes about his or her daily routine.

There is also described herein a caloric burn garment comprising a pant portion covering the lower abdomen, crotch and buttocks, and leg portions covering at least the upper thighs. One or more resistance bands are positioned so as to increase resistance for hip flexors and simultaneously affecting the work of the posterior muscle chain; one or more resistance bands is attached to the distal part of the thigh section of the leg portion; and one or more resistance bands is slanted backwards on the posterior side of the garment, one by the interior, forming an interior band, and the other from the exterior of the leg portion of the garment, forming the exterior band, and extending towards the waistline. One or more of the resistance bands intersect at the ischium, the external band is attached on an iliac crest and the internal band is attached to the external part of an ischial crest.

Further, there is described herein a shaper garment, comprising at least two resistance bands positioned to increase resistance in the pelvic girdle and/or lower limbs and inducing muscle toning or caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment. In this shaper garment, the at least two resistance bands extend from leg portions of the garment and slant backwards on a posterior side of the garment, one of the at least two resistance bands extends from an exterior side of one of the leg portions of the garment and extends upwards towards the waistline, and the other of the at least two resistance bands extends from an exterior side of the other leg portion of the garment and extends upwards towards the waistline, wherein two of the at least two resistance bands cross at or near the ischium.

Additionally, a shaper garment is described comprising at least four resistance bands positioned to increase...
resistance in the pelvic girdle and/or thighs and inducing caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment; wherein the at least four resistance bands extend from a distal part of the thighs; two or more of the at least four resistance bands slant backwards on the posterior side of the garment, at least one by the interior and at least another by the exterior of the thigh portions of the garment and extending towards a waistline, wherein at least two of the resistance bands intersect at the ischium, and wherein the exterior band extends across the iliac crest and the interior band extends across the external part of the ipsilateral iliac crest.

Through the use of the non-stretch bands, the garment has the effect of increasing external load. This results in an increase in muscle work and a concomitant increase in energy expenditure, or overall caloric loss. It also results in muscle toning.

An objective for the underwear is to increase exercise of body muscles used in daily living. This is achieved by causing certain muscles to work against the more restrictive nature of the underwear, i.e., against carefully positioned resistance or “non-stretch” bands, as will be described more particularly below.

Advantageously, and contrary to what is known in the art, the novel garment of the present application results in the burning of more calories for the same amount of work as wearing a conventional pair of underwear. The closest known prior art consists of high-end training garments used to enhance athletic performance through energy saving compression bands along the targeted muscle groups. An example of this closest art is Wacoal’s CW-X series, designed to enhance training performance while decreasing energy expenditure.

Scientifically, muscle toning is measured by EMG. Caloric burn is measured by oxygen consumption, through VO2 max measurements. Comparable prior art, such as Wacoal, claim overall lower VO2 max consumptions for the wearer during exercise. Significantly, the garment of the present application results in the opposite effect: There is a higher O2 consumption under similar circumstances of use.

Other aspects and features of the present application will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments thereof, along with the accompanying figures.

BRIEF DESCRIPTION OF THE FIGURES

Embodiments of the garment of the present application will now be described, by way of example only, with reference to the attached Figures wherein:

FIGS. 1 and 1a show a commercial embodiment of an undergarment of the present application;

FIGS. 2 to 4 reveal the concept upon which the caloric burn aspect of an undergarment of the present application is based;

FIG. 5 is a diagrammatic posterior view of one embodiment of an undergarment of the present application;

FIG. 6 is a posterior view of a prototype embodiment of an undergarment of the present application, as worn on a mannequin;

FIG. 7 is a close-up posterior view of the undergarment of FIG. 6;

FIG. 8 is an anterior view of the undergarment of the undergarment of FIG. 6;

FIG. 9 is an alternative anterior view of the undergarment of FIG. 6;

FIGS. 10 and 11 are energy expansion graphs showing the efficiency of the novel garment of the application in inducing caloric burn;

FIGS. 12 to 15 show the “resistance effect” that is created by the carefully positioned non-stretch bands, or equivalent thereof, that are found in the garment of the present application;

FIG. 16 shows a comparison of the resistance angle curve of a garment of the present invention with resistant bands and a garment without resistant bands;

FIG. 17 shows a comparison of resistance tests for different sizes of garments of the present invention with resistant bands as compared to a garment without resistant bands;

FIG. 18 shows an illustration of the rectus femoris electromyographic activity during hip flexion with and without resistant band garments of the present invention; and

FIG. 19 shows the percentage of increase in the rectus femoris during hip flexion for each subject wearing garments with resistant bands in accordance with the present invention.

