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MULTI-USE APPARATUS IN MECHANICS AND HEAT

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ABSTRACT
The equipment, which has versatile applications in mechanics and heat, consists of a base, a detachable upright post, a bottom level adjuster, and a top holder. It is applicable for conducting experiments on several subjects including uniform acceleration, friction, moment of inertia, conservation of linear momentum, center-of-gravity, principle of moments, simple harmonic motion, Bernoulli's principle, heat expansion, and heat conductivity. Throughout the execution of an experiment, its crucial components are systematically assembled. The holder is fitted with a locking mechanism that ensures the secure fastening of interchangeable accessories. The tests can be tailored to suit the intended results. The components of the apparatus are detachable, facilitating easy assembly and disassembly, while also allowing for increased storage capacity, transportation convenience, and inventory management. To facilitate and expedite the process of assembling and disassembling, all components are meticulously and systematically stored in a container. The current concept provides a multitude of advantages through the optimization of mechanics and the implementation of heat-efficient testing.
Keywords: Multi-use apparatus in mechanics and heat, Universal apparatus for mechanics and heat

INTRODUCTION

The multi-use apparatus for mechanics and heat can conduct twelve experiments, including verifying ideas related to uniform acceleration, friction, moment of inertia, conservation of linear momentum, center-of-gravity, principle of moments, simple harmonic motion, Bernoulli's principle, heat expansion, and heat conductivity (Hydrodynamics, 1738).

The aggregate of all the forces acting on a rigid body is referred to as the resultant of forces. Computerized analysis or a free-body diagram can be utilized to calculate and visualize the resultant force exerted on an object. At the start of the force table setup, a horizontally placed circular platform is carefully leveled. The setup involves concurrent and coplanar forces. A weight holder can be hung from the loop of the free end of the string, and the ring remains stationary due to the presence of a pin, even when forces are applied.

By positioning the pin precisely at the center of the ring on the force table, it will maintain equilibrium even when subjected to external forces. In order to reduce friction and achieve equilibrium, the ring is gently pushed in various directions until it reaches the center of the table, indicating that it is in a state of balance. By utilizing the circular scale on the table, we may ascertain the orientation of each force and identify the one that serves as an equilibrium to the rest. Constant acceleration also called uniform acceleration deals with an instance where the velocity is constant both at the start and at the end of a given time period. The acceleration can be found out from the slope of a velocity-time graph in case the acceleration is steady. The foundation of the structure consists of a metal disk and an inclined plane design. The base supports a standing post that has a level adjustment and a holding. In order to determine the distance covered by the disk, a stopwatch is employed while it is being rolled down the inclined plane.

Friction is necessary for a solid object to move or roll over another. Although it has the potential to yield advantages, it presents a challenge to the movement. This friction measuring apparatus utilizes a meter stick, a wooden block, a rope, a pulley mechanism, and various weights. A weight holder securely attaches the weights to one end of the string, while a piece of wood functions as the opposite end. Increasing the weight of the block of wood results in an increase in friction, while the rope passes through the highest part of the pulley.

The moment of inertia, which measures a body's rotational inertia, quantifies its resistance to changes in rotational speed caused by the application of torque (Mulhayatiah, Suhendi, Zakwandi, Dirgantara, and Ramdani, 2018). The moment of inertia, similar to mass in linear momentum calculations, remains constant for rigid bodies while calculating their angular momentum.

The device calculates the moment of inertia using the base, a level adjuster, and a holder. The inclined plane is equipped with parallel hollow and solid cylinders, positioned in relation to each other, starting from its highest point. The balls are pitted against each other based on their rate of descent down the inclined surface.

According to hook's law the displacement of the body is directly proportional to the stress or force applied on a body provided the deformation is small. There is a direct proportion between the force that is applied to a solid and the extent to which it causes movement of the molecules, atoms, or ions in that solid third is elastic solids according to Hooke's law (Wo Yem, 2016; Eseceli, 2019).

