

Project Type Synthesis Homework

Your Name

October 16, 2025

Abstract

Briefly summarize the purpose and key findings of this document.

Contents

1	US4509509A: Apparatus for Treating the Joints of the Human Body	4
1.1	Description	4
1.2	Images	4
1.3	Mechanism kinematics	4
2	US4520827A: NMS Aided Continuous Passive Motion Apparatus	4
2.1	Description	4
2.2	Images	5
2.3	Mechanism kinematics	5
3	US4549534A: Leg Exercise Device	5
3.1	Description	5
3.2	Images	6
3.3	Mechanism kinematics	6
4	US4566440A: Orthosis for Leg Movement with Virtual Hip Pivot	6
4.1	Description	6
4.2	Images	7
4.3	Mechanism kinematics	7
5	US4974830A: Continuous Passive Motion Device	7
5.1	Description	7
5.2	Images	8
5.3	Mechanism kinematics	8
6	US5203321A: Passive Anatomic Ankle–Foot Exerciser	8
6.1	Description	8
6.2	Images	8
6.3	Mechanism kinematics	9
7	US5333604A: Patella Exercising Apparatus	9
7.1	Description	9
7.2	Images	9
7.3	Mechanism kinematics	9

8	US6267735B1: Continuous Passive Motion Device Having a Comfort Zone Feature	9
8.1	Description	9
8.2	Images	10
8.3	Mechanism kinematics	10
9	US6325770B1: Device for Producing Continuous Passive Motion	10
9.1	Description	10
9.2	Images	11
9.3	Mechanism kinematics	11
10	US5252102A: Electronic Range of Motion Apparatus for Orthosis/Prosthesis/CPM	11
10.1	Description	11
10.2	Images	12
10.3	Mechanism kinematics	12
11	US5280783A: Continuous Passive Motion Device for Full Extension of Leg	12
11.1	Description	12
11.2	Images	13
11.3	Mechanism kinematics	13
12	US4492222A: Knee Exercise Machine	13
12.1	Description	13
12.2	Images	14
12.3	Mechanism kinematics	14
13	US10272291B2: Knee Flexion and Extension Therapy Device and Method of Use	14
13.1	Description	14
13.2	Images	15
13.3	Mechanism kinematics	15
14	US4603687A: Continuous Passive Motion Orthopedic Device	15
14.1	Description	15
14.2	Images	16
14.3	Mechanism kinematics	16
15	US5239987A: Anatomically Correct Continuous Passive Motion Device for a Limb	16
15.1	Description	16
15.2	Images	17
15.3	Mechanism kinematics	17
16	US4546763A: Continuous Passive Motion Method and Apparatus	17
16.1	Description	17
16.2	Images	18
17	Methods	18

18 Results	18
19 Discussion	18
20 Conclusion	18

1 US4509509A: Apparatus for Treating the Joints of the Human Body

1.1 Description

Early CPM concept emphasizing adjustable thigh and calf supports driven by a motorized linkage to provide controlled flexion/extension. Focuses on modular supports and variable range/speed settings to accommodate different patient anatomies and therapy progressions.

1.2 Images

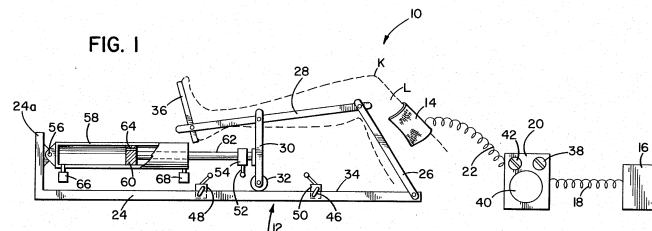


Figure 1: US4509509A apparatus illustrating adjustable thigh/calf supports and drive linkage.

1.3 Mechanism kinematics

2 US4520827A: NMS Aided Continuous Passive Motion Apparatus

2.1 Description

Integrates neuromuscular stimulation with CPM so electrical stimulation can be synchronized with passive motion. Aims to reduce atrophy and enhance neuromuscular re-education while maintaining safe, programmable knee motion profiles.