DETAILED DESCRIPTION

Definitions

Unless specifically defined, all terms used herein have the meanings or definitions that would be ordinarily understood or used by those of skill in the art to which the present application pertains.

As used herein, the terms “undergarment”, “underwear” and all other similar terms are used synonymously and interchangeably to describe a garment or clothing that is worn under outer clothing, usually close to the skin. For greater certainty, the terms are used to designate garments or clothing not only worn close to the skin, but on the lower part of the body, i.e., the buttocks, hips and thighs.

The term “shaper” is used to describe clothing that provides improves the appearance of the wearer by providing a slimming effect. These garments include outer and undergarments.

Throughout the specification, for ease of reference, embodiments described as “undergarment”, “underwear” or other similar terms also apply to outer garments.

As used herein, the expression “non-stretch” used to describe the resistance bands (or equivalent thereof) that are an integral part of the garment, means that the fabric that constitutes these bands (or equivalent thereof) are relatively more resistant (i.e., less stretchy or elastic) than the fabric that is used to construct the remainder of the undergarment.

As used herein, the expression “caloric burn” means that there is an expansion of energy (i.e., calories) that is a benefit and advantage of the garment of the present invention.

As used herein, the expression “caloric burn” means that there is an expansion of energy (i.e., calories) that is a benefit and advantage of the garment of the present invention.

Generally, a novel garment is described herein. This garment has the added feature of inducing caloric burn when it is worn (i.e., while the wearer is involved in his or her daily routine). It also induces muscle toning.

A caloric burn garment is described herein, which comprises a pant portion covering the lower abdomen, crotch
and buttocks, and leg portions covering at least the upper thighs. The garment includes one or more resistance bands are positioned so as to increase resistance for hip flexors and simultaneously affecting the work of the posterior muscle chain; one or more resistance bands is attached to the distal part of the thigh section of the leg portion; and one or more resistance bands is slanted backwards on the posterior side of the garment, one by the interior, forming an interior band, and the other from the exterior of the leg portions of the garment, forming the exterior band, and extending towards the waistline. The one or more resistance bands intersect at the ischium, the external band is attached on an iliac crest and the internal band is attached to the external part of an ipsilateral iliac crest.

[0041] Optionally, the garment may include an extended waist section to shape the torso. Further, it is optional that the leg portions extend throughout a portion or the entire length of the legs.

[0042] In one embodiment of the caloric burn garment, at least one of the resistance bands is positioned to increase resistance for a hip flexor and work the posterior muscle chain.

[0043] There is also described herein a shaper garment comprising at least two resistance bands positioned to increase resistance in the pelvic girdle and/or lower limbs and to induce muscle toning or caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment. In this embodiment, the at least two resistance bands extend from leg portions of the garment and slant backwards on a posterior side of the garment, one of the at least two resistance bands extends from an exterior side of one of the leg portions of the garment and extends upwards towards the waistline, and the other of the at least two resistance bands extends from an exterior side of the other leg portion of the garment and extends upwards towards the waistline. In this embodiment, two of the at least two resistance bands cross at or near the ischium.

[0044] Optionally, the at least two resistance bands further comprise two further resistance bands, one of the further resistance bands extending from an interior of one of the leg portions of the garment towards the waistline and the other of the at two further resistance bands extending from an interior side of the other leg portion.

[0045] As a further option, the two further resistance bands may extend to an external portion of the ipsilateral iliac crest.

[0046] It is also optional that at least one of the resistance bands is positioned to increase resistance for a hip flexor and work the posterior muscle chain.

