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LEG CAST WITH MEANS FOR ADJUSTING THE AMOUNT OF WEIGHT SUPPORTED BY THE PATIENTS FOOT DURING WALKING

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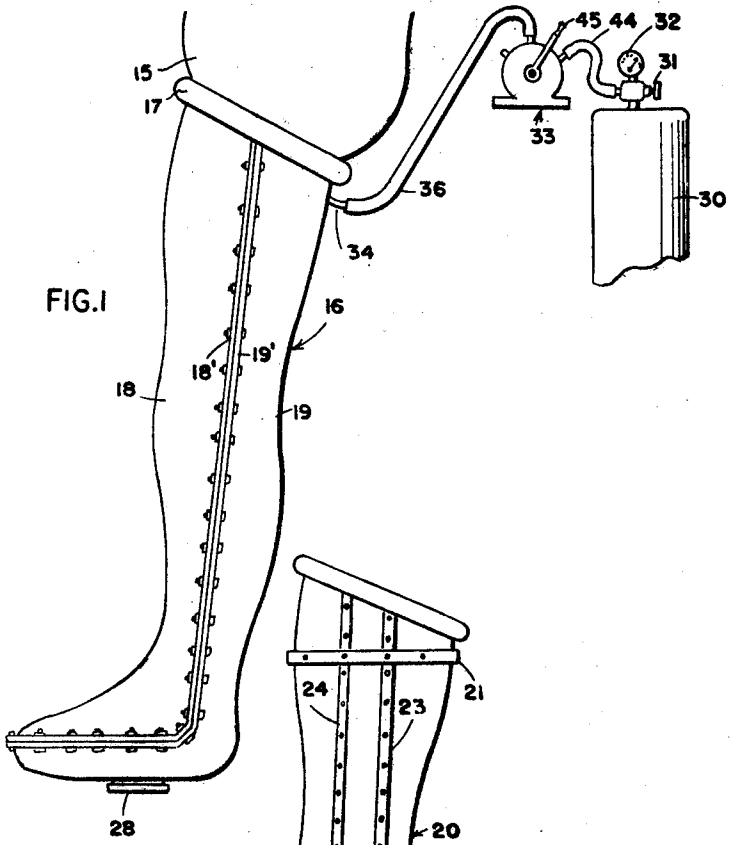


FIG.1

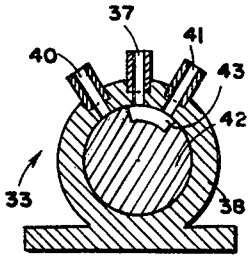


FIG.4

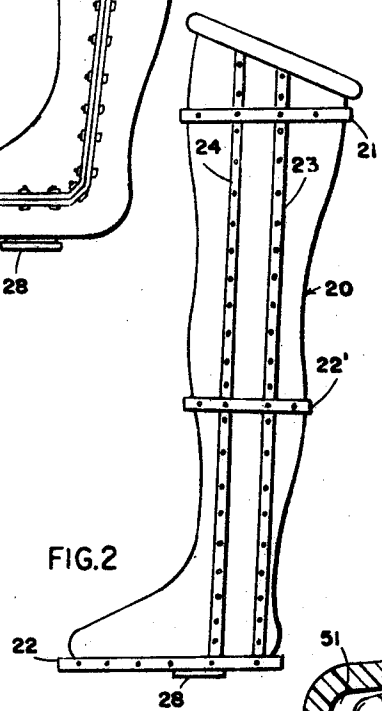


FIG.2

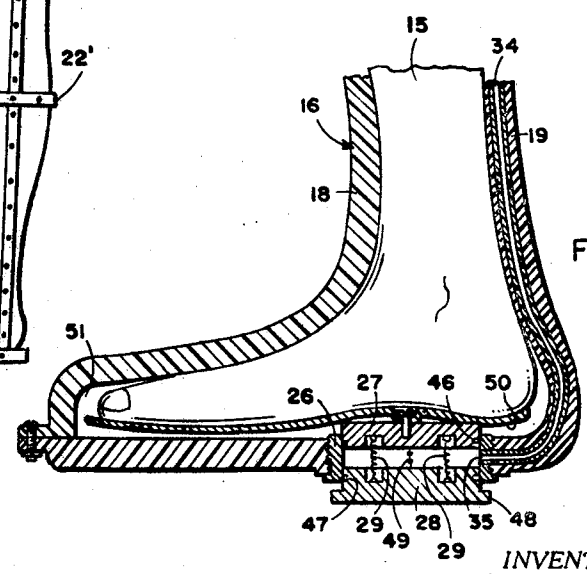


FIG.3

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LEG CAST WITH MEANS FOR ADJUSTING THE AMOUNT OF WEIGHT SUPPORTED BY THE PATIENT'S FOOT DURING WALKING

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10 Claims

ABSTRACT OF THE DISCLOSURE

The sole region of a cast encasing a patient's leg, has a vertical cylinder therethrough carrying two slidable pistons which are normally biased to be close to each other, and between which pistons, air under adjustable pressure can be introduced. The lower face of the lower piston is always below the cast. Atop the upper piston, within the cast, is a foot-supporting saddle. An ischial weight-bearing ring or a thigh clamp at the upper end of the cast, makes the cast to shunt the full body weight when the patient stands, and there is no pressure within the cylinder. When such pressure is present, the lower piston becomes a "floating" heel, and the intensity of such pressure determines the extent of the load borne by the injured leg.