Conservation of linear momentum is one of the most important concepts in the field of physics and according to the basic postulates it is possible to state that the amount of momentum of all the items of the system does not change. The Principle of Transmissibility (2021) is applied in conjunction to this principle to solve systems of forces that act at or within a structure.

A body is perfectly balanced at its center of gravity, as its weight is evenly distributed throughout. While a human's center of gravity might change when assuming different postures, the center of gravity for most other objects remains consistent. The Principle of Moments, often known as Varignon's Theorem, states that the moment of any force is equal to the total of the moments of its components.

Yernagula, Thorat, Khan, and Aland (2019) define simple harmonic motion as a specific type of periodic motion. In this motion, the force that brings the object back to its original position is directly proportional to the distance it has moved from that position and acts in the same direction. One example of a mathematical model for motion is the explanation of how a mass on a spring oscillates in response to Hooke's law, which states that there is a linear elastic restoring force. The utilization of simple harmonic motion to model molecular vibration, as explained in Gowri et al. (2017), establishes the foundation for the analysis of more intricate periodic motion through Fourier analysis techniques.

According to Bernoulli's principle in fluid mechanics, there is a simultaneous decrease in static pressure or potential energy of a fluid and an increase in its speed. The Bernoulli principle, named after Daniel Bernoulli, is applicable solely to isentropic flows in which non-adiabatic processes (such as heat radiation) and irreversible processes (such as turbulence) have minor effects.

those having a low thermal conductivity exhibit a reduced rate of heat flow in comparison to those with a high thermal conductivity. Insulating materials, such as Styrofoam, have lower thermal conductivity compared to metals, resulting in reduced heat transfer efficiency.

Assembling, dismantling, storing, transporting, and stacking a multi-use gadget designed for mechanics and heat is effortless. Moreover, it exhibits exceptional durability and affordability. This innovation optimizes the efficiency, reduces complexity, accelerates, and enhances the precision of mechanical and thermal experimentation.

SIGNIFICANCE OF THE TECHNOLOGY

The present invention pertains to an apparatus for experimenting to determine the resultant of forces and confirm concepts on uniform acceleration, friction, a moment of inertia, Hooke's law, conservation of linear momentum, centre-of-gravity, principle of moments, simple harmonic motion, Bernoulli's principle, heat expansion and heat conductivity. Various setups are assembled and disassembled using

the stand, bolts nuts, and accessories. All parts are stored in a single box. The said multiuse apparatus is light, compact, and versatile.

OBJECTIVES OF THE STUDY

The experiments in this text cover various topics related to mechanics and heat. The first experiment focuses on determining the resultant forces, while the second experiment examines the motion of a body rolling down an inclined plane. The third experiment aims to determine the coefficient of static friction between two materials. The fourth experiment focuses on the moment of inertia, demonstrating which cylinder has a greater moment of inertia. The fifth experiment investigates the property of elasticity, while the sixth experiment observes the transfer of momentum from the incident ball to another ball. The seventh experiment aims to locate the centre gravity of a regular and irregular body using the plumb-line method. The eighth experiment studies the concept of torque and the condition for a body to be in rotational equilibrium. The ninth experiment focuses on the simple harmonic motion of a simple pendulum, illustrating simple harmonic motion and determining acceleration due to gravity. The tenth experiment analyzes the motion of two balls when air is blown between them. The tenth experiment demonstrates how moving airlifts a wing and keeps it airborne. The tenth experiment focuses on the heat expansion of each metal by observing the order in which wax balls melt in each shafting. The tenth experiment demonstrates the various heat transfer characteristics of various metals. The apparatus is then returned to a singular box for safekeeping and next experimentation.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF DRAWINGS

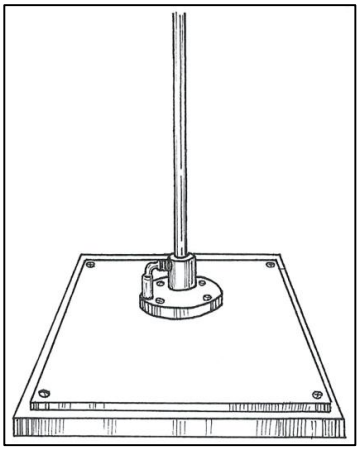

Figure 1 shows the front view of the main component set-up of the multi-use apparatus in mechanics and heat apparatus.