[0047] Further, the leg portions may extend to the ankle of the wearer.

[0048] The shaper may comprise an extended waist section to shape the torso of the wearer.

[0049] In a further embodiment described herein, a shaper garment is described, which comprises at least four resistance bands positioned to increase resistance in the pelvic girdle and/or thighs and inducing caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment. In this embodiment, the at least four resistance bands extend from a distal part of the thighs; two or more of the at least four resistance bands slant backwards on the posterior side of the garment, at least one by the interior and at least another by the exterior of the thigh portions of the garment and extending towards a waistline, and at least two of the resistance bands intersect at the ischium. The exterior band extends across the iliac crest and the interior band extends across the external part of the ipsilateral iliac crest.

[0050] Optionally, this embodiment of the shaper may comprise an extended waist section to shape the torso of the wearer. The shaper garment may extend to the ankle of the wearer.

[0051] An embodiment of this garment, which is shown as worn on a mannequin in FIGS. 5 to 9 and described more particularly below, induces caloric burn by offering resistance and modifying the motor control system responsible for gait.

[0052] The novel garment of the application has been carefully designed with a view to eliminating many of the inconveniences or harmful aspects of girdle-like support garments. Specifically, it has been noted that girdle-like support can lead to muscle flaccidity. When muscles are weak, the body loses the contribution of global muscle support, and this in turn can be a precursor to develop musculoskeletal dysfunction and related health issues.

[0053] The present garment is not a girdle but rather a supporting garment that engages select muscles in the trunk and hip regions of the wearer and that are activated through regular activity (more specifically, with movements involving hip flexion). It is this increase in muscle activity that leads to caloric burn. Regular to moderate activities have been found to be the most favorable to induce the desired result. The effects of the garment are enhanced when the wearer performs daily living activities or exercise, as explained further in the Examples below.

[0054] The expansion of energy, or caloric burn, is possible due to the strategic positioning of bands of material having a density, or a series of densities, that differ(s) from the overall density or thickness of the primary fabric or material that is used to make the garment. These bands create a "resistance" against which muscles in the lower extremities of the body will gently work or exercise, resulting in the expansion of energy.

[0055] The basic principles of manufacturing behind the garment are based on knitting techniques, differing fiber contents and the choice of fabric (or fabrics) woven together. The garment can be created using knitted or woven materials, or combinations of both, in keeping with practices known in the art.

[0056] For knitted garments, the type of knitting machine along with the specific fiber content, such as polymer and elastomer mixtures as well as synthetic and natural fibers, play an important role in the efficacy of the final product.

[0057] Several types of stitch construction are used in the same garment in order to create varying textile tensions or densities resulting in both elastic and inelastic elements in different sections of the garment. Stitch density, elasticity and capacity to stretch vertically and horizontally contribute to either augment or diminish the resistance in the garment.

[0058] For woven types of garment, the differing tensions are created by assembling fabrics of differing fiber contents, mixtures of Lycra®, nylon and elastomeric treated fabrics. The resistance bands are sewn or heat-bonded in place in the garment to create the same effect as in a knitted version, namely, an elastic garment with carefully positioned non-stretch bands, or the equivalent thereof. The denier (number of grams of fiber per 9000 meters of thread) of the fibers differs according to the fabric selected for the garment and has a direct impact on the characteristics of the final product.
For both knitted and woven fabric constructions, the number of threads per inch along with the tension in grams per force, are determining factors in the strength of the resistance or the degree of elasticity in the garment. The gussets of both garments are primarily cotton and Coolmax®. The final products are also treated with the finishing agents used to soften the fabrics, wick moisture, and a special agent to retain fiber memory so that the elasticity and resistance can be maintained over multiple washings.

The concept is shown graphically in FIGS. 1 to 4. As shown more particularly in FIGS. 1, 1a and 2, non-stretch bands or the equivalent thereof are placed so as to increase the resistance in the pelvic girdle and lower limbs.