2.2 Images

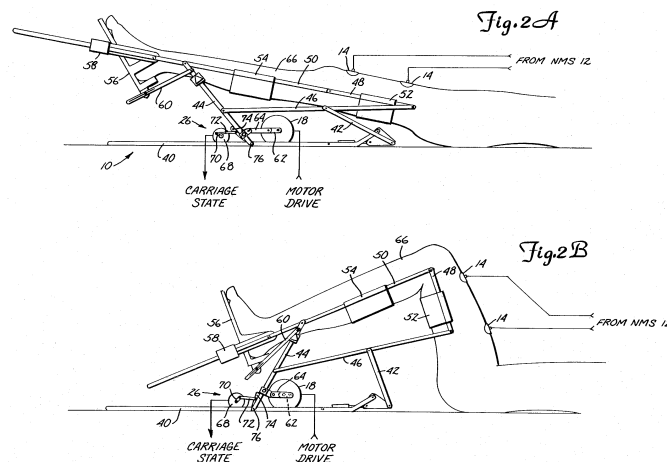


Figure 2: US4520827A concept combining CPM with synchronized neuromuscular stimulation.

2.3 Mechanism kinematics

3 US4549534A: Leg Exercise Device

3.1 Description

Compact leg exercise mechanism configured for passive knee cycling with an emphasis on home-use practicality. Utilizes a simple linkage and foot support to provide repeatable, low-load flexion/extension with minimal setup.

3.2 Images

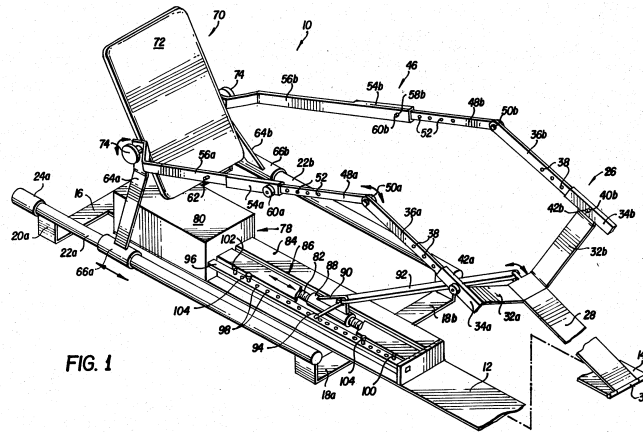


Figure 3: US4549534A leg exercise linkage aimed at repeatable passive motion.

3.3 Mechanism kinematics

4 US4566440A: Orthosis for Leg Movement with Virtual Hip Pivot

4.1 Description

Introduces a *virtual hip pivot* to better replicate natural hip-knee kinematics during knee motion, reducing shear and improving alignment. The orthosis geometry helps maintain consistent joint axes throughout the CPM cycle.

4.2 Images

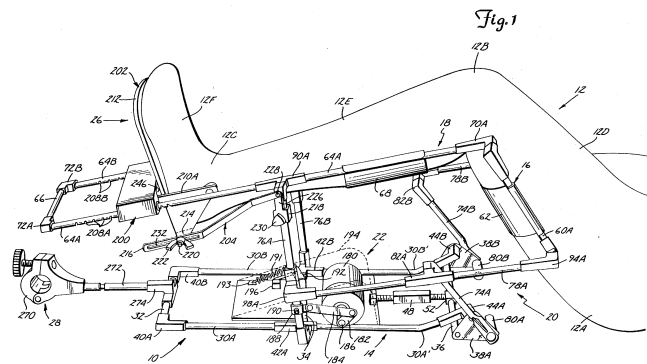


Figure 4: US4566440A orthosis showing geometry for a virtual hip pivot.

4.3 Mechanism kinematics

5 US4974830A: Continuous Passive Motion Device

5.1 Description

Programmable CPM with quick-adjust femoral and tibial cradles and mechanical end-stop management. Emphasizes user-friendly ROM adjustments and reliable actuator control for consistent therapy dosing.