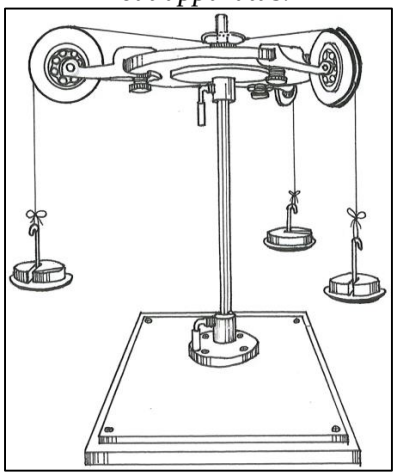

Figure 1.1 shows the perspective view of the multi-use apparatus for mechanics in heat for resultant forces experiment component set-up.

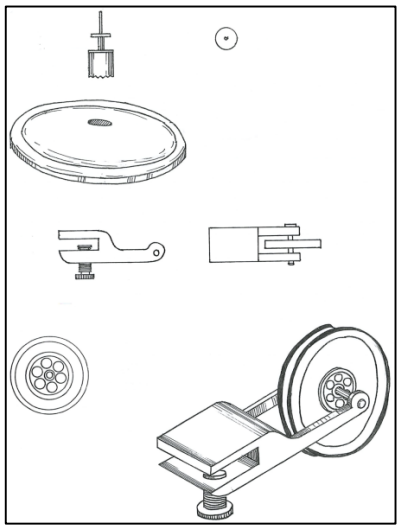

Figure 1.1.1 shows the blow-up views of the multiuse apparatus for mechanics in the heat for the resultant forces experiment component set-up.

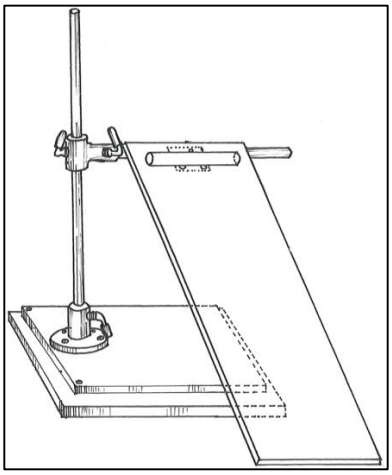

Figure 2 shows the perspective view of the multi-use apparatus for mechanics in heat for Uniform acceleration experiment component set up.