Looking more specifically at FIG. 1, a prototypical embodiment of the garment of the application is shown. An undergarment is generally designated by the number 10 and includes a panty 2, a gusset 4, a waistband 6 and leg bands 8. Resistance bands 20 are strategically positioned within the undergarment (see FIG. 2) so as to provide resistance and muscle toning, and this in turn results in an increase in caloric burn. FIG. 1a shows the undergarment of FIG. 1 in its intended use, as worn by an individual.

By increasing the work load to the pelvic girdle muscles during unipodal stance, there is an increase in the work of the contralateral posterior muscle chain to stabilize the trunk in this unstable condition. For example, during walking, when right hip flexors contract to move the right lower limb forward, the left hamstrings and gluteus maximus, as well as the right latissimus dorsi via the thoraco-lumbar fascia all increase their activities.

As further shown in FIG. 3, non-stretch bands are attached to the distal part of the thigh. The conic effect of the thigh prevents the band from moving upwards. From this anchoring point, two non-stretch bands, or the equivalent thereof, are slanted backwards, one by the interior and the other from the outside of the thighs, up to the waistline. As illustrated in FIG. 4, the two bands intersect at the ischium (A) in order to rely on a rigid point for better efficacy. Thereafter, the outer band will focus on the opposite iliac crest (B) while the internal band is attached to the external part of the ipsilateral iliac crest (C). The exact positioning of the bands, or equivalents thereof, may be modified somewhat but are based on the above idea.

Returning now to FIGS. 5 to 9, an embodiment of an undergarment in which the above-described concept has been reduced to practice is shown. As may be seen more particularly in FIGS. 5 and 6, the sections of the undergarment that include the equivalent of the bands described above are shown in darker-colored fabric and are made of a denser material. This material is relatively inelastic when compared with the remainder of the material comprising the undergarment in order to engage the underlying muscles into activity and induce caloric burn. It also induces muscle toning. FIGS. 7 and 8 show anterior views of the undergarment, including the thigh bands or strips that effectively anchor the posterior bands in place to ensure maximum efficiency when in use.

It will be understood that the principles behind the garment of the present application can be included within a limitless number of embodiments that can include an endless variety of aesthetic and other practical features. For example, the garment can be made from a number of different fabrics and materials. It can also be made in an infinite number of colors and include elements that are more gender specific for individual appeal and comfort. In addition, the garment may be extended to cover a greater portion or even the entire length of the legs and feet, or the waist band section elongated along the torso to provide further support and enhance its ability to provide an overall slenderizing effect.

Without wishing to be bound by any theory, the caloric burn effect of the novel garment of the present application is believed to rely on the muscle chain theory. Specifically, bands having very little or no elasticity are strategically positioned within the garment, as described in greater detail below, to trigger the muscle chains and then affect moving and postural muscles. The result is that the person wearing the garment expends energy by gently but effectively forcing the muscles to work against the resistance bands. Advantageously, as will be shown further below, the effects are noticeable even when the wearer engages in normal daily activity. The caloric burn effect can be enhanced through moderate activity.

FIGS. 10 and 11 are energy expansion graphs demonstrating the caloric burn effect of the garment of the present application. Caloric burn evaluation methods were based on the measurement of heart rate (an indirect energy expenditure) as well as oxygen intake, VO2 (a direct energy expenditure). In FIG. 10, the results are shown for a cross section of individuals wearing regular underwear, a slimming type of underwear and the caloric burn undergarment of the present application. It may be seen from this graph that the caloric burn effect is optimal when the wearer engages in moderate activity. This finding is confirmed by the results shown in FIG. 11, which contrast the energy expenditure resulting from wearing a slimmer and the undergarment of the present application.

Example 1

Biomechanical Concept of Muscle Effort in Human Locomotion

All muscular efforts lead to an elevation of the energetic metabolism that varies with the intensity of the effort. The greater the effort, the greater the degree of solicitation to the muscle fiber engaged with the effort. This in turn leads to a greater need for energy, and therefore to an increase in energy consumption.