5.2 Images

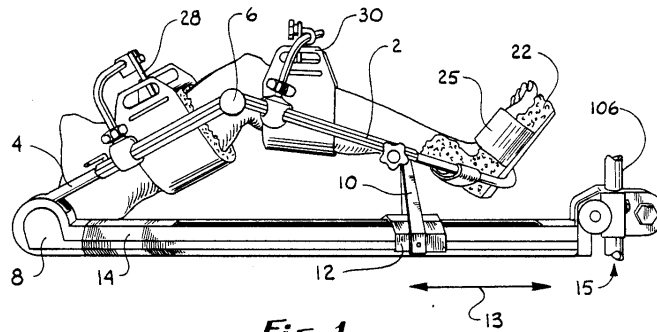


Figure 5: US4974830A CPM with adjustable cradles and end-stop control.

5.3 Mechanism kinematics

6 US5203321A: Passive Anatomic Ankle–Foot Exerciser

6.1 Description

Lower-limb passive motion device centered on anatomically aligned pivots and adjustable motion limits. Although focused on the ankle–foot complex, its design principles for alignment and controlled arcs inform knee CPM alignment strategies.

6.2 Images

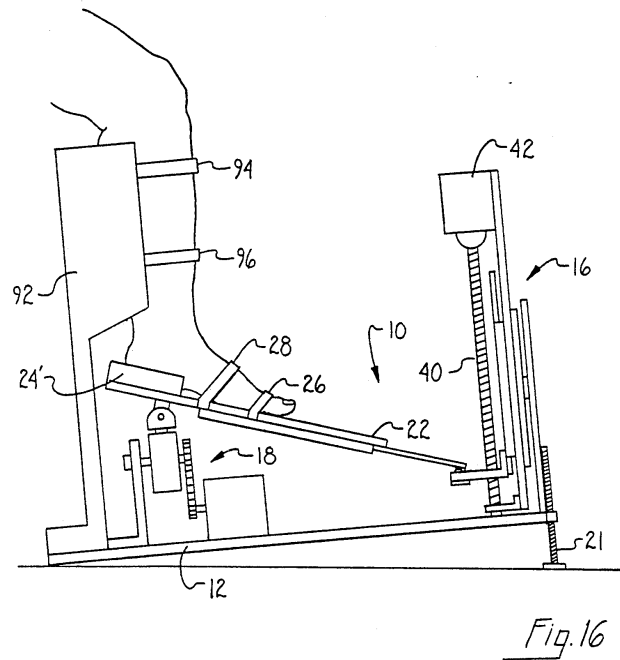


Figure 6: US5203321A passive device emphasizing anatomical pivot alignment.

6.3 Mechanism kinematics

7 US5333604A: Patella Exercising Apparatus

7.1 Description

Targets patellar tracking and anterior knee mechanics, providing controlled patellar motion and load pathways. Highlights isolated patellofemoral mobilization that can complement tibiofemoral CPM to address maltracking concerns.

7.2 Images

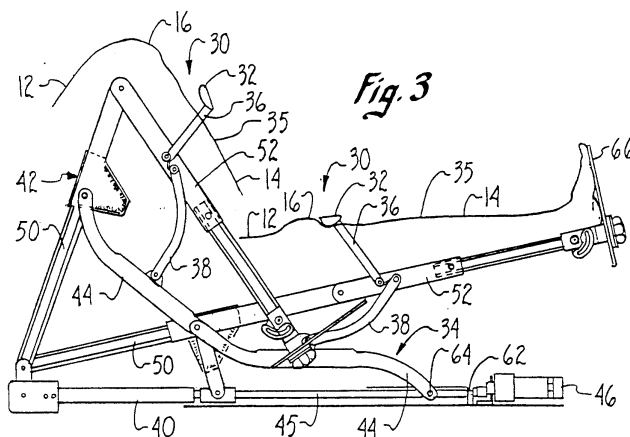


Figure 7: US5333604A apparatus for targeted patellar motion and tracking.

7.3 Mechanism kinematics

8 US6267735B1: Continuous Passive Motion Device Having a Comfort Zone Feature

8.1 Description

Implements a *comfort zone* deadband that avoids painful end ranges by adapting speed or reversing before irritation thresholds. Designed to increase tolerance and session duration while preserving therapeutic ROM gains.