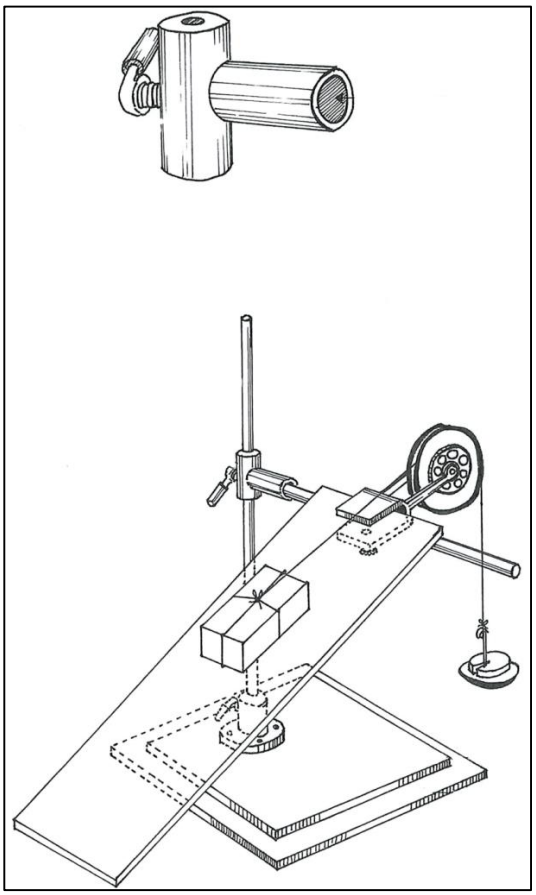

Figure 2.1 shows the side view of the multi-use apparatus for mechanics in the heat for Uniform acceleration experiment component set up.

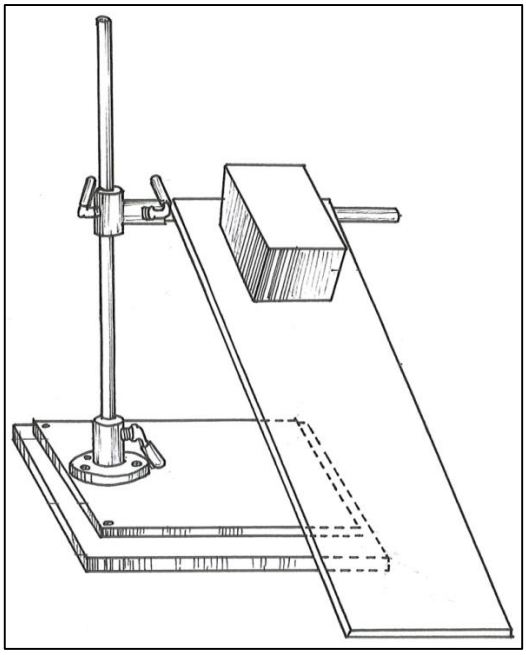

Figure 3 shows the perspective view of the multi-use apparatus for mechanics in the heat for the Frictionexperiment component set-up.

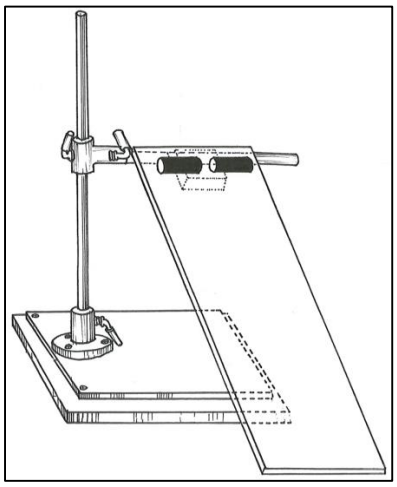

Figure 4 shows the perspective view of the multi-use apparatus for mechanics in the heat for a moment of inertia experiment component set-up.

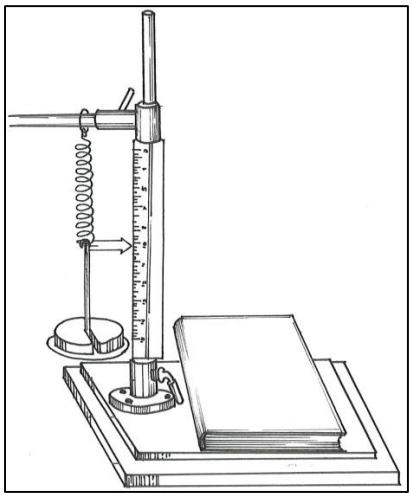

Figure 5 shows the perspective view of the multi-use apparatus for mechanics in heat for Hooke's law experiment component set-up.