The mechanical work accomplished by the muscles during locomotion can be divided in 2 components:

\[ W_{ext} = W_{elas} + W_{int} \]

With each step, the CG undergoes a translation or a linear displacement upwards and forwards under the effect of the \( W_{elas} \). This is accomplished by the muscles that modify the energy potential \( E_{pot} \), its upward kinetic energy \( (E_{kin}) \) and its kinetic energy forward \( (E_{kin}) \). \( W_{elas} \) is the algebraic sum of \( W_{elas} \) which is a fraction of the external work necessary for the displacement of the body forward and upwards, respectively.

During stance phase, the foot has a null speed relative to the ground while the CG continues its translation at its own speed. In turn, during the oscillation of the lower limb, the foot is brought back towards the front with a speed superior to the center of gravity. Therefore, with each step,
the limbs are, turn by turn, in front of or behind the CG. \(W_{\text{ext}}\) is therefore the work accomplished by the muscles to recon- figure the system (Williams 1993).

[0075] The proposed mechanical model for walking by Cavagna et al., 1963 is characterized by the variation in opposition in the phases of potential energy and the kinetic energy forward and upwards. The opposing mechanism of these phases permits the reciprocal transformation of these two forms of mechanical energy, one into the other, just like a pendulum, leading to the most efficient use of energy while walking (FIGS. 12 to 15). The neurology of the body is adapted to regulate the body to reproduce this efficient movement as much as possible.

[0076] The reciprocal pendulum mechanism of \((E_{\text{pot}} + E_{\text{kin}}})\) and \(E_{\text{kin}}\), characteristics of the walking motion has the effect of minimizing the mechanical work effected by the muscles to move the center of gravity and, consequently, minimizing the energy costs. The percentage of energy recuperated by the pendulum mechanism is given by:

\[
R = \frac{(W_p - W_{\text{ext}})}{(W_p + W_{\text{ext}})} \times 100
\]

[0077] In a perfect pendulum effect, \(R = 100\% \) and \(W_{\text{ext}} = 0\). In this situation, the variations of potential energy and the kinetic energy are in a perfect opposing phase. All factors perturbing one of these conditions will have the effect of disrupting the efficiency of the walking cycle. The pendulum mechanism constitutes the first physical objective interpretation of the existence of an optimal speed during walking.

[0078] The speed at which walking is the closest to the conditions of a pendulum is ideal for optimal energy efficiency by the body. Above this speed, \(W_{\text{ext}}\) increases, and therefore directly increasing the energy expended in movement.

[0079] Preliminary Efficacy Results of the Garment of the Present Application

[0080] With its non-extensible band, the garment of the present application has the effect of increasing the \(W_{\text{ext}}\) which represents a direct increase of the muscular work involved in the same movement and therefore a direct increase of the energy expended. When the energy spent increases, more calories are consumed to perform the same work.

[0081] Work from Thys et al. 1996 demonstrated that the optimal speed for walking is between 4 and 5 km/hr (2.5 to 3 MPH). It is therefore at these speeds that the pendulum effect is optimal. To confirm the efficacy of the garment of the application, it was tested at these walking speeds. The cumulative results show an average increased energy expansion of 20.7%.

Example 2

Typical Day for a 35-45 Year Old Female Living in the USA (Body Weight 163 pounds and 64 inches)

[0082] Background about Calories Required in a “Typical” Day

[0083] During rest (lying comfortably, essentially no activity) the body’s tissues require about one-fourth of a liter of oxygen. The oxygen powers all bodily functions for the nervous system, digestion, brain and muscle activity, temperature regulation, and so on. In effect, the oxygen keeps the trillions of cells functioning while in the resting state. Oxygen use is related to heat production in a very precise manner. Every 1 liter of oxygen “burned” releases 5 calories (kilocalories) of heat energy. Thus, oxygen use is really a measure of heat production. At rest, the body’s tissues consume one-fourth of a liter, the equivalent of one-fourth of 5 kcal or 1.25 kcal for each minute at rest. There are 1440 minutes in a day, so if a person did nothing all day long (remained in the resting state), 1440 x 1.25 kcal = 1800 kcal would still be “burned.” This value is the minimum energy (or calories) that the body requires at rest. This can be called the resting energy metabolism (the basal metabolism differs slightly—a little less energy required—and is measured under strict laboratory conditions, usually in a medical setting).