8.2 Images

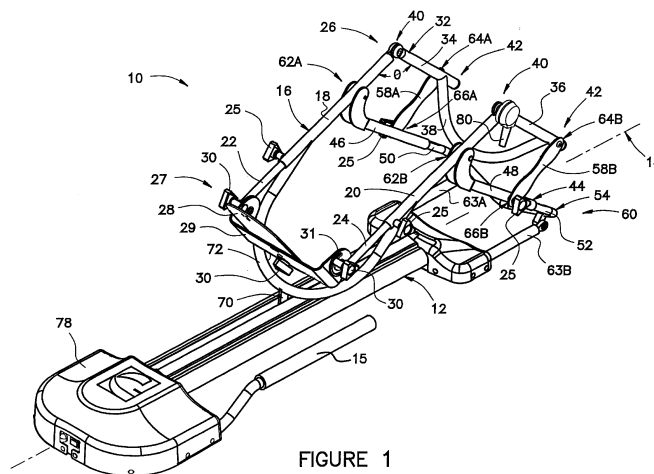


Figure 8: US6267735B1 CPM featuring an adaptive comfort-zone deadband.

8.3 Mechanism kinematics

9 US6325770B1: Device for Producing Continuous Passive Motion

9.1 Description

Mechanical drive (e.g., cam/gear) tuned to follow a knee-like path, aiming for physiologic tibiofemoral motion. Focuses on smooth kinematics and robust transmission to reduce backlash and improve comfort.

9.2 Images

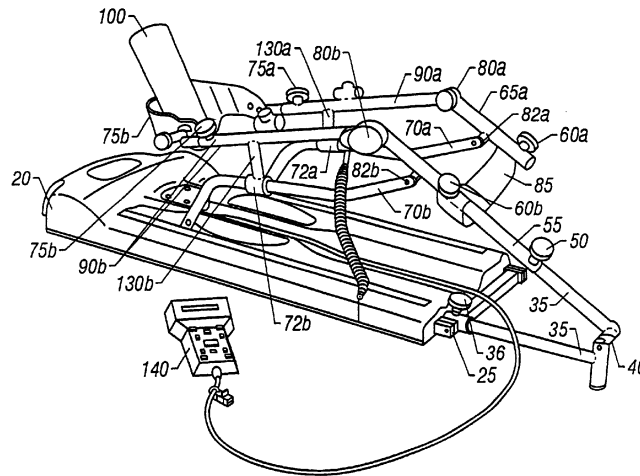


FIG. 3

Figure 9: US6325770B1 transmission tuned for knee-like motion paths.

9.3 Mechanism kinematics

10 US5252102A: Electronic Range of Motion Apparatus for Orthosis/Prosthesis/CPM

10.1 Description

Integrates electronic ROM sensing and feedback into an orthotic/CPM framework. Enables measurement-driven progression, alarms for unsafe limits, and data logging for clinical assessment.

10.2 Images

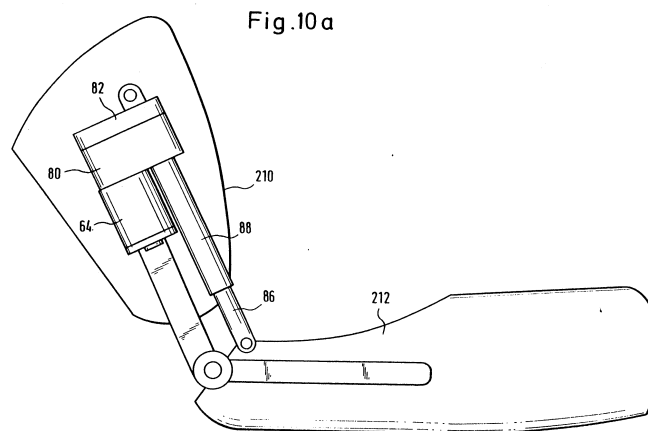


Figure 10: US5252102A apparatus with integrated electronic ROM sensing.