The present invention relates to, and its principal object is to provide a novel and improved leg cast construction including mechanism affording the patient the capability to practice walking, and so arranged that the injured leg shall support a part of the body weight, which burden is adjustable, and finally to carry the entire body weight at some subsequent practice session.

A further object thereof is to provide a novel and improved leg cast and operating system of the character described, which can be made for a reasonable cost, easy to manipulate and efficient in carrying out the purposes mentioned.

Other objects and advantages will become apparent as this disclosure proceeds.

For one practice of this invention, the sole of an ischial-bearing cast, is provided with an upright cylinder therethrough having two pistons between which a pressurized gas may be fed to build up a pressure which is adjustable. The upper piston carries a foot-supporting saddle within the cast, in a slight space allowing movement thereof along the vertical. In the absence of pressure within the cylinder, the pistons assume close relation, and in taking a step with the encased leg, the entire body weight is borne by the cast and imposed on the hip bone. Upon feeding compressed gas into the cylinder, the pistons move in opposite directions. The lower piston extends always below the cast. A valve means controls the gas feed from a supply source, and the pressure is indicated by a suitable gage in the feed line. The cast may be an assembly of plastic sections which can be taken apart, or in one piece of plaster, arranged with rigid reinforcement structure.

In the accompanying drawing forming part of this specification, similar characters of reference indicate corresponding parts in all the views.

FIG. 1 is a side elevational view of a plastic cast encasing a leg; said cast being of a construction and associated with mechanism embodying the teachings of this invention. The components of the system are shown in disproportionate relation in order to include them in the limited space available on the sheet.

FIG. 2 is a side elevation of a plaster cast with rigid

reinforcement structure, and embodying similar mechanism as taught herein.

FIG. 3 is an enlarged fragmentary central longitudinal section of the cast structure shown in FIG. 1. Here, pressurized air has been admitted into the cylinder.

FIG. 4 is an enlarged central sectional view of a valve means suitable to control the air system.

In a preferred embodiment shown in the drawing, the numeral **15** designates a leg encased in a surgical cast indicated generally by the numeral **16**. This cast is a shell structure provided at its mouth with an ischial weight-bearing ring **17**, which as is well known, makes the cast able to shunt and support the full body weight when the patient stands, so no part of the weight is borne by the injured limb. The cast **16** is of plastic, molded to fit the leg, and is made in sections **18**, **19**, having facing perimetrical flanges **18'**, **19'**, which are bolted together, and of course, such sections are separable. This cast **16** is sufficiently strong and sturdy to support the full body weight. When however, the cast is of plaster as **20**, rigid reinforcement rings **21** and **22**, around the top and bottom respectively, and vertical bars **23**, **24**, along each side of the cast, are joined to form a unitary cage structure, for instance of aluminum bar stock, which is sufficient to support the body weight when the wearer stands up. There may be a central ring **22'**.

For the practice of this invention, the cast is provided with a vertically positioned cylinder **26**, securely mounted through the sole region of the cast, in substantially axial alignment with the leg's axis. There are two pistons **27**, **28**, slidably fitted in the cylinder **26**, and connected by tension coil springs as shown at **29**, to keep them normally close together with a slight space between them for the admission of compressed air from a supply tank **30**, whose output is controlled by a suitable valve **31**, and the pressure in the feed line is indicated by a gage **32**. A two-way valve device indicated generally by the numeral **33** is provided to direct compressed air into the cylinder **26**, by a metal tube **34**, which is preferably imbedded in the cast's wall; said tube being connected at its lower end to the intake port **35** of the cylinder **26**, and at its upper end is exposed for connection by a hose **36**, to the radial port **37** in the stator **38** of the valve **33**. Said port **37** is equi-distant and intermediate two other radial ports **40** and **41**, in the valve stator **38**. The rotor **42** of this valve has a socket **43** in its periphery, of sufficient size to span the central port **37** with either of the adjacent ports. The port **41** is connected to the air supply tank **30**, by a tube **44**, while the port **40** is open to the atmosphere. A handle **45** is provided to turn the rotor **42**. O-rings **46** and **47** having elastic quality, serve as piston rings.