[0084] This resting energy value above is for a typical person of average body weight and height, and varies slightly for people who are bigger and taller and smaller and lighter, and all those between. To compute the total quantity of calories that a person requires in a typical day requires knowing how many additional calories are required for all other activities above the resting level. This varies tremendously depending on what the person does during his or her non-sleeping hours.

If the person sleeps for 8 hours, that leaves 16 hours for sitting, walking, recreation, etc. The value could go as high as 3500 to 4000 or more “extra” calories burned in a highly trained, competitive endurance athlete who trains strenuously at a large percentage of his or her maximum capacity each day, to only 300-400 calories for a confirmed couch potato.

[0085] The table below shows an example of physical activities for a 35-45 year old female living in the USA who weighs 163 pounds and is 64 inches tall. Calorie charts are available to compute the calories burned for each of the activities in the table based on a body weight of 163 pounds. In the example, it is assumed that the total calories burned through physical activity equals 700 calories. This means that for this person on a typical day, she would “burn” or require a total of 1800 (resting metabolism) + 700 (the activities) = 2500 kcal for the day. By wearing the garment of the present application during the day, she would burn an extra 35 to 105 kcal. The last row gives the equivalent for the number of pounds of fat loss. Approximately 3500 kcal is equivalent to 1 pound of fat loss. The values in the table were calculated as number of calories x 365 days – total number of extra calories burned daily, divided by 3500 kcal. For example, if the undergarment has a 10% effect, this means 70 “extra” kcal daily x 365 days = 25,550 kcal, or the equivalent of 7.3 pounds of fat loss during the year that are attributable to wearing the undergarment.

<table>
<thead>
<tr>
<th>Percent of 700 kcal</th>
<th>10 percent of 700 kcal</th>
<th>15 percent of 700 kcal</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 extra calories</td>
<td>70 extra calories</td>
<td>105 extra calories</td>
</tr>
<tr>
<td>12,775 kcal yearly</td>
<td>25,550 kcal yearly</td>
<td>38,325 kcal yearly</td>
</tr>
<tr>
<td>3.7 pounds fat loss</td>
<td>7.3 pounds fat loss</td>
<td>11 pounds fat loss</td>
</tr>
</tbody>
</table>

Example 3

Independent Study Conducted at the University of Virginia: Impact of a Lightweight Nylon Fiber Undergarment on the Energy Cost of Walking in Middle-Aged Women

[0086] PURPOSE: The energy deficit required to prevent weight gain in most adults averages approximately 100 kcal daily. As a novel approach to closing this energy gap, we
examined the effects of a nylon fiber undergarment designed to gently resist hip flexion during movement on the energy cost of walking.

METHODS: Fifteen middle-age women (age=39.4±6.6 yr; stature=167.9±6.4 cm; body mass=74.6±7.6 kg; BMI=26.4±1.6 kg/m²) participated in 2x15-min treadmill walking tests separated by 15-min of rest. Treadmill velocity remained constant for each test (3.0 mph) with grade increased 5% every 5-min (5%, 5%, 10%). In a randomized order, subjects completed one test wearing the undergarment (G) and a control test with their usual undergarment (C). Indirect calorimetry assessed energy expenditure (EE; kCal/min⁻¹) for each treadmill grade as the mean of the last 2-min of each 5-min segment.

RESULTS: No significant differences occurred in EE between G and C at 0% grade (G=4.69±0.7 vs C=4.70±0.8 kCal/min⁻¹; p=0.96). Walking EE tended to be higher with the G at 5% grade (G=6.73±0.8 vs C=6.58±0.9 kCal/min⁻¹; p=0.11); in contrast, EE was significantly elevated with the G at 10% grade (G=9.41±1.1 vs C=9.13±1.2 kCal/min⁻¹; p=0.04). Eleven subjects (73%) who responded to the garment increased walking energy expenditure by 3 to 16%.