10.3 Mechanism kinematics

11 US5280783A: Continuous Passive Motion Device for Full Extension of Leg

11.1 Description

Prioritizes achieving and maintaining full knee extension with adjustable extension bias and end-range control. Useful for post-operative protocols where extension deficits are common.

11.2 Images

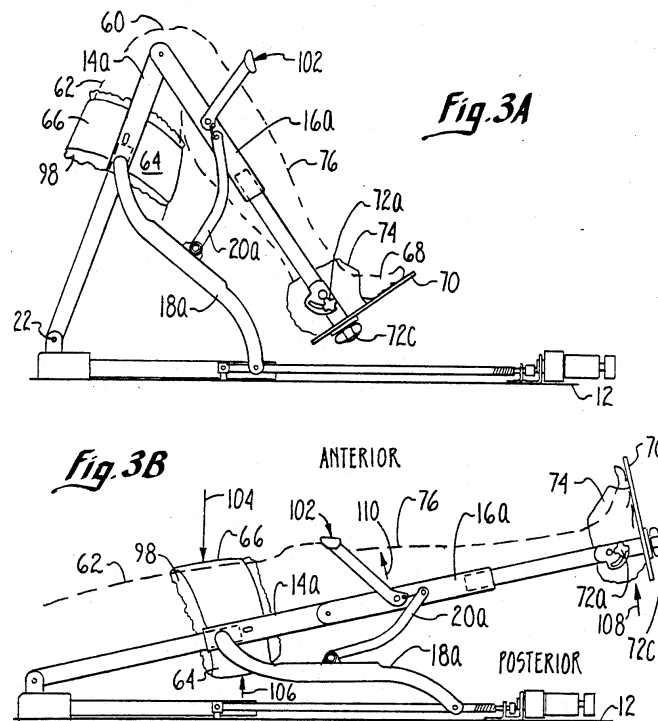


Figure 11: US5280783A CPM emphasizing controlled full-extension capability.

11.3 Mechanism kinematics

12 US4492222A: Knee Exercise Machine

12.1 Description

Adjustable axis alignment between femoral and tibial supports with a stable footplate to promote consistent knee pivoting. Emphasizes structural simplicity and robust construction for repeated clinical use.

12.2 Images

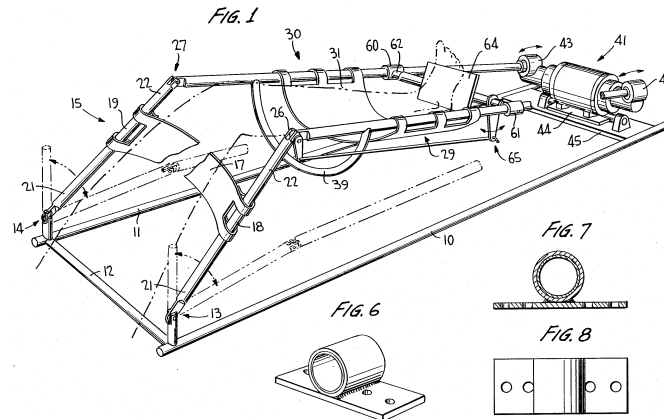


Figure 12: US4492222A knee exercise machine with adjustable axis alignment.

12.3 Mechanism kinematics

13 US10272291B2: Knee Flexion and Extension Therapy Device and Method of Use

13.1 Description

Modern therapy platform with modular brace interfaces and sensor-ready architecture for tracking compliance and motion. Highlights portability and user-centric controls to support clinic-to-home continuity.