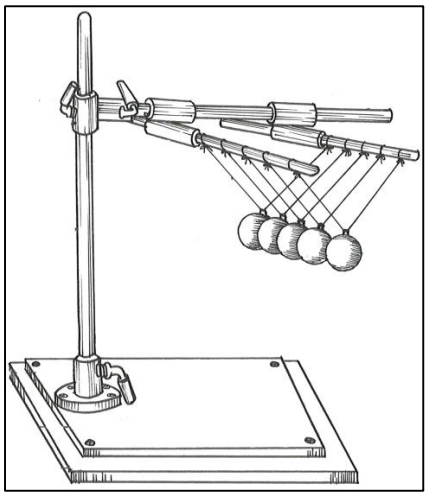

Figure 6 shows the perspective view of the multi-useapparatus for mechanics in heat for conservation of linear momentum experiment component set-up.

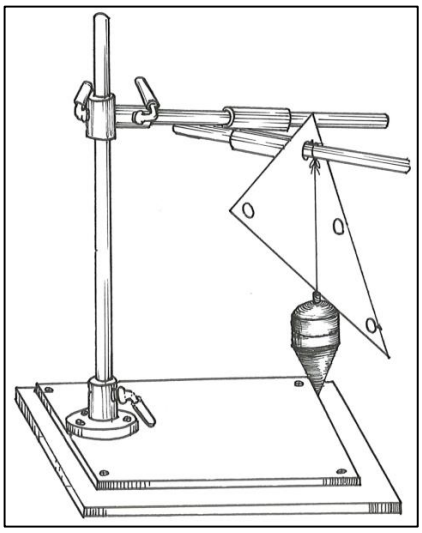

Figure 7 shows the perspective view of the multi-use apparatus for mechanics in the heat for the centre forgravity experiment component set-up.

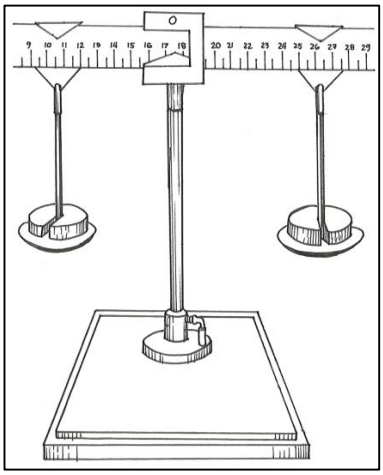

Figure 8 shows the perspective view of the multi-use apparatus for mechanics in the heat for the principle of moments experiment component set-up.

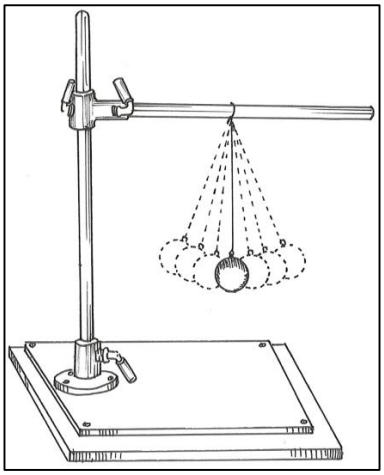

Figure 9 shows the perspective view of the multi-use apparatus for mechanics in heat for a simpleharmonic experiment component set-up.

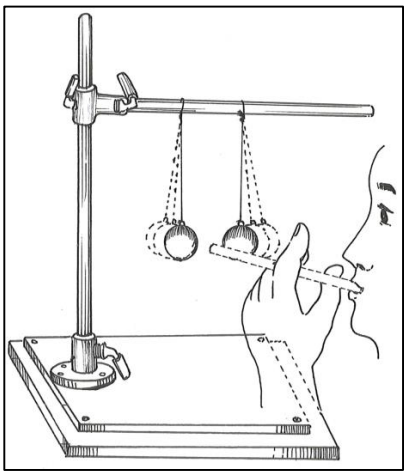

Figure 10 shows the perspective view of the multi-use apparatus for mechanics in heat for Bernoulli's principle experiment component set-up.