CONCLUSIONS: The nylon undergarment effectively augmented the energy cost of walking particularly at higher treadmill grades. This may have direct utility to increase the caloric cost of other common physical activities of daily living such as walking uphill, hiking, or stair climbing.

Example 4
Testing of Resistance Offered by Garment Having Resistant Bands while Bending the Thigh in Various Degrees of Hip Flexion and Effect on Muscle Activity

Methodology:

Resistance tests: In order to evaluate the pure resistance of the garments of the present invention, a dummy articulated with the anthropometric characteristics of a medium sized woman was used. The use of this dummy allowed the evaluation of the resistance without artifacts from the subject (Descarreaux et al., 2006; Duan et al., 2003).

The dummy is equipped with a goniometer placed at the hip to evaluate resistance at different angles during movement. To measure the resistance, straps were used to mobilize the thigh with a force gauge on the other end. When flexing the mannequin's hip, measurements of the resistance required to flex the hip to 70 degrees were taken, which is the average flexion during stair climbing.

Electromyography: sEMG data were collected using rigid bipolar electrodes applied bilaterally over the Rectus femoris. A ground electrode was placed on the right patella of each participant. Skin impedance was reduced by (1) shaving body hair, (2) gently abrading the skin with fine-grade sandpaper (Red Dot Trace Prep, 3M, St. Paul, Minn., USA), and (3) wiping the skin with alcohol swabs. EMG activity was recorded using a Delsys Surface EMG sensor with a common mode rejection ratio of 92 dB at 60 Hz, an input impedance of 10¹⁵ Ω (Model DE2.1, Delsys Inc., Boston, Mass., USA) and sampled at 1,000 Hz with a 12-bit A/D converter (PCI-6024E, National Instruments, Austin, Tex., USA). The EMG data were filtered digitally by a 10- to 450-Hz bandpass, zero-lag, fourth-order Butterworth filter.

The data were collected by LabView (National Instruments, Austin, Tex., USA) and processed by Matlab (MathWorks, Natick, Mass., USA).

Kinematics: Kinematics data were collected by a motion analysis system (Optotrac Certus, Northern Digital, Waterloo, ON, Canada). LEDs were positioned on the right side of each participant on 4 landmarks: (1) lateral condyle of the femur, (2) greater trochanter, (3) anterior superior iliac spine (ASIS) and (4) posterior superior iliac spine (PSIS). The data were sampled at 100 Hz and low-pass filtered by a dual-pass, fourth-order Butterworth filter with a cutoff frequency at 5 Hz.

Results:

Part 1 Resistance Tests

FIG. 16 illustrates typical force-angle curves recorded from the dummy. The analysis of the results suggests that the force necessary to bend the thigh (hip flexion) with the garment of the present invention having resistant bands is on average twice as much as when the mannequin has no underwear. After 20° of flexion, after tensioning the band, the resistance reached between 2 and 2.5 pounds. Since the weight of the thigh represents 10% of total body weight, 2.5 pounds of resistance is a 16.6% increase for a woman of 150 pounds.

FIG. 17 illustrates the summary of 80 tests (10 for each size). As can be seen, the same trend exists for each size of the garment of the present invention. Differences were observed that are between 2 and 2.5 pounds.

Part 2 Electromyography Study

For the electromyographic study, 16 subjects were used. The rectus femoris muscle activity as well as the right angle of flexion of the hip were measured. The movement of the thigh flexion was the same as that measured on the dummy. FIG. 18 shows an example of data from a hip flexion.

FIG. 19 summarizes the average increase in muscular activity of the rectus femoris during hip flexion for each subject. The mean average for the group (black line) is 35.80%.

Conclusion:

When wearing a garment of the present invention having resistant bands, there is an increase in resistance during movement and by consequence a direct increase in the effort produced by the muscles associated with hip flexion itself. This is conclusive in demonstrating that wearing such a garment has a positive impact on the physical condition of individuals in that it does in fact create more resistance to the movement. More resistance elicits increased muscular activity, which leads to toning of these muscles. Wearing these garments caused the wearer to spend more energy for the same movement done without a garment with resistant bands in accordance with the present invention. These results follow the same tendency as those observed by McKay et al. (2004) in aerobic activities. According to the results of Kubo et al. (2008) it appears that walking from 30 to 40 minutes, four times per week, is sufficient to significantly increase the volume (tone) of the hip flexors. Since wearing the garment of the present invention offers more resistance when walking,
the benefits observed in study Kubo et al. (2008) may be obtained using the garment of the present invention, within a shorter timeline.