13.2 Images

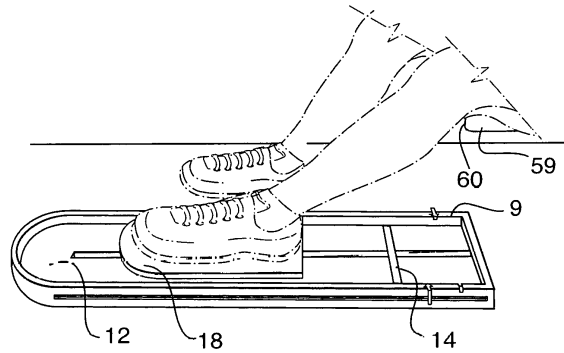


FIG. 8

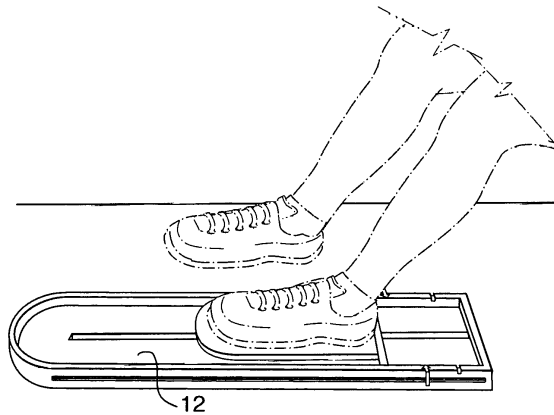


FIG. 9

Figure 13: US10272291B2 modern therapy platform for knee flexion/extension.

13.3 Mechanism kinematics

14 US4603687A: Continuous Passive Motion Orthopedic Device

14.1 Description

Counterbalanced support arms with a motorized actuator and alignment aids to minimize off-axis loads. Designed for steady, repeatable cycles with straightforward mechanical adjustments.

14.2 Images

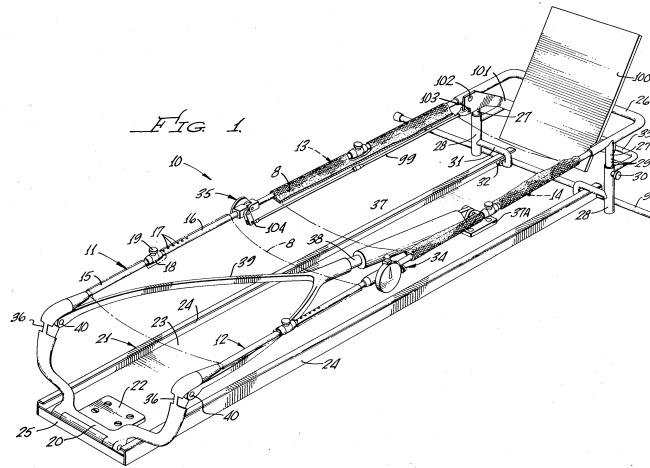


Figure 14: US4603687A CPM with counterbalanced arms and alignment aids.

14.3 Mechanism kinematics

15 US5239987A: Anatomically Correct Continuous Passive Motion Device for a Limb

15.1 Description

Axis-following mechanism intended to accommodate the knee's migrating instantaneous center of rotation. Reduces misalignment-induced shear by adapting the motion path to a more anatomic "J-curve".

15.2 Images

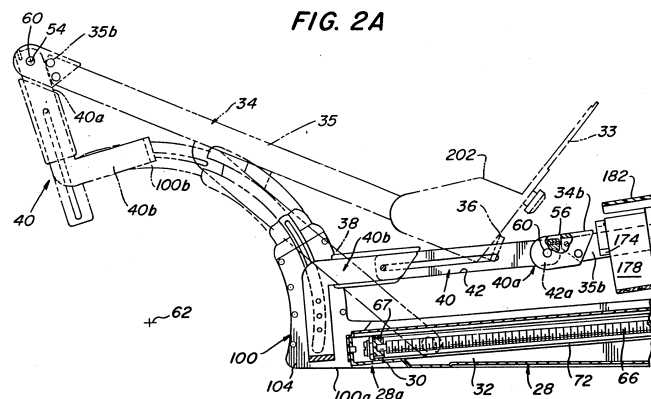


Figure 15: US5239987A device adapting to the knee’s shifting rotation center.

16 US4546763A: Continuous Passive Motion Method and Apparatus

Claims both apparatus and therapy parameters, including programmable cycle timing, dwell at end range, and progressive ROM. Focuses on protocolization of CPM dosing alongside reliable mechanical delivery.

17 Methods

14

18 Results

Present results, figures, and tables. For example, include an image like in Figure [17](#).

Figure 17: Example figure caption.

19 Discussion

Interpret the results, discuss limitations, and relate to prior work.

20 Conclusion

Summarize key takeaways and outline future work.