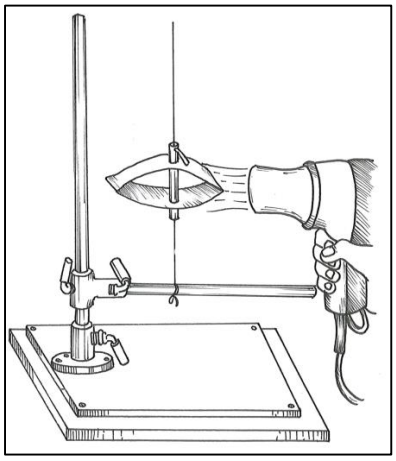

Figure 11 shows the perspective view of the multi-use apparatus for mechanics in heat for anotherpreferred Bernoulli's principle experiment set-up.

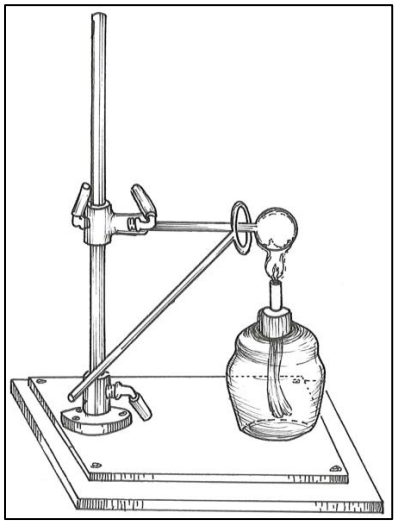

Figure 12 shows the perspective view of the multi-use apparatus for mechanics in heat for heat expansion experiment component set up.

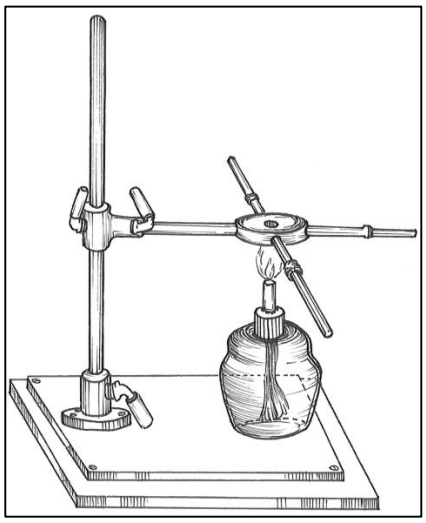

Figure 13 shows the perspective view of the multi-use apparatus for mechanics in heat for heatconductivity experiment component set-up.

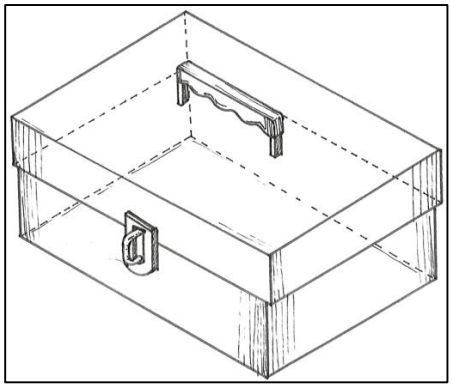

Figure 14 shows the singular box.

SUMMARY OF THE INVENTION

This invention presents an apparatus for carrying out physics experiments in mechanics and heat, which is rather universal. This is a combination of a base plate of laminated glossy surfaces, the upstanding post holder and a central table like member. Major sub-assembly consists of a base plate made of laminated smooth material, an upstanding post holder and central tabular part. Another component is the presence of several constituent parts of experiments for different kinds of experiments in mechanics and heat; therefore, the apparatus is rather useful for performing experiments in physics classes. The appropriate structures of the apparatus are adopted to study forces uniform acceleration; friction; the moment of inertia; Hooke's law; conversation of linear momentum; centre of gravity; the principle of moments; simple harmonic motion; Bernoulli's principle; heat expansion; and heat conductivity.