REFERENCES


[0103] In the preceding description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the embodiments of the novel garment of the present application. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the invention. Moreover, while the application has been described primarily in relation to a specific embodiment thereof, the concept behind it may be used in a variety of different types of undergarments, and even garments worn externally, including embodiments that cover the entire leg or torso, for example.

[0104] The above-described embodiments of the garment of the application are therefore intended to be examples only. Variations, alterations and modifications can be made to the particular embodiments described herein by those of skill in the art without departing from the scope of the invention, as it is defined by the claims appended hereto. References noted herein are hereby incorporated by reference.

What is claimed is:

1. A caloric burn garment comprising a pant portion covering the lower abdomen, crotch and buttocks, and leg portions covering at least the upper thighs, wherein:
   one or more resistance bands are positioned so as to increase resistance for hip flexors and simultaneously affecting the work of the posterior muscle chain;
   one or more resistance bands is attached to the distal part of the thigh section of the leg portion; and
   one or more resistance bands is slanted backwards on the posterior side of the garment, one by the interior, forming an interior band, and the outer from the exterior of the leg portions of the garment, forming the exterior band, and extending towards the waistline, wherein said one or more resistance bands intersect at the ischium, the external band is attached on an iliac crest and the internal band is attached to the external part of an ipsilateral iliac crest.

2. The caloric burn garment of claim 1, further comprising an extended waist section to shape the torso.

3. The caloric burn garment of claim 1, wherein the leg portions extend throughout a portion or the entire length of the legs.

4. The caloric burn garment of claim 1, wherein at least one of the resistance bands is positioned to increase resistance for a hip flexor and work the posterior muscle chain.

5. A shaper garment comprising:
   at least two resistance bands positioned to increase resistance in the pelvic girdle and/or lower limbs and inducing muscle toning or caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment;
   the at least two resistance bands extending from leg portions of the garment and slanting backwards on a posterior side of the garment, one of the at least two resistance bands extending from an exterior side of one of the leg portions of the garment and extending upwards towards the waistline, and the other of the at least two resistance bands extending from an exterior side of the other leg portion of the garment and extending upwards towards the waistline, wherein two of the at least two resistance bands cross at or near the ischium

6. The shaper garment of claim 5, wherein the at least two resistance bands further comprise two further resistance bands, one of the further resistance bands extending from an interior of one of the leg portions of the garment towards the waistline and the other of the at two further resistance bands extending from an interior side of the other leg portion.

7. The shaper garment of claim 6, wherein the two further resistance bands extend to an external portion of the ipsilateral iliac crest.

8. The shaper garment of claim 5, wherein at least one of the resistance bands is positioned to increase resistance for a hip flexor and work the posterior muscle chain.

9. The shaper garment of claim 5, wherein the leg portions extend to the ankle of the wearer.

10. The shaper garment of claim 5, further comprising an extended waist section to shape the torso of the wearer.

11. A shaper garment comprising:
   at least four resistance bands positioned to increase resistance in the pelvic girdle and/or thighs and inducing caloric burn when worn during daily activities; the resistance bands being more resistant than the remainder of the shaper garment; wherein
   the at least four resistance bands extend from a distal part of the thighs;
   two or more of the at least four resistance bands slant backwards on the posterior side of the garment, at least one by the interior and at least another by the exterior of the thigh portions of the garment and extending towards a waistline, wherein
   at least two of the resistance bands intersect at the ischium, and wherein the interior band extends across the iliac crest and the interior band extends across the external part of the ipsilateral iliac crest.

12. The shaper garment of claim 11, further comprising an extended waist section to shape the torso of the wearer.

13. The shaper garment of claim 11, wherein the shaper garment extends to the ankle of the wearer.