The lower piston **28**, at its very bottom, has an outward flange **48**, which normally bears against the lower rim of the threaded bushing which serves as the cylinder **26**. The lower face of said lower piston is always below the cast **16**. A chain **49** connects the pistons to maintain the lower one associated with the cylinder. The upper piston **27**, mounts a foot-supporting saddle **50** which is in a space **51** within the cast, to permit a vertical movement of said saddle and its associated piston. The permitted movement of the pistons, is suggested to be at most, about one-quarter of an inch.

Although an ischial bearing cast is preferred, this invention contemplates a cast reaching up partway on the thigh, where a ring clamped to the thigh, bears on the mouth rim of the cast, like **17** on **16**. Such slight modification in structure is believed understood without the necessity of further illustration.

A patient, fitted with the cast herein taught, on an injured leg for the purpose of immobilizing said limb, or else on a leg which has been inactive for any reason

whatever, can practice walking, preferably at first with the aid of a crutch, cane or walker device; the system herein provided, allowing the patient to control the extent to which the injured leg will bear of the burden of his full body weight, from nil to full weight, according to his requirements and comfort.

It is evident that when no pressure is furnished within the cylinder **26**, the flange **48** of the lower piston **28**, will bear against the lower rim of the cylinder, and so the cast will shunt the entire body weight. By applying compressed air into the cylinder, the pistons **27** and **28** will move apart, thereby providing a pneumatic cushion for the impact of his step, afforded by the "floating" heel offered by the lower piston **28**.

So, he then shifts the valve rotor **42** to the position shown in FIG. 4, and opens and adjusts the valve **31**, so compresed air of five pounds per square inch pressure is entered into the cylinder. In taking a step, the sick leg will bear an impact equal to the pressure on the pistons which, for instance, are of an area of two square inches, so the leg will be subject to an impact of ten pounds, while the balance of his weight will be shunted by the cast and borne by his hip bone. If the impact is too much for the patient to tolerate with comfort, he will reduce the pressure in the cylinder **26**, by shifting the handle **45** so the cavity **43** spans the ports **37**, **40**, which will empty the cylinder. Then he will manipulate the valves **31** and **33**, to furnish the cylinder with a supply of compressed air at a lower pressure, which he will note by reading the gage **32**. At subsequent practice sessions, he will successively increase such pressure of the medium supplied into the cylinder **26**, so the shunting by the cast will be in modulated decreases, while the burdens borne by the leg will be in modulated increments, finally reaching full body weight. The greater the pressure is in the cylinder, a greater portion of the total body weight will be borne by the leg.

If the patient has both legs injured, then he will have the equipment described herein in duplicate. If only on one leg, then the other shall be shod with a shoe, for walking practice.

A compressed air or carbon dioxide supply in a small tank **30**, or an aerosol canister for such supply of pressurized medium, and the valve and gage equipment, may be carried on a belt worn by the user, thereby making the outfit portable and convenient.

I claim:

1. In combination, a shell cast for encasing a patient's leg, a cylinder fixed in upright position through the sole of said cast substantially coaxially with the longitudinal axis of said cast, upper and lower pistons slidably carries

in the cylinder, a foot-supporting saddle within said cast, free for slight vertical movement therein; said saddle being fixed atop the upper piston, first means holding the lower piston so its lower face is below the cast when the pistons are closest to one another, second means maintaining the lower piston in association with the cylinder; said cylinder having a port for the admission of a pressurized medium between said pistons, and a third means at the upper end of the cast, adapted to engage the patient and support the patient's weight when a step is taken by the patient on the cast-encased leg.

2. The combination as defined in claim **1**, wherein the first means is an outward flange on the lower end of the lower position.

3. The combination as defined in claim **1**, wherein the second means comprises a foldable member of predetermined length within the cylinder and connecting said pistons.

4. The combination as defined in claim **1**, wherein the third means is an ischial weight-bearing ring.

5. The combination as defined in claim **1**, including spring means within the cylinder, connecting the pistons and biasing them towards each other.

6. The combination as defined in claim **1**, wherein the pistons are always in spaced relation.

7. The combination as defined in claim **1**, wherein said port extends through the wall of the cast.

8. The combination as defined in claim **7**, wherein that part of said port which is through the cast, comprises a passage extending from the cylinder, thence upwardly, in and along the wall of the cast; opening in the upper art of said cast, for connection to a supply of pressurized medium.

9. The combination as defined in claim **1**, wherein the cylinder is an exteriorally threaded bushing, threadedly engaged with the cast.

10. The combination as defined in claim **1**, including a supply of pressurized fluid medium, means connecting said supply to said port, and valve means interposed in such connecting means to selectively control the admission of said medium into the cylinder and to make said cylinder communicative with the atmosphere.

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