RESULTS

1. The apparatus incorporates a range of mechanics and heat physics activities, such as force, uniform acceleration, friction, moment of inertia, Hooke's law, momentum, center of mass/mass, principles of moments, oscillations, Bernoulli, thermal expansion, and heat conduction. They are associated with other main component set-ups such as a laminated smooth base, a post holder, and a tabular member on which the elements are centrally placed.
2. Moreover, the emergent forces are used in designing a flat cap that is associated with the central tabular portion and the overall layout constitutes the primary components. The circular platform is larger and made up of a transparent type of material and has a graduation etch throughout the

outline. This cap works with similar platforms. The platforms have a locking system and a hole in the middle, when the pin comes out, it provides a mark of the obtained force. Around the circumference of the outer rim there are a number of clamp jaws, and these are twenty in number and separated by elongated horizontal and vertical gaps. The aim of the experiment is to investigate vectors and graphical techniques of finding the resultant of several forces. Subsequently, to measure the equal and opposite effect, use the graded instrument to check if the platform is balanced and backward, after which position the clamp jaws around the platform.

3. This multi-use apparatus used for physics experiment in mechanics and heat is made up of a part which creates the experiment of uniform acceleration component. This consists of a main component setup and holder and an adjustable holder which the two are coupled by a wing nut WN. The holder receives a flat horizontal plate named tabular member and is sliding over the central section. The analysis of experimental results will be focused on investigation of the body motion on an inclined plane. The adjustable holder required is placed and fixed at the middle of the central tabular member while the inclined plane is slid through the horizontal member. Next, the disk rests on the highest point of the inclined plane and the value of the uniform acceleration is determined.
4. The multi usage equipment for conducting mechanics and heat physics experiments is comprised by the portion having a friction experiment component. The component consists of a holder that is adjustable with the help of a wing nut WN along the central tabular member. The holder obtains one arm or the horzontal tabular member and it is fastened up by one wing nut. Being a component of the screw conveyor, the inclined plane can be made of a single piece of wooden plank or acrylic plastic. A string S leads the weights W and the wood which is a pulley system.The pulling force results in the wood moving upwards through the string S with weights W till the coefficient of static friction between two materials is determined. The holder fits and is fixed in the middle part of the central tabular member, and the inclined plane is placed in any position, with respect to the vertical plane of the center of the central tabular member.

5. The equipment compiled out of Moment of Inertia experiment part and the mechanics and heat experiment part connected with an adjustable holder is used for the multiple purposes in physics experiments. It comprises an end of the horizontal tabular member received by the holder who is fixed by use of a wing nut. Depressed to a sliding position along the central part of the horizontal tabular member is an inclined plane that can be of wood or acrylic plastic material. The rationale behind the experiment is to show which of the two cylinders has the largest moment of inertia. The adjustable holder is mounted and fixed at the midportion of the central tabular member and the inclined plane is hinged at any position. The hollow and solid cylinders are placed at that end of the inclined plane which is at the highest point relative to the ground.
6. The multi-use apparatus for performing physics experiments in mechanics and heat is defined by the adjustable holder with the help of the winged nut WN located along the semi-circular central tabular member. A horizontal tabular member is passed through a recess of the holder and is fastened with help of wing nut WN. A spring ring can slide around the edge of the tabular member and a weight holder with loads can be connected with a hook. A hook for an indicator of the spring's displacement is located and a graduated member is employed to determine displacement. A heavy member is placed above the base this will be used as balancing weight for the set up being done. The objectives of the experimentation are to identify the property called elasticity and the value of the member with graduated reading at the end of the experiment shall be arrived at by subtraction of the initial from the final readings.
7. The object of many uses for the performing of experiments within the field of physics in mechanics and heat is stated in the first claim, with the added feature of a Hooke's Law experiment component set-up. The part and parcel of the main component are organs of the main component setup and an adjustable holder connected through WN. The holder gets a tabular

member in the horizontal direction and is tightened by a wing nut. A ball holder is fastened to the string whereby the balls are securely fixed in place. The experiment focuses on searching for the transfer of momentum from the incident ball to the other balls. The outermost ball is slightly displaced away from the remaining balls and therefore pass the momentum on to the rest.

8. The multi-use of the experimental physics equipment in mechanics and heat entails the commencement of a centre-of-gravity experiment set-up. The component is composed of an adjustable holder having a horizontal tabular section, a holder that ensures the positioning of cardboard through any of its hole, and a plumb bob placed beside the cardboard via a string. The experiment is to determine the centre of gravity of a regular and irregular body using plumb-line method. Cardboard is anchored by the holder and another string with the plumb bob is dropped next to the cardboard. The experiment is repeated until all the holes are firmly held through the holder and all the lines are made. To aim of the study is to find the centre of gravity of a regular and an irregular body using a plumb line.

9. The multi-use apparatus for carrying out the physics experiments in mechanics and heat is this piece of equipment that has a principle of moments experiment component set up. The component consists of a plank holder, a graduated plank, gliders holding weight holders, and the weights on the weight holders. The purpose of this subject experiment is to observe the effects of torque and the principle of rotational equilibrium. Weight plates are packed in the weight holders and one glider is kept fixed and the other one is slid to make the balance between the two weights. The reading is then made once the equilibrium is struck.
10. The flexible, many-purpose device to carry out the experiments of physics in mechanics and heat contains a simple harmonic experiment setup component. It is consisting of a main component and an adjustable manner mounted with a wing nut as a coupling in between the two. Thus, the experiment will focus on the swinging of a simple pendulum to assess both simple harmonic motion and the local g value. The ball is pushed in one direction and is left swinging until it comes to a standstill and the time taken used in timing the swinging of the ball is recorded from a stop clock.
11. The object of claim 1 is the multi-purposed instrument for mechanics and heat physics experiments performances. It comprises a central body component Setup and an adjustable arm holder enveloped by a wing nut WN. The central tabular member is held in place by a wing nut WN. In this gadget, balls are hanged on the tabular member via strings and positioned at a specific interval from each other. This experiment intends to investigate the interaction of two balls based on behavior of air between them executing a reducing distance.
12. The balanced instrument for performing mechanics and heat experiments in physics is identified in claim 11. It is made from a main mount component, and one adjustable clamp holder fastened by a wing nut in between. Another option has a paper member hanged from the horizontal tabular member with the help of a string. The experiment's purpose is to show how an airlift station removes a wing and sustains it in the air. A wind from a blower lifts the paper member and moves it.
13. The general use assembly for demonstrative physics experiments in mechanics and heat is selected in claim 1. The devise comprises heat expansion experiment parts that are; an adjustable stand, a metal ball, a metal ring, and an alcohol lamp. The rationale behind the experiment is to find out the order in which the wax balls melt within the respective shafting in order to establish the conductivity of the metal used in each one of them. The metal ball provided is installed on the distal end position of the horizontal tabular member, while the metal ring is to be passed around the ball. The alcohol lamp ignites flame on the ball, when the flame has been burning for the required time in the metal ball, the metal ring is passed through the hot ball of metals. Nevertheless, the metal ring does not fit through the heated metal ball that expands as a result of being heated.

14. . The multi-purpose equipment used in the performance of mechanics and heat experiments is defined by the heat conductivity experiment component. The equipment includes a main part construction and an instalment holder adjusted with a wing turn WN. The component setup has been laid out with a round-shaped metallic disc, optimally copper or brass being fixed to the far end of the tabular horizontal member. A number of small metal shafting with the use of brass, copper and iron are screwed around the circumference of the round metal disc. Every shafting has a wax at the middle part of it and the metal disk is made hot through the hole prepared at the centre of the metal disk by the help of the flame from the alcohol lamp. There is a time set for the time taken before the wax in respective metal shafting starts melting. The experiment seeks to work in a way that shows that high K value materials transfer heat more quickly than poor K value materials.
15. The structure of the multiple use device by which the physics experiments in mechanics and heat are done according to claim 1 is designed in such a way that all the arrangements of the experiment component set up are made in a single box